Mohnen, S.M.

Neighborhood context and health: How neighborhood social capital affects individual health.

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NEIGHBORHOOD CONTEXT AND HEALTH:

How neighborhood social capital affects individual health

BUURTCONTEXT EN GEZONDHEID:
Hoe sociaal kapitaal in buurten
individuele gezondheid beïnvloedt

(met een samenvatting in het Nederlands)

NACHBARSCHAFTSKONTEXT UND GESUNDHEIT:
Wie nachbarschaftliches Sozialkapital
individuelle Gesundheit beeinflusst

(mit einer Zusammenfassung in deutscher Sprache)

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Sigrid Mechthild Mohnen
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te Bitburg, Duitsland

Promotoren: Prof. dr. B.G.M. Völker
Prof. dr. H.D. Flap
Prof. dr. P.P. Groenewegen

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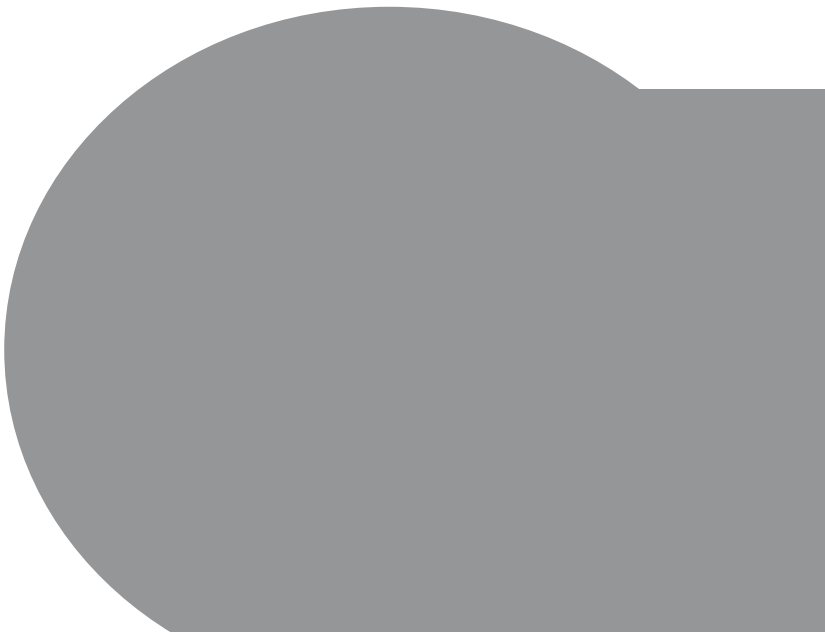
Chapter 1

Introduction



Introduction

1.1 Health differences between neighborhoods

An individual's health is not only dependent on one's physical condition but also on the social environment in which one lives. It has been shown recently that also the neighborhood in which one resides influences health. How is this possible? Which neighborhood characteristics matter for an individual's health?

These types of questions inspired a number of studies in health sciences showing that the neighborhood is indeed an important context for explaining individual variation in health. Before, health research focused more on individuals, their life style and their efforts to prevent illness (e.g., Health-Belief-Model, Rosenstock (1974) and Strecher and Rosenstock (1997)). The ecological approach, among others previously elaborated in social psychology (Barker 1968), builds on these ideas while placing people into contexts (Macintyre and Ellaway 2000; Sallis, Cervero, Ascher, Henderson, Kraft, and Kerr 2006).

In this chapter, general explanations of why small-area contexts affect health will be discussed. This chapter summarizes the existing empirical evidence on neighborhood social capital and self-rated health and introduces the hypotheses tested in this dissertation. Moreover, data sources and statistical tools used in this dissertation are introduced. The chapter ends with a brief outline of the empirical chapters of this book.

Anglo-American studies have demonstrated that individual health clusters in neighborhoods. For the Netherlands, neighborhood studies in Amsterdam have shown that neighborhoods differ in regard to life-expectancy (Lau-Ijzerman, Habbema, Van der Maas, Van den Bos, Drewes et al. 1980). Analyses summarized in this dissertation also show statistically significant differences between neighborhoods in the Netherlands. Approximately 3.5% (= ICC, reported in Section 2.3) of the variance in individual self-rated health can be attributed to the neighborhood level by the neighborhood one lives in. If average health is compared between neighborhoods, the likelihood of good or very good health can increase 1.5 times (median odds ratio[1] = 1.51 (1.01/1.63)).

In the last two decades, stimulated by the spread of multilevel analysis, several studies of neighborhood effects on health have been published. These studies usually utilize up to two traditional explanations and a selection mechanism. The

1 "The aim of the median odds ratio (MOR) is to translate the area level variance in the widely used odds ratio (OR) scale, which has a consistent and intuitive interpretation. The MOR is defined as the median value of the odds ratio between the area at highest risk and the area at lowest risk when randomly picking out two areas the MOR can be conceptualized as the increased risk that (in median) would have if moving to another area with a higher risk." (Merlo, Chaix, Ohlsson, Beckman, Johnell et al. 2006, page 292)

traditional explanations focus, on the one hand, on conditions of the physical environment and, on the other hand, on socio-economic conditions, such as poverty, unemployment, or deprivations. A third and new explanation is that *neighborhood social capital* stimulates individual health and thereby explains the health differences between neighborhoods. This dissertation focuses on this new explanation, but it also tests the two traditional ones. All three explanatory arguments and the selection mechanism are reviewed in the following.

Environmental characteristics, such as air pollution, are known for their long-term effects on health. For instance, a Dutch study showed that traffic-related air pollution is associated with higher risks of mortality (Beelen, Hoek, Van den Brandt, Goldbohm, Fischer et al. 2008). The 'built environment' and the availability of facilities also determine health. A lack of services and amenities, such as grocery stores (Wrigley 2002), health care and welfare facilities, or green spaces (Maas 2009) within a neighborhood is considered an explanation for why health clusters in neighborhoods. Physical environmental factors have been linked to several important health indicators, from mortality to, for example, the spread of influenza.

Another explanation for health differences between neighborhoods is the traditional socio-economic explanation for ill health that cites poverty and a lack of material possessions as conditions for illness. Wealth inequality between neighborhoods affects health in Western societies despite high general welfare and the presence of welfare states (Pickett and Pearl 2001). Studies from North America (Diez-Roux, Nieto, Muntaner, Tyroler, Comstock et al. 1997; Wen, Cagney, and Christakis 2005) have demonstrated that socio-economic neighborhood differences do affect health outcomes. Even in Western Europe with its well-established health systems, there are statistically significant differences between neighborhoods with respect to individual health (Van Lenthe, Borrell, Costa, Diez Roux, Kauppinen et al. 2005; Fagg, Curtis, Stansfeld, Cattell, Tupuola, and Arephin 2008). A study from Sweden (Malmström, Sundquist, and Johansson 1999) demonstrated that highly educated people living in neighborhoods with, on average, low socio-economic status are more likely to report worse health than people with the same educational level who live in the most affluent areas. Neighborhood effects have also been demonstrated for specific diseases and health-related behaviors. For instance, Van Lenthe and Mackenbach (2002) found that neighborhood deprivation was related to obesity in the Eindhoven region in the Netherlands. Another Dutch study showed that life expectancy in poor neighborhoods is 2 to 3 years lower than in neighborhoods with a higher average household-equivalent income (Van der Lucht and Verkleij 2001). Individuals living in the most affluent areas are healthier than individuals living in poorer neighborhoods, irrespective of their own individual social status (Hou and Myles 2005).

An important question is whether these neighborhood effects represent context effects or whether they are rather a consequence of the distribution of individuals with different characteristics among neighborhoods. Neighborhood differences may be the result of composition effects, e.g., in the case of segregation between neighborhoods based on individual characteristics that also affect individual health. The neighborhood composition effects on health are explained by Malmström (1999) as "similar types of persons have similar illness experiences

no matter where they live," whereas neighborhood context effects on health are described as "similar types of individuals will have different self-reported health status in different types of neighborhoods" (page 1181). An example of a composition effect is young people who all live in a particular neighborhood. As a result of the age composition of the inhabitants, this neighborhood is relatively healthy compared to other neighborhoods because young people are, on average, healthier than older people. The composition effect may be the result of a selection process if these young people purposely chose to live in this neighborhood. The selection process refers to clustering of similar individuals in neighborhoods due to selective choices of residence, which indicate, consequently, that individual attributes might account for neighborhood differences in health. It is possible that both composition/selection and context effects play a role in individual health (Pickett and Pearl 2001; Macintyre, Ellaway, and Cummins 2002; Subramanian, Lochner, and Kawachi 2003; Droomers, Van Hooijdonk, Deerenberg, Mackenbach, and Kunst 2009). To establish a neighborhood explanation, it is necessary to filter out composition effects to reach "true neighborhood-level variation" (Subramanian, Lochner, and Kawachi 2003). A context effect is established when it explains parts of the true neighborhood-level variation.

Not all variation in health is explained by the traditional explanations. There is a new hypothesis that differences in neighborhood social capital might explain variations in health between neighborhoods (Cattell 2001; Subramanian, Lochner, and Kawachi 2003; Wen, Cagney, and Christakis 2005; Poortinga 2006a; 2006b; Kawachi, Subramanian, and Kim 2008a; Van Hooijdonk, Droomers, Deerenberg, Mackenbach, and Kunst 2008; Snelgrove, Pikhart, and Stafford 2009; Eriksson, Ng, Weinehall, and Emmelin 2011). Neighborhood social capital is a particular form of social capital, i.e., context or community social capital.[2] It must be distinguished from individual-level social capital (that is, social networks of ties to specific others, e.g., relatives, a good friend or a next-door neighbor (Lin 2001)), although it is rooted in social relations. This origin of social capital on the individual level is illustrated in the following: "The core idea of social capital theory is that social networks have value" (Putnam 2000, page 18).[3] Coleman defined social capital as such: "Social capital (…) inheres in the structure of relations between actors and among actors" (1988, page S98) and is "an important resource for individuals and may affect greatly their ability to act and their perceived quality of life" (1988, page 116). Still, upon this network-orientated definition of social capital, it is also stated that both communities and individual ties produce social capital (Putnam 2000, page 20; Halpern 2005). Communities might be characterized by a high density of

2 Another example of contextual social capital, in addition to neighborhood social capital, is country-level social capital, whose association with health is elaborated by Kawachi, who prefers to only use the term social capital for macro-level social capital but not for individual-level networks: "Social cohesion and social capital are both collective, or ecological, dimensions of society, to be distinguished from the concepts of social networks and social support, which are characteristically measured at the level of the individual" (Kawachi and Berkman 2000, page 175).

3 "If social capital is to be useful as a scientific (and practical) concept, advocates need to abjure slippery definitions that encompass features of society that do not rest on social networks, which everyone agrees are at the core of the concept" (Putnam 2004, page 668).

informal networks (Halpern 2005, page 17). However, crucial to social capital on the community level is having common norms, behavioral reciprocity[4] and mutual trust.[5,6] An example from Robert Putnam (2000) illustrates neighborhood-level social capital (2007, p. 138):

> *"My wife and I have the good fortune to live in a neighborhood of Cambridge, Massachusetts, that has a good deal of social capital: barbecues and cocktail parties and so on. I am able to be in Uppsala, Sweden, confident that my home is being protected by all that social capital, even though – and this is the moment for confession – I actually never go to the barbecues and cocktail parties. In other words, I benefit from those social networks even though I am not actually in them myself."*

If a neighborhood's cohesion is high, residents watch each other's properties or invest otherwise in the contextual social capital of the neighborhood. Everyone who lives in the neighborhood benefits from this cohesion. Crucial here is that not the cohesion of one's individual relationships matters but the cohesion of the relationships on the group or neighborhood level. In addition, effects of individual and neighborhood relationships can be different. The idea that something new develops from a community is also expressed in the phrase: "The whole is more than the sum of its parts."[7] This expression of the German 'Gestalt'-theory is based on research on 'melody'. A melody is more than the sum of notes. In the neighborhood context, this means that the whole is a close-knit community with shared norms, whereas the sum would only be the number of inhabitants, ignoring their interrelatedness. Neighborhood social capital is access to resources generated by relations between people in a local community. These resources develop because people are interconnected. One person alone would not be able to achieve the same, even with a high level of human or financial capital.

Whereas Putnam enjoys a high social capital neighborhood, an inhabitant of a Dutch neighborhood straightforwardly describes the lack of social capital in her neighborhood: "*(…) Als je in een wijk woont waar de mensen elkaar niet aankijken is het echt niet leuk wonen hoor*." J. uit A. | 12:22 | 08-Feb-2011 [It is absolutely unpleasant to live in a neighborhood where people do not acknowledge each other]. This is one of a few blog messages in response to the online web article 'Gezellige

4 Putnam described the principle of generalized reciprocity: "I'll do this for you now, without expecting anything immediately in return and perhaps without even knowing you, confident that down the road you or someone else will return the favor" (Putnam 2000, page 135: Chapter 8: Reciprocity, Honesty, and Trust).

5 "The almost imperceptible background stress of daily "transaction costs" – from worrying about whether you got back the right change from the clerk to double-checking that you locked the car door-may also help explain why students of public health find that life expectancy itself is enhanced in more trustful communities (Kawachi, Kennedy, and Glass 1999)." (Putnam 2000, page 135)

6 At the country and regional levels, contextual social capital can also mean the level of civic participation and the benefits of memberships.

7 This expression is based on an article written by Von Ehrenfels (1890) who is known as one of the founders of Gestalt philosophy (King 2005, page 96).

'buuv' goed voor gezondheid' of the Dutch newspaper the 'Telegraaf.' The article was a reaction to Chapter 2 of this book, which was published in Social Science & Medicine, February 2011. The media embraced this topic, showing that there is a high interest in the 'social environment influencing health' in Dutch society.

The Dutch National Institute of Public Health and the Environment (RIVM [National Institute for Public Health and the Environment] 2011) as well as the European Union (2003) and the World Health Organization (Kreuter, Lezin, Young, and Koplan 2001) cite high social cohesion - high contextual social capital - as a potential condition for good health.

In addition of being in the public interest, research on neighborhood social capital is also of scientific relevance. In addition to the reported two traditional explanations of why health clusters between neighborhoods, a third could be supported (while using Dutch-specific data). Here, it is a challenge not only to show neighborhood effects of social capital but also to clarify that these neighborhood effects are not artifacts of the individual-level social capital[8] but instead real community effects. Establishing the effects of neighborhood social capital might also influence other public health questions. Neighborhood social capital might, for example, interact with health inequality. A further scientific advantage of knowing the effect of neighborhood social capital on health would be that neighborhood-related health interventions would have to take into account the level of social capital in a neighborhood as a factor through which interventions might become more effective.

Next to the question of whether neighborhood social capital affects health this dissertation aims to answer the following two basic questions: What are the conditions under which neighborhood social capital affects health most? Furthermore, how can we explain the association between neighborhood social capital and health? Thus far, it is assumed that people are equally exposed to social capital and other characteristics in their neighborhoods. This dissertation inquires into the question, whether differences in exposure to social capital are associated with differences in health. It might be that neighborhood social capital has been underestimated because not everybody in a neighborhood is equally exposed to social capital.

When effects of neighborhood social capital are established, the question rises, how we can understand why it works. Below, possible mechanisms at the individual level are discussed. In the last empirical chapter of this book, one potential explanatory mechanism, i.e. health related behavior, is tested.

In sum, this dissertation shows whether and how neighborhood social capital positively influences individual health, thereby contributing to the scientific and social discussion on this issue. This book inquires into the extent to which health differences are explained by social capital, while taking into account conditions on the neighborhood and the individual level, which have been shown to influence health, too. Moreover, the circumstances under which neighborhood social capital is most valuable for individual health are explored. For example, people who are often at home and more exposed might have an increased effect of social capital on health.

8 Chapter 3 studies neighborhood-level social capital (= community feeling) separated from individual-level social capital (= contact to next-door neighbors).

Lastly, a possible mechanism behind the association between neighborhood social capital and health is tested. The overarching research question of the book is:

Research question: *Does neighborhood social capital affect individual health, under which circumstances, and how?*

1.2 Existing empirical evidence about neighborhood social capital and health

To give an overview of existing research on neighborhood social capital and health is not an easy task because studies vary in several aspects. First, social capital is a broad concept which allows for different operationalizations. Studies influenced by Putnam (2000) or Kawachi and his colleagues (2008a) used measurements of social capital, such as trust, membership in organizations, or social participation (Moore, Shiell, Hawe, and Haines 2005). In addition to typical Putnam measurements, Poortinga (2006b) used a neighborhood social capital measurement. Respondents had to state whether they agreed with the following statement: "This area is a place where neighbours look after each other." Eriksson et al. (2011) asked similar questions and found more stable findings with a neighborhood-related measurement than with the conventional measurement of aggregated general trust and participation. Furthermore, findings of macro-social capital effects on health are hard to compare because different geographical areas have been studied (from countries to neighborhoods). When neighborhoods were studied, the size of neighborhoods differed as well (read more about this in Section *1.3.4.4 Excursus – What is a neighborhood?*). Moreover, studies differ with regard to the outcome variable: Life expectancy, physical, mental, or self-rated health. These health outcomes were sometimes used as population outcomes (thus, the dependent health variable was aggregated, e.g., in Van Hooijdonk et al. (2008)) or – as in most cases – analyzed as individual-level indicators. Studies differ with respect to the groups they focus on: Children, adults, or the elderly. Some studies are representative of whole countries, others for specific cities or rural regions. Finally, studies differ in methodological aspects. For instance, some studies do not have a sufficient number of cases at the micro or macro levels and consequently no multilevel analysis could be applied. Even if multilevel analysis was conducted, some studies only used this technique to study the neighborhood variance of health; in a next step, contextual social capital was added as an individual-level variable instead of as a neighborhood-level variable (e.g., Pampalon, Hamel, De Koninck, and Disant 2007).

Kim, Subramanian, and Kawachi present a systematic literature review of 'Social capital and self-rated health' (2008) while differentiating between individual and contextual social capital. This review examined 32 studies. While individual-level social capital demonstrated a strong positive relationship with self-rated health, findings on social capital on the contextual-level were mixed, especially after taking the social composition of the areas into account (Kim, Subramanian, and Kawachi 2008). Of the 32 studies, 13 were conducted at small-area levels, such as in neighborhoods, and out of these, eleven present results of neighborhood social

capital as a neighborhood-level variable. Four out of eleven showed a health-improving relationship (Steptoe and Feldman 2001; Wen, Browning, and Cagney 2003; Poortinga 2006a; 2006b), while also four showed no association (Browning and Cagney 2003; Drukker, Kaplan, Feron, and Van Os 2003; Franzini, Caughy, Spears, and Eugenia Fernandez Esquer 2005; Ziersch, Baum, MacDougall, and Putland 2005). Finally, three studies used different kinds of social capital measurements, and results of these different measurements were mixed (Drukker, Buka, Kaplan, McKenzie, and Van Os 2005; Kavanagh, Bentley, Turrell, Broom, and Subramanian 2006; Yip, Subramanian, Mitchell, Lee, Wang, and Kawachi 2007).[9]

Since this systematic literature review, published in 2008, more evidence on contextual social capital and health was published. I focus on neighborhood social capital and self-rated health because these studies have research questions best comparable to the main question of this dissertation.

Six recent studies that find (partly) protective effects of neighborhood social capital on self-rated health are sorted chronologically[10]: Sundquist and Yang (2007), Carpiano (2008), Snelgrove et al. (2009), Fujisawa et al. (2009), Giordano, Ohlsson, and Lindström (2011), and Eriksson et al. (2011).

Sundquist and Yang (2007) used Swedish data to perform multilevel analyses to study the association between 'linking social capital'[11] and self-rated health. Linking social capital is measured as the percentage of neighbors who voted in the last election. Voting people are assumed to be generally responsible and cooperative. However, there may be many motivations for voting, and these might have nothing to do with the neighborhood community.[12] Whether the neighbors are related to each other remains unclear. Thus, a limitation of this study is that social capital is measured with a crude proxy.

Carpiano et al. (2008) showed using data of caregivers in urban neighborhoods of the U.S. city Los Angeles, C.A., that `neighborhood organization participation' is a neighborhood resource with advantages for self-rated health. This study stands out because of the use of the ecometrics procedure to aggregate neighborhood perception (read more about ecometrics in Section 1.4.3) and because of the exploration of

9 The study conducted by Drukker et al. (2005) is presented here as evidence of 'mixed results' and not as evidence of non-significant associations between neighborhood social capital and health. Table 8.2 of Kim, Subramanian and Kawachi (2008) incorrectly presents non-significant results of Drukker et al. (2005). Drukker found significant effects of contextual social capital measurements on Dutch children in Maastricht and on Hispanic children in Chicago, but not on non-Hispanic children in Chicago.

10 This is not the result of a systematic literature review. However, it is the result of a careful search for recent publications on contextual/neigho(u)rhood social capital or social cohesion and self-rated health.

11 Sunquist refers here to a specification of social capital. First, Putnam (2004, page 669) has specified *bonding ("*that is, exclusive social networks that are bounded within a given social category") and *bridging* ("that is, inclusive social networks that cut across various lines of social cleavage, linking people of different races, ages, classes, and so on") social capital, and *linking* social capital was added later by Szreter and Woolcock: "Szreter and Woolcock suggest that to bridging and bonding should be added a third category of linking social capital. More precisely, they suggest that linking networks are an especially important sub-type of bridging networks, namely, networks that connect actors of different degrees of institutional power." (Putnam 2004, page 669)

12 For example, a person voting for a party that promises to lower the tax rate has a low sense of community and solidarity. Such a person might otherwise also act selfishly.

interaction effects between macro- and micro-level social capital. A limitation is the focus on only one employment group and one city.

Snelgrove et al. (2009) analyzed the effects of neighborhood social capital (= social trust and civic participation) on individual self-rated health with British data. The results of the multilevel analyses were mixed. Aggregated social trust showed a stable and positive effect on health, while social participation did not.

Fujisawa et al. (2009) used Japanese data and found positive effects of small-area social capital on self-rated health independent of individual-level social capital. Social capital was measured with a social cohesion index as well as with neighborhood-related perceptions regarding helpfulness, kindness, and greetings. These variables have been employed in the analysis as individual and aggregated variables.

Giordano et al. (2011) used British data to study individual-, household-, and small-area level social capital effects on self-rated health.[13] At the small-area level (on average, 2500 households per postcode), only one (no volunteer work) of five[14] contextual social capital measurements was significant and negatively associated with poor health.

Eriksson et al. (2011) used data from Umeå, a northern-Sweden municipality with, on average, young inhabitants, to study contextual social capital effects on self-rated health. As aforementioned, contextual social capital was only associated with health when neighborhood-related social capital questions were aggregated, not when trust or social participation was used. Moreover, neighborhood-related social capital was only significant for women, not for men. Eriksson explained the 'women-only' finding by the assumption that women are more often at home during the day to take care of their household and children. However, whether women in the city of Umeå are actually housewives and mothers was unknown. The main limitation of the study is the use of only 49 neighborhoods[15] and five dummy variables on contextual social capital. Additionally, the response rate was rather low, and women were over-represented in the resulting sample.

Five out of the aforementioned recent six papers did not use neighborhood covariates to control for alternative neighborhood-level hypotheses. Carpiano (2008) controlled for socio-economic disadvantage (significant) and residential stability (non significant) at the neighborhood level. In Carpiano's study, only one out of four used neighborhood social capital variables demonstrated a significant association with self-perceived health. It was not reported whether the other social capital variables had an effect prior to the model controlling for economic disadvantage. It is unclear whether contextual social capital is mostly non-significant because of the neighborhood control variable or because of the kind of social capital measurement.

13 The relevant question in the interview was: 'Compared to people your own age, would you say that your health over the past twelve months has been excellent, good, fair, poor or very poor?'

14 The other contextual social capital measurements have been 'cannot trust others', 'does not participate', 'unwilling to improve neighourhood', and 'low perceived reciprocity.' These measurements were aggregated to the household and neighborhood levels and integrated all together into one model (Table 2, Model 5) at once.

15 Neighborhoods can be single postcodes or groups of postcodes; it is unclear how many people, on average, are living in these neighborhoods.

Until now, it was unclear whether contextual social capital, measured with a neighborhood-related indicator, is significantly associated with self-rated health when neighborhood control variables are also taken into account. Furthermore, Eriksson et al.'s (2011) study stimulates the discussion of whether context effects affect all people equally (Macintyre, Ellaway, and Cummins 2002).

Taken together, existing evidence on neighborhood social capital and self-rated health is inconsistent. However, because of differences in study design, sampling, and measurements it is, so far, not understood whether and how social capital really matters for health. All we know is that social capital should be taken into account as another condition for health.

1.3 Social capital theory and hypotheses

This dissertation tests hypotheses from social capital theory to study the association between neighborhood social capital and individual health. Evidence of conditions for health next to neighborhood social capital is also presented and it is, as far as possible inquired into the mechanisms which make social capital effective.

1.3.1 The direct effect of neighborhood social capital on individual health

To understand the association between the two macro-phenomena, i.e. neighborhood social capital and health of neighborhood residents (= individual health clusters in neighborhoods), it is necessary to study the underlying mechanisms at the individual level (Coleman 1990, page 2). The clustering of health into neighborhoods was presented to demonstrate that the neighborhood level matters for health in the Netherlands. However, the focus of interest in this thesis is individual-level health. Therefore, the first step of this dissertation is to establish empirically the link between the macro-characteristic *neighborhood social capital* and the micro-characteristic *self-rated health*.

Neighborhood social capital is a 'capital' that individuals can actively make use of. The neighborhood community can also passively socialize individuals with beneficial effects on health. The assumption of a *positive* association between neighborhood social capital and individual health is based on individual-level social capital theory (Coleman 1988, page S105) and based on evidence presented in Chapter 1.2.

At the beginning of this introductory chapter, two alternative hypotheses were described that might also explain health differences between neighborhoods: The socio-economic hypothesis and the physical environment hypothesis. For instance, a neighborhood might not produce beneficial health outcomes because of its cohesive community but rather because of the wealth in the neighborhood or because of a beautiful aesthetic condition of the neighborhood.

A composition effect can be another alternative explanation for clustering of health (good or bad) in neighborhoods. Furthermore, neighborhoods in urban settings might differ from neighborhoods in rural settings. It can be argued that

personal contact might be easier in the countryside, where everybody knows each other from childhood by name. However, people in cities, on the other hand, live geographically close to each other and have more opportunities for daily contact. In urban settings, social capital might vary more and might therefore provide more functions for individuals. Little is known about whether the effects of social capital are stronger or weaker in an urban or rural setting because most studies focus only on neighborhoods in large cities. In this dissertation, data on levels of population density (urban density of the municipality[16]) are taken into account.

The first hypothesis tested in Chapter 2 of this dissertation is the direct-effect hypothesis:

Hypothesis 2.1:[17] *The more neighborhood social capital, the better one's individual health–independent of relevant socioeconomic and physical conditions at both the neighborhood and individual levels and independent of the urban density of the municipality.*

Figure 1.1 shows a graphical illustration of the first hypothesis (arrow) tested in this dissertation. The plus sign indicates a hypothesized positive association.

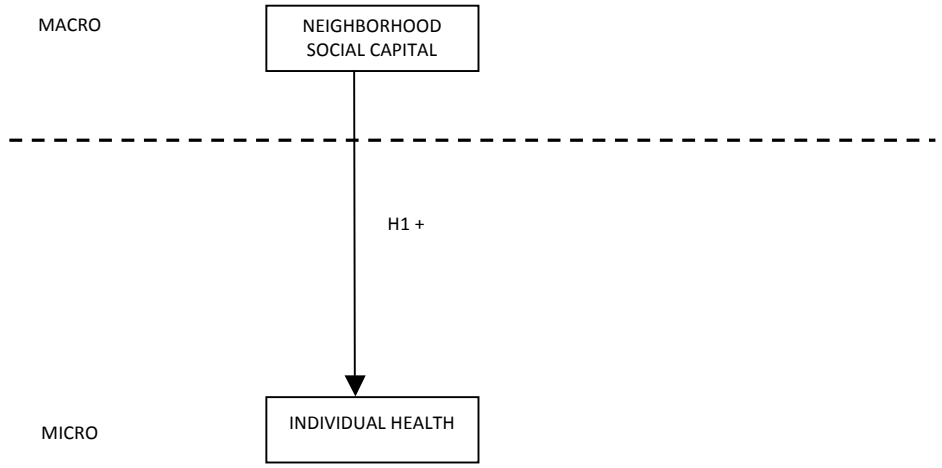


Figure 1.1: The direct effect of neighborhood social capital on individual health

1.3.2 Macro and micro social capital – independent or inter-related?

In this dissertation, differences between effects of micro- (contact with specific neighbors, relatives, or friends) and macro- (neighborhood community) level social capital on health are elaborated. Before the different effects on health can be studied,

16 Urban density of the municipality is chosen because some neighborhoods in cities have low density but still have city facilities nearby.

17 The hypothesis has the number '2.1' because 2 stands for the chapter number and 1 for the first hypothesis tested in chapter 2.

however, the differences between micro and macro-level social capital must be clarified. A Dutch online newspaper entry shows how easy a neighborhood is mixed up with relations to neighbors

> *"Ik moet er niet aan denken dat ik me niet thuisvoel in een buurt, en waar ik geen contacten heb. Ik heb het wel bijzonder goed getroffen met onze buren aan beide kanten, dat is uniek! Niet dat we de deur bij elkaar platlopen, maar af en toe, in de zomer vaker, heel spontaan even gezellig borrelen of eten."* Anonymous, living in Lisse | 12:42 | 08-Feb-11 [I cannot think of feeling not at home in my neighborhood and having no contacts with my neighbors. I'm lucky with both my next-door neighbors, which is really unique! We do not bother each other, but from time to time, more often in the summer, we meet up for drinks or a bite, very spontaneous and cozy.]

It is unclear whether the person is under the impression of living in a high social capital neighborhood or of merely having nice next-door neighbors. Unfortunately, in research, macro-level social capital is often mixed up with evidence regarding personal networks.[18] Even when micro- and macro-level social capital are separated, studies testing only the contextual component of social capital risk the criticism that contextual social capital is only an artifact of individual social capital.

Two main effects of social capital?

According to social capital theory, individuals are presumed to be better off in general and healthier in particular when they live in communities with high levels of macro-level social capital–even if they have few actual social ties. Social capital has several forms, and it can be assumed that some of them do not require any specific ties to be effective. For example, in a neighborhood with a high level of social capital, a woman does not fear walking the streets at night because she feels protected (Coleman 1990, page 310).[19] In this example, it is not necessary to have individual relationships to specific neighbors to benefit from macro-conditions. Chapter 3 tests the following hypothesis:

Hypothesis 3.1: *The more social capital in a neighborhood, the better the health of its residents–independent of individual-level social capital.*

Similarly, the argument regarding *individual-level social capital* predicts that individual health is positively affected by a person's network, regardless of the neighborhood in which he or she lives. It has been argued that individual-level social capital has both a direct and a buffering effect on individual health (see Hammer 1983); individuals with more individual-level social capital are less often ill, and when they

18 For example, Halpern, page 91ff, or "in the book Bowling Alone (2000), Robert Putnam cites evidence from every type of study, including not only social cohesion, but also social networks and social support." Kim et al. (2008, page 193).

19 An example related to a health outcome would be: A full-time working man who uses public transportation to travel to his work might profit from his high social capital neighborhood, in which it is a norm to clean up snow from the sidewalks the man uses every morning. If the same man lived in a different neighborhood without this norm, he might slip and break a leg.

do fall ill, they are better able to cope with diseases. Coping strategies refer to behavioral and psychological efforts that people employ to master, tolerate, reduce, or minimize stressful events (Tijhuis, Flap, Foets, and Groenewegen 1995; Taylor and Seeman 1999). Some positive effects of social support (emotional support, informational support, and instrumental support) work without them being aware of it. Uchino et al. (1996) show that more social support is associated with better immune system functions and that it benefits the endocrine and cardiovascular systems (e.g., by resulting in lowered blood pressure) with decreased chances of coronary artery diseases, susceptibility to infectious diseases, and atherosclerosis (Diez-Roux, Nieto, Muntaner, Tyroler, Comstock et al. 1997; Taylor, Repetti, and Seeman 1997; Stockdale, Wells, Tang, Belin, Zhang, and Sherbourne 2007; Diez-Roux and Mair 2010). Whether health benefits generated by individual-level social capital depend on a context, in particular, the social community of the context, is studied less often. Exceptions are Moore, Bockenholt, Daniel, Frohlich, Kestens and Richard (2010) and Poortinga (2006b) who indicate that individual-level social capital is positively associated with health, independent of the contextual-level social capital. To build upon this existing literature and to extend our knowledge on the interrelatedness of micro- and macro-level social capital, this thesis differentiates between individual-level social capital *within* and *outside* the neighborhood.

Hypothesis 3.2: *The more individual-level social capital within and outside the neighborhood, the better the individual-level health – independent of neighborhood-level social capital.*

Accumulation

Upon the main effects of individual- and neighborhood-level social capital, social ties at the individual level might strengthen the relationship between neighborhood-level social capital and health. One might have access to the resources of a greater number of others and, as a result, receive more support. All ties with others at step one may lead to many more ties at step two, via one's spouse, family, friends, co-workers, work supervisors, or neighbors. Individual-level social capital might be a mechanism of the relationship between contextual social capital and health (Lin 2001; Carpiano 2007). Informational support, for instance, cannot reach the individual without a social direct tie.

Different parts of individual-level social capital, such as the relationships within and outside the neighborhood, might affect the influence of neighborhood-level social capital in different ways. If health-relevant information is known in the neighborhood community, one only knows about it if someone else tells one.

Hypothesis 3.3a: *The more local individual-level social capital people have, the larger the effect of neighborhood social capital on individual health.*

However, friends from outside the neighborhood might influence the effects of neighborhood social capital differently than neighbors discussing the 'neighborhood news.' For instance, a cohesive neighborhood community might have organized a soccer field. A resident can only make use of it when he has friends – the greater part of them usually living outside his neighborhood – to come over and play with him.

Hypothesis 3.3b: *The effect of neighborhood social capital on health is larger the more non-local individual*-level *social capital people have.*

Furthermore, it is also reasonable to assume that one might find social contact easier in neighborhoods with a good social atmosphere. Newcomers in such a neighborhood might find contacts much easier if there is already much communication between neighbors. Individual contacts, for example, to next door neighbors are relevant for the newcomer's health.

Hypothesis 3.4: *The effect of individual-level social capital on health is larger the more neighborhood social capital a person has.*

Compensation

Aside from the argument of accumulation or reinforcement of individual-level and neighborhood-level social capital effects on health, it may also be the case that having much of one type of social capital compensates for a lack of another. For example, a person who actually has only a few social ties and lives in a neighborhood with much social capital might nevertheless feel embedded in a community because of the neighborhood cohesion and therefore, have good health. Moreover, effects of neighborhood social capital on health might be weaker if a person has many ties outside of the neighborhood. The last three hypotheses of Chapter 3 read:

Hypothesis 3.5a*: If individuals lack local individual-level social capital but have ample neighborhood social capital, effects on health are still positive.*

Hypothesis 3.5b: *If individuals lack non-local individual-level social capital but have ample neighborhood social capital, effects on health are still positive.*

Hypothesis 3.6: *If individuals lack neighborhood social capital but have ample (local or non-local) individual-level social capital, effects on health are still positive.*

Figure 1.2 illustrates the hypotheses H3.1 to H3.6

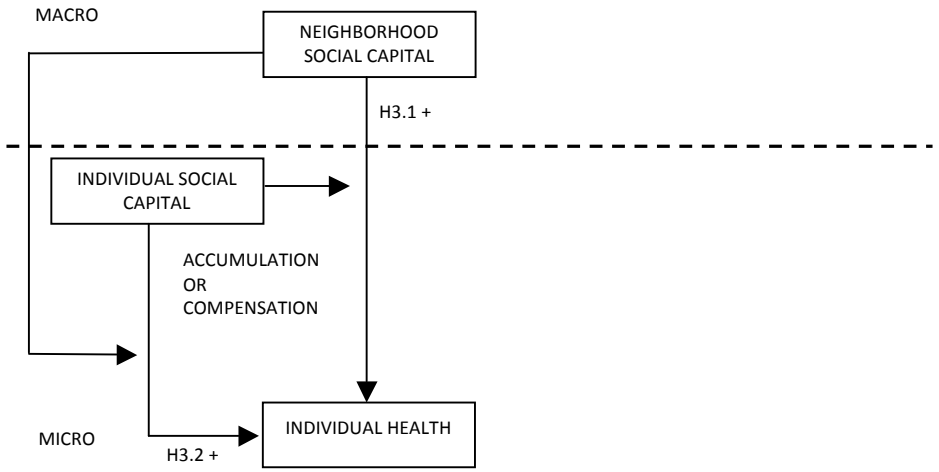


Figure 1.2: Interrelatedness of micro- and macro-social capital

1.3.3 Neighborhood social capital – Exposure to a public good?

Neighborhood social capital is available to every member of the community, and it can be used more often than once, even by several people at the same time. Neighborhood social capital is called a 'public good' because inhabitants without having made any investments enjoy its benefits. The neighborhood Putnam is living in (according to the quotation in Section 1.1) would not only watch over Putnam family's house but also the houses of other members of the neighborhood because it is a norm in this neighborhood to watch over each other's property.[20]

So, social capital is perceived here as a public good, which can be 'consumed' by all residents of the neighborhood, no matter whether or not they contributed to its creation. Above, we formulated the hypotheses (hypotheses 3.1) that the more social capital in a neighborhood the better the health of residents. Having 'more' social capital can also imply that one is more exposed to this good than others. This idea that exposure to social capital might have effects next to the general level of social capital is discussed in Chapter 4. It is studied whether the length of time one is exposed to neighborhood social capital matters. There is a whole body of work in epidemiology with studies on exposure. The best-known research is on exposure to smoking. For instance, a Dutch cohort study observed an increased pancreatic cancer risk per increment of 10 years of smoking (Heinen, Verhage, Goldbohm, and Van den Brandt 2010). An example of the neighborhood context is the long-term exposure to air pollution and its established association with respiratory mortality (Beelen, Hoek, Van den Brandt, Goldbohm, Fischer et al. 2008).

20 An aspect of the public good that I am not addressing is the 'free-rider' problem. The problem is that there is underinvestment in public goods because nobody has a motive to invest. A 'free-rider' profits from a public good without investing in it himself, since he or she cannot be excluded.

The effect of length of exposure to neighborhood social capital on health has thus far been neglected in neighborhood health studies (Chaix 2009). At best, duration of residence was a control variable (Harpham 2008). One exception is a Japanese study that focuses on social capital and self-rated health while comparing short-term and long-term residence (Yamamura 2010). A small sample size, the lack of a neighborhood-level measure of social capital, and other methodical shortcomings do not allow for generalization of the findings. Still, it is interesting that the social capital[21] effects are stronger for people living for more than 20 years in the same neighborhood than for people living there for a shorter time.

Although evidence regarding the duration of exposure in neighborhood research is lacking, evidence regarding the influence of exposure to the 'host country' (as another social environment exposure) exists in the field of immigrant health research. After a longer period of residence, norms of the host country were internalized with effects on health behavior and health outcomes, e.g., an increase of body mass index (BMI) in the U.S. (Goel, McCarthy, Phillips, and Wee 2004; Park, Neckerman, Quinn, Weiss, and Rundle 2008). Chapter 4 tests the 'exposure hypothesis':

Hypothesis 4.1: *The longer one is exposed to a high level of neighborhood social capital, the better one's health is.*

To internalize neighborhood norms, one might not only 'need' to live there for several years but also to spend some time in the neighborhood. People tend to work or go to school away from their neighborhoods during the daytime. Particular people, however, are likely to spend more time during the day in the neighborhood because, e.g., they are taking care of children or are elderly (retired). These individuals are more likely to be exposed to neighborhood social capital. The second hypothesis tested in Chapter 4 reads:

Hypothesis 4.2: *The more time one spends in the neighborhood, the more one is exposed to neighborhood social capital, and the better one's health.*

Figure 1.3 illustrates the interaction effect of length or intensity of living in a neighborhood and the effect of neighborhood social capital on individual health.

21 Operationalized as civic engagement with the questions: "Are you actively involved in volunteer activity?" and "Are you actively involved in the activity of a neighborhood association?" (Yamamura 2010, page 2)

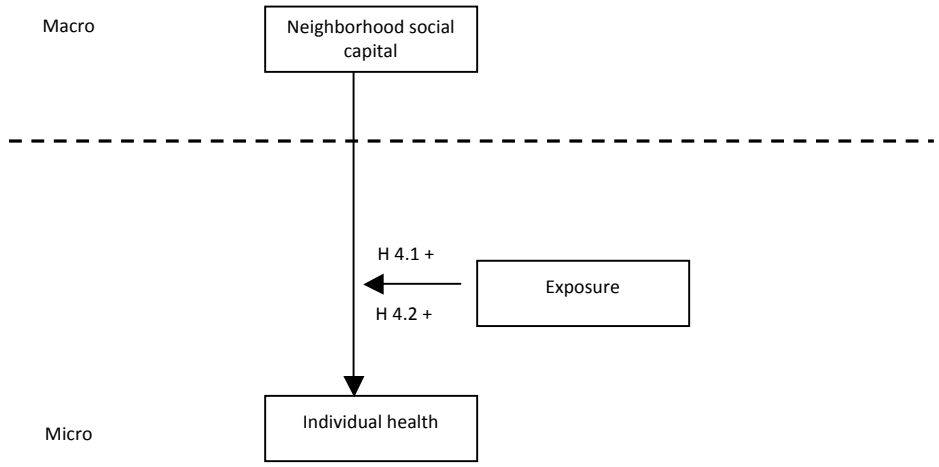


Figure 1.3: Neighborhood social capital – exposure to a public good?

1.3.4 How does neighborhood social capital affect individual health?

Assuming that there is a relationship between neighborhood social capital and individual health (which is confirmed in the next chapters), the question is why does social capital actually matter? How can we understand this relationship?

Despite the increasing use of ideas on social capital in public health research, the question of what mechanisms might produce the link between neighborhood social capital and health outcomes is not posed often (Kawachi 1999, page 122). Kawachi and Berkman (2000, page 184) complain about a lack of knowledge on "mechanisms by which social capital could exert a context effect on individual health." The following three mechanisms are a rough summary of the ideas in the current literature.

1.3.4.1 Bio-psychological mechanism: Neighborhood-generated well-being

The bio-psychological mechanisms of neighborhood social capital may not require explicit, direct social contact. Various forms of reciprocity, sharing and trust (Harpham, Grant, and Thomas 2002) or feelings of 'belonging to a community' and 'general well-being' may affect the endocrine system. Being surrounded by people who are nice to each other might increase positive feelings (well-being), which makes coping with stress easier, resulting in good health. A hypothesis testing the bio-psychological mechanism would read as the following: *The more neighborhood social capital, the greater the well-being, the better one copes with stress, and the better one's health.*

This dissertation does not test this hypothesis because our dependent variable *self-rated health* and the mechanism variable *well-being* are likely to be strongly correlated. Contextual social capital has been shown to be a predictor of not only health but also of well-being (Yip, Subramanian, Mitchell, Lee, Wang, and Kawachi 2007).

1.3.4.2 Lobby mechanism: Lobby for provision of services and access to facilities

Putnam, Leonardi, and Nanetti (1993) introduced the hypothesis that local well-being will be larger in those places where local social capital is high because of better health and social services. If citizens are well connected amongst each other, they are better able to put pressure on local politicians and civil servants to practice good government and provide good public services, in particular, accessible health and welfare services (Altschuler, Somkin, and Adler 2004). We know from deprivation research that people in deprived areas are often less organized and have less power to improve neighborhood facilities than inhabitants of more affluent areas. Perhaps inhabitants of the neighborhoods low on social capital will have fewer social ties with political actors and the government, and they will be less able to formulate and advocate the needs of the neighborhood in a clear way (Prentice 2006). Therefore, neighborhood health differences might be partly explained by differences in the extent to which health care services are accessible (Kawachi and Berkman 2000; Van der Linden, Drukker, Gunther, Feron, and Os 2003; Prentice 2006). Accessibility to healthy food might cause differences between neighborhoods as well (Wrigley 2002; Larsen and Gilliland 2008). A well-connected neighborhood might also lobby more effectively for a walk-friendly and green neighborhood, which also has positive implications for health (Maas, Van Dillen, Verheij, and Groenewegen 2008; Sundquist, Eriksson, Kawakami, Skog, Ohlsson, and Arvidsson 2011). Even if municipalities intend to support neighborhoods, it is unclear which facilities are appropriate. More interaction among the residents of neighborhoods and between residents and local politicians might enhance the power of the latter and result in the availability of facilities that are tuned to the needs of its inhabitants. Service availability is especially relevant for (parents of) young children, the elderly, and people with low-incomes. Altschuler et al. (2004) found that residents of lower-income neighborhoods utilized social capital in an effort to procure that which they were not able to purchase with their own financial capital. Subramanian et al. (2006), however, found that neighborhood services did not appear to have an independent effect on the self-rated health of the elderly. The herein discussed mechanism can be summed up as follows (but is not tested in this thesis):[22] *The more neighborhood social capital, the better the access to health-related facilities and social services as well as individual health.*

1.3.4.3 Norm-and-control-mechanism: Processes of informal social control, norms, and health-related behavior

If everybody were to feel responsible for their neighborhood and to take care of the people in them and their environment, the area would be a better place to live. Communities with high informal social control experience less crime and less deviant behavior from adolescents (Sampson, Raudenbush, and Earls 1997). The underlying assumption is that norms steer individual behavior because individuals are interested in reaching their goals and being accepted in the community in which they live (Flap and Völker 2004). People conform to norms because deviancy is detected and sanctioned. In line with these arguments, it is likely that neighborhood social control also stimulates conformity to norms on health-related behavior in the

22 For details, see Section *1.3.4.4*.

neighborhood, e.g., neighbors can monitor public alcohol abuse or under-age smoking (Kawachi 1999, page 1191). The mechanism discussed here can be summed up in the following.

Hypothesis 5.1: *The more neighborhood social capital, the more informal social control, and thus, the better the health-related behavior and, ultimately, individual health.*

Hypothesis 5.1 is illustrated in Figure 1.4 and tested in Chapter 5.

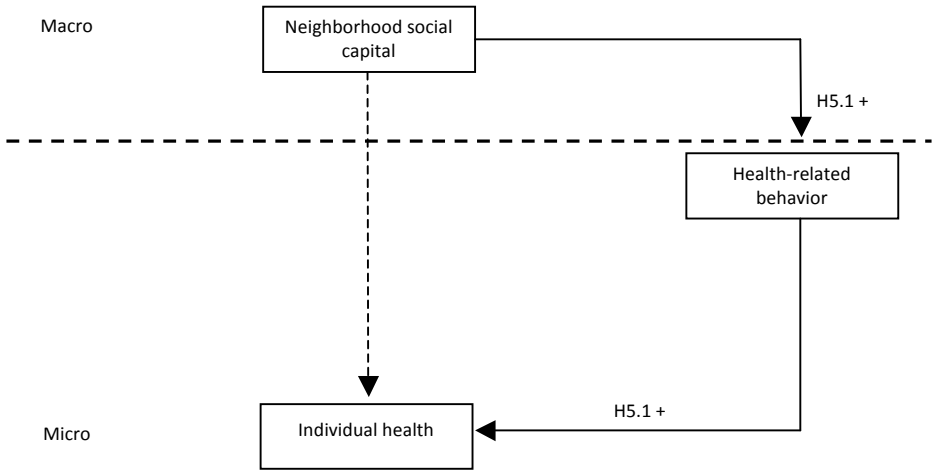


Figure 1.4: Mechanims of the association between neighborhood social capital and health

Hypothesis 5.1 assumes norms to be positively related with healthy behavior. But norms are not necessarily sanctioning behavior which is undesired for social or medical reasons. Group norms on what is appropriate behavior can differ a lot from general social norms, leading to undesired effects of social capital if the group is cohesive. In research on individual-level social capital, some empirical studies have investigated the negative effects[23] of social capital. Examples of negative effects of individual-level social capital are the spread of injection-related drug use (Friedman and Aral 2001) and the spread of obesity within a network (Christakis and Fowler 2007). Studies on the negative side of contextual social capital and health are lacking thus far. However, it cannot be excluded that neighborhood communities can be a source of vulnerability (Portes 1998, page 15; Friedman and Aral 2001, page 415). For example, a Swedish study showed that 7% of the variation in smoking during pregnancy was at the neighborhood level (Sellström, Arnoldsson, Bremberg, and Hjern 2008). Only socio-economic explanations were discussed. If neighborhood

23 "It is now generally understood that like physical and human capital, social capital can be used for pro-social or anti-social purposes." (Putnam 2000 chapter 22: The Dark Side of Social capital; Putnam 2004, page 668).

social capital is high in these communities, and at the same time, smoking during pregnancy is tolerated and practiced, the health of mothers and their infants might be harmed. Portes (1998) describes four negative aspects of community social capital: Exclusion of outsiders, excess claims on group members, restrictions of individual freedoms, and downward-leveling norms. The reported example of a 'restriction of individual freedom' refers to a very cohesive countryside neighborhood. Social control would inhibit personal freedom and force "independent-minded" young people to leave (Portes 1998). Portes' example of downward-leveling norms refers to an ethnic minority group and its norms. Being a member of an ethnic minority group can restrict personal freedom and career chances. The group puts the interest of the group above individuals' interests and economic success.

For this dissertation it was not possible to inquire straightforward into behavioral norms, but health related behavior was studied. Additionally, it was tested whether the percentage of religious people in a neighborhood — used as a proxy for conformity to general social norms — increases the effects of neighborhood social capital on health.

1.3.4.4 Excursus – what is a neighborhood?

This dissertation does not test the '*Lobby mechanism: Lobby for provision of services and access to facilities*' — because the influence of health-related facilities on health is likely not to be neighborhood-specific. Moreover, some decisions on facilities (e.g., to install dentist offices) are made far beyond the influence of a cohesive neighborhood. Larger units, such as cities, regions, or countries, not neighborhoods, are responsible for planning health care infrastructure. If we seek to understand the relationship between neighborhood social capital and individual health, the explanatory mechanism has to fit the neighborhood and not a higher-level area. At this point, the need arises to discuss the function and the measurable size of 'a neighborhood.'

There is no common neighborhood definition in current literature. The definitions range from individual perceptions of inhabitants (Wen, Browning, and Cagney 2003; e.g., Hume, Jorna, Arundell, Saunders, Crawford, and Salmon 2009) through neighborhood constructs based on neighborhood networks (see Hipp, Faris, and Boessen 2011) to statistical and contiguous units, such as postcodes (e.g., Poortinga 2006a). To test our hypotheses, we need to find a neighborhood definition that applies to small neighborhood arguments. Overly large neighborhood units might inhibit the development of a neighborhood community feeling. As mentioned in the beginning of this introductory chapter, social capital is inherent to the structure of relations, and as argued in Hypothesis 5.1, a consequence of social capital might be shared norms. In a cohesive neighborhood community norms can be established and maintained with powerful health implications (Coleman 1990, page 311). Effective norms can lead to, e.g., feelings of safety for the elderly (Coleman 1990, page 311) or the monitoring of suspicious behavior of unknown people on private property.

Three conditions have to be fulfilled to formulate a neighborhood definition that allows internalization of norms. First, boundaries have to be clear. Only in a situation of physical proximity feelings of community can develop (Coleman 1988, page S105). Second, these boundaries have to be stable and contiguous (Hipp, Faris,

and Boessen 2011, page 2). Annual changes to neighborhood boundaries would prevent members of a community from feeling to belong to a stable community. A third condition of a neighborhood definition for local-level arguments is that the boundaries have to comprise a community that is not overly large in size. It is still unclear what 'too large' means. When does a neighborhood comprise too many inhabitants to result in a sense of community? A review of neighborhood sizes used in studies on mental disorder presents (up to) 8000 people as the maximum and ideal number of inhabitants (Weich 2005). Of interest are two studies on mortality performed in the same city, Chicago. One study used a neighborhood size of 50,000 inhabitants and found no significant results for neighborhood social capital on mortality (Wen, Cagney, and Christakis 2005). The other study, with a neighborhood cluster of 8000 people, however, corroborates the hypothesis that neighborhood social capital is associated with lower neighborhood death rates (Lochner, Kawachi, Brennan, and Buka 2003). The U.K studies of Poortinga (2006a; 2006b) and Snelgrove et al. (2009) indicate that postcodes with, on average, 7000 inhabitants might be a good measure for neighborhood studies on self-rated health. North-American studies on self-rated health employed, on average, 3500 (Moore, Bockenholt, Daniel, Frohlich, Kestens, and Richard 2010) or 4000 (Carpiano 2008) individuals per neighborhood to study neighborhood effects.

The neighborhood level in this book is an administrative unit and measured by 4-digit postal codes: The smallest neighborhood unit accessible that included the necessary neighborhood information to test the hypotheses of this dissertation. The Dutch 4-digit postal codes have, on average, 4000 inhabitants. These relatively small units comprise areas between 1-8 km^2, with 2500 – 3000 addresses, on average. Moreover, the neighborhoods do not incorporate natural or built barriers because they have been chosen to suit the daily routes of postmen. An advantage over most recent publications is that the neighborhoods studied here are not restricted to urban neighborhoods (like, for example, Carpiano 2008). The data used essentially cover the whole of the Netherlands, including rural areas where 4-digit postal codes may coincide with whole settlements or villages.

1.4 Data and Methods

The hypotheses are tested with various data sets, using advanced statistical methods.

1.4.1 Data used in this thesis

This study used five cross-sectional survey data sets in total; see Table 1.1 for an overview. In Chapters 2, 3, and 4, the 2006 or 2009 'Housing and Living Survey' (WoON) are used as individual data sets (see Table 1.1). The WoON survey data were collected under the authority of the former Ministry of Housing, Spatial Planning, and Environment (VROM). It is representative of residents of the Netherlands who are 18 years old and older. The interviews took approximately 40 minutes (Van Huijsduijnen, Van Til, Verhoog, Gopal, Ferment, and Van Galen 2007). WoON evaluates the physical and social housing conditions of the Dutch population. Health

researchers hardly ever use this data source because its main focus is on the physical and social housing situation. However, it also incorporates self-rated health as a standard question and several control variables common in health research.

Table 1.1: Number of cases on individual and neighborhood level of surveys used in this dissertation

	WBO 1998	WBO 2002	WoON 2006	WoON 2009	DNSGP-2, 2001
Originally in the data set: Individuals	117,569	75,043	64,005	78,071	12,699
Originally in the data set: Neighborhoods	3517	3480	3495	3393	771
Response rate	78%	61%	56%	59%	65%
Used as individual data set for:			Chapter 2 Chapter 3	Chapter 4	Chapter 5
Used to generate neighborhood information in:	Chapter 5	Chapter 5	Chapter 2 Chapter 3 Chapter 4	Chapter 4	

For Chapter 5, an individual data set was needed that not only incorporates health information but also health-related behavior variables. Therefore, in Chapter 5, the adult respondents of the 'Second Dutch national survey of general practice' (DNSGP-2, 2001/2002) were used as an individual data set (See Table 1.1). This survey contains detailed health-related behavior information and was conducted in 2001 by the NIVEL (Netherlands Institute for Health Services Research) in a sample of 104 general practices, including 195 general practitioners serving a practice population of approximately 400,000 people in total (Westert, Schellevis, and Jabaaij 2006). One part of the DNSGP-2 was used in particular: The Health Interview Survey, with a 5% random sample of the practice population. Patients were interviewed at home via computer-assisted personal interviews (Schellevis, Westert, De Bakker, and Groenewegen 2006).

In the individual data sets, some of the neighborhood-aggregated information was merged on the basis of the 4-digit postal code. If possible, neighborhood information was matched to the data set, which was measured *before* the health outcome variable. In addition to WoON, its ancestor survey, the 'Dutch housing demand survey' (WBO), was used (see Table 1.1). For each chapter, additional neighborhood information aggregated to the 4-digit postal code level was derived from "Nederland Regionaal" from statline.cbs.nl, the online web portal of Statistics Netherlands.

1.4.2 Analyses

The main statistical tool employed is the multilevel technique because this enables us to disentangle context and composition (Leyland and Groenewegen 2003). The relationship between neighborhood social capital and health will be assessed by means of multilevel logistic regression analyses while controlling for individual and contextual independent variables. Self-rated health as a dependent variable has been used consistently through all chapters, which makes the chapters comparable. Using self-rated health as an indicator of actual health is a well-established methodological step, and the correlation with objective health measurements is high (Simon, De Boer, Joung, Bosma, and Mackenbach 2005).

Our main explanatory variable on the neighborhood level is neighborhood social capital. In Chapter 2, 'neighborhood social capital' is measured by five questions (of WoON 2006) regarding contact among neighbors. Items inquire into the following:

- contact with direct neighbors;
- contact with other neighbors;
- whether people in the neighborhood know each other;
- whether neighbors are friendly to each other; and
- whether there is a friendly and sociable atmosphere in the neighborhood.

Response categories were 'totally agree', 'agree,' 'neutral,' 'do not agree,' and 'totally do not agree' (thus, ranging from 1 to 5). Note that the items indicating neighborhood social capital are neighborhood-related measures of social capital, as has been the case in Poortinga and Eriksson. For the aggregation of our measurement to the level of neighborhoods, we applied 'ecometrics' following the work of Raudenbush and Sampson (1999), Browning and Cagney (2003), Carpiano (2008), and Steenbeek (2011).

1.4.3 Ecometric-based measurement of neighborhood social capital

To arrive at contextual information from individual data, individual information must be aggregated to a higher level. In our case, that higher level is the neighborhood. The most straightforward aggregation procedure is to calculate the average for each neighborhood or the standard deviation of the items measured at the individual level (Stafford, Bartley, Sacker, Marmot, Wilkinson et al. 2003; see also Cummins, Macintyre, Davidson, and Ellaway 2005). However, this procedure does not solve a number of problems.

First, variables measuring neighborhood social capital are based on individual perceptions, and it is likely that these perceptions are influenced by the characteristics of the respondent. For example, older individuals might compare neighborhood social capital with what they remember from former times and therefore, report systematically lower scores of social capital in their current neighborhood than younger people do. Another example is women, who, on average, spend more

time at home and in the neighborhood than men and who might thus perceive more neighborhood social capital than their male counterparts.

Second, because the number of respondents differs per neighborhood, the reliability of the aggregated measurement, in our case the social capital measurement, also differs between the neighborhoods. Those with more respondents produce more reliable measurements.

Third, the items that measure social capital are not independent of each other but rather are nested within respondents; that is, answers on one item are likely to be associated with answers on another item.

In summary, one seeks an approach that accounts for individual differences in response to certain items, for differences in the number of respondents on which the estimation is based, and for dependency among the items that measure social capital. One method that meets these requirements is the recently developed ecometrics approach (Raudenbush and Sampson 1999; see Mujahid, Diez-Roux, Morenoff, and Raghunathan 2007; Steenbeek 2011). This approach accounts for the nesting of social-capital items within individuals and includes the neighborhood level in the analysis, resulting in a three-level model; one level for neighborhoods, another for individuals, and the last level for the items measuring social capital.

To estimate the level of social capital per neighborhood, ecometric procedures were applied in this dissertation. For instance, in Chapter 2, we adjusted for seven individual characteristics that can influence the perception of neighborhood social capital, i.e., sex, age, education, income, employment status, home ownership, and years of residence. The ecometric model accounts for differences in the numbers of respondents per neighborhood by shrinking deviating neighborhoods with smaller numbers of respondents to the general average (Hox 2002, page 29). The interdependence of individual responses to items is handled by ecometrics via the separate level for the social-capital items in the multilevel model. In Chapter 2, the three-level model estimating neighborhood social capital is as follows:

$$Y_{ijk} = \gamma_{000} + \sum_{m=1}^{4} \alpha_m D_{mijk} + \sum_{q=1}^{7} \delta_q X_{qjk} + v_{00k} + u_{0\,jk} + e_{ijk} \qquad \text{(Formula 1.1)},$$

where Y_{ijk} is the response to item i of person j in neighborhood k, γ_{000} is the grand mean of neighborhood social capital, m is the number of social capital variables (five in total; one serves as a reference), D are item dummies, q is the number of individual-level adjusters (seven in total), X are the adjuster variables, v is the neighborhood variance, u is the individual variance, and e is the item variance.

The most important parameters are the neighborhood-level residuals, v, which indicate the degree to which the social capital of neighborhood k differs from the grand mean, γ_{000} . These residuals constitute the neighborhood social capital measure. Positive values indicate higher-than-average levels of neighborhood social capital.

The reliability of ecometric scales depends on the variance at the three levels, i.e., the items nested within respondents, and the respondents nested within neighborhoods (Hox, 2002, p. 170). The reliability of neighborhood social capital is estimated by

$$\lambda_k = \frac{\sigma^2}{\sigma^2 + \frac{\tau^2}{J_k} + \frac{\omega^2}{nJ_k}} \qquad \text{(Formula 1.2),}$$

where σ^2 is the variance at the neighborhood level, τ^2 is the variance between individuals per neighborhood, and ω^2 is the variance between the items. J_k is the number of individuals in neighborhood *k*. Finally, *n* is the number of items that measure neighborhood social capital.

The average reliability of our ecometric-based neighborhood social capital measurement in Chapter 2 was 0.620.[24] The correlation — performed at the neighborhood level — between an aggregated social capital measure and the ecometrics-based social capital measure is 0.797**. Normally, a correlation of 0.8 is high; however, in this case, it is not that high because the same thing was measured, only the procedure of aggregation differed. This difference and the clear advantages of the ecometric procedure (see also Steenbeek 2011) were the reason why ecometrics was used to generate neighborhood social capital in this dissertation. Neighborhood social capital was the main independent variable in the hypotheses-testing analyses of Chapters 2 through 5.

1.4.4 Consistency of the measurement of neighborhood social capital

In this thesis, an ecometric procedure has been used a total of six times to estimate neighborhood social capital. Four different waves of the WBO/WoON data sets were used (Table 1.2). Chapters 4 and 5 used more than one WBO/WoON data set because change variables were calculated. A change variable is the change of neighborhood social capital between two points of time. The ecometrics procedure used all possible available cases and lost fewer cases than were lost in the main (hypotheses-testing) analyses of the empirical chapters because these imply more variables with more missing information. An exception was Chapter 5. To generate the change variable, ecometrics was based only on the DNSGP-2 neighborhoods (n = 729) used in the main analysis of Chapter 5.

Table 1.2 shows that, on average, 18 to 29 people per neighborhood were used to create the neighborhood social capital variable while using ecometrics measurement. For the first empirical chapter, five items have been used to generate neighborhood social capital. For Chapter 3, only three items have been used because of theoretical reasons, as was the case in Chapters 4 and 5. The number of control variables in the ecometric procedure differed in the four empirical chapters.[25] One variable changed; the other seven controls remained the same. Self-rated health was not a constant control variable. Independent of the discussion of whether it

24 The interpretation is similar to a Cronbach's alpha in psychometrics scale analysis. The range is from 0 to 1, and a value above 0.600 is considered adequate (Moss, Prosser, Costello, Simpson, Patel et al. 1998).

25 Note that control variables were used in the ecometrics procedure *and* in the analysis to test the hypothesis. Here, I discuss only the control variables of the ecometric procedure.

is statistically correct to integrate subjective health as a control variable in the ecometric procedure–while subjective health is also the dependent variable in the main analyses of the empirical chapters–did not matter whether subjective health was controlled for. The ecometric measure changed only marginally after including subjective health.

Table 1.2: The measurement of neighborhood social capital in chapters 2 to 5

BC	WBO/ WoON wave	# of respondents used in the chapter's analyses	# of neighborhoods, used in chapter's analyses	# of respondents used for ecometrics	# of respondents on average in ecometrics process	# of NSC items	# of ecometrics control variables
2	2006	61,235	3273	64,005	(64005 / 3495 =) 18	5	7
3	2006	53,260	3273	64,005	18	3	8
4	2006 &	65,990	3001	64,005	18	3	8
	2009			78,071	(78071 / 3393 =) 23		
5	1998 &	9270	672	117,569		3	7
	2002			20,825	(20825 / 729 =) 29		

BC= Book chapter, WBO = 'Dutch housing demand survey', WoON = 'Housing and Living Survey', # = numbers, NSC = Neighborhood social capital.

1.5 Outline of this book

This thesis aims to contribute to the understanding of the relationship between neighborhood social capital and individual health. Each chapter tests one or more hypotheses, developed in Chapter 1.3. The empirical chapters are illustrated in Figure 1.5 by arrows. The numbers of the chapters are integrated into the Figure with surrounding circles. Figure 1.5 is the combination of Figures 1.1 to 1.4. All figures show the separation between the macro- and micro-levels. Neighborhood social capital is a macro-level indicator. In contrast, self-rated health and all studied factors are settled at the micro-level.

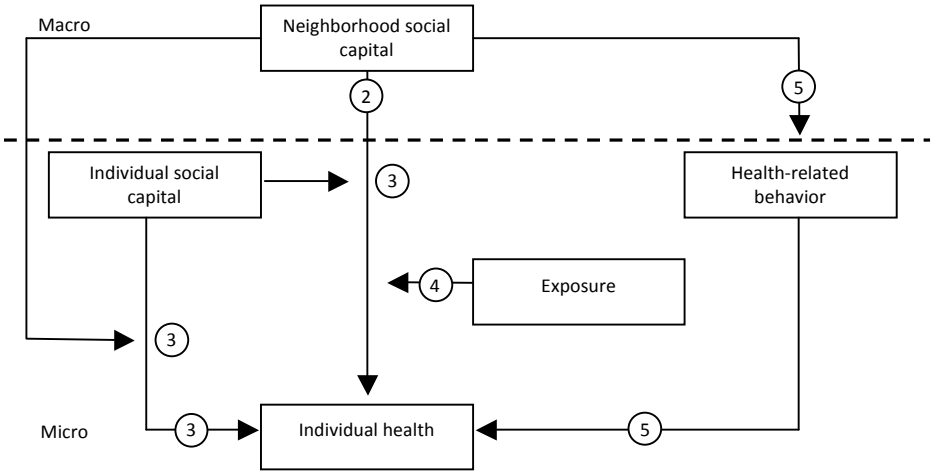


Figure 1.5: Illustration of the book's chapters

Chapter 2 addresses the direct effect of neighborhood social capital on health while using a Dutch national representative data set. This chapter improves on previous research in several ways. The multilevel analyses are rich in control variables at both levels. Furthermore, an advantage over existing literature is the straightforward and neighborhood-related measurement of neighborhood social capital as well as the large number of (urban and rural) neighborhoods used.

In Chapter 3, I further examine the effect of neighborhood social capital on health while controlling for two different kinds of individual-level social capital. One measurement concerns the frequency of contact with neighbors. The second individual-level social capital measurement concerns contacts with friends and (non-household) relatives, who presumably do not live in the same neighborhood. This empirical chapter is a case sui generis in existing literature that examines the interaction between neighborhood social capital and individual social capital, separated into within- and outside-neighborhood contacts. By testing the accumulation and compensation hypotheses, it can be explored whether neighborhood social capital is actually a 'public good.' A 'public good' will need no micro-level personal contact for 'access' to the macro-level resources.

Chapter 4 is the product of a combination of social science and epidemiology. This chapter adds to existing social science research the idea of *exposure* and to epidemiology a promising and often-neglected environmental factor: Social capital. Chapter 4 explores whether people who live longer in the same neighborhood or are more often in the neighborhood during the daytime are more likely to be more exposed to neighborhood social capital and are healthier in consequence. Particularly interesting is the use of more than one data source. This chapter does not suffer from a 'single source bias.' The data source to measure health was not the same as that which was used for social capital.

Chapters 2, 3, and 4 demonstrate that neighborhood social capital exists in Dutch neighborhoods, that it is health-improving and that people are affected differently by it. Chapter 5 addresses a mechanism to explain the relationship between neighborhood social capital and health. Chapter 5 tests five health-related types of behavior as possible mediators. The main idea is that residents' behavior is affected by the neighborhood they live in, in particular, by the people they are surrounded by. If a neighborhood with a high level of social capital stimulates health-promoting behavior, this might explain why social capital affects individual health. The analyses of Chapter 5 will add to previous research in three respects. Types of behaviors that have a non-dichotomous relationship with health have not been forced into two categories but instead were analyzed more completely and with suitable analysis techniques. Secondly, types of behavior were kept apart in the analysis to separate the individual mediation effects. A few recent publications have shown that physical activity is affected by contextual social capital; however, in Chapter 5, physical activity as a mediation effect of the association between neighborhood social capital and health is used for the first time.

Finally, Chapter 6 provides an overview of the leading ideas, findings, and conclusions of this thesis. Limitations and future research will be discussed as well.

Chapter 2

Neighborhood social capital and individual health

This chapter (co-authored by Peter P Groenewegen, Beate Völker, and Henk Flap) appeared in 2011 as "Neighborhood social capital and health" in *Social Science & Medicine*, 72(5):660-667.

Neighborhood social capital and individual health

2.1 Introduction

In recent decades, research on local contexts, such as neighborhoods, and their association with various individual outcomes, e.g., fertility (Mayer and Jencks 1989), career (cf. Wilson 1996), well being (Völker, Flap, and Lindenberg 2007), or deviance (Chung and Steinberg 2006), has become an extensive and important field of study in the social sciences. More specifically, in health sciences, interest in neighborhood conditions and their impact on individual health has grown enormously. There are two general strands of literature in the field of neighborhood effects on health: One is directed toward the influence of socio-economic neighborhood conditions on health, e.g., prosperity; the other focuses on conditions related to the physical environment, e.g., pollution.

Studies from North America on the first type of explanation of ill health, that is, low prosperity (Diez-Roux, Nieto, Muntaner, Tyroler, Comstock et al. 1997; Wen, Cagney, and Christakis 2005), have convincingly shown that neighborhood prosperity matters for various kinds of health outcomes. Also, within Western European countries, where health care systems are highly developed, living in deprived neighborhoods is associated with increased ill health irrespective of an individual's own socio-economic position (Malmström, Sundquist, and Johansson 1999; Van Lenthe and Mackenbach 2002).

Studies on the second type of explanation, that is, health being negatively affected by the physical characteristics of the environment such as home maintenance or environmental pollution, also showed an influence on individual health. The physical qualities of one's living environment substantially affect health (see, e.g., Beelen, Hoek, Van den Brandt, Goldbohm, Fischer et al. 2008).

It has been suggested that next to socio-economic and physical conditions, social conditions in the neighborhood also matter for individual health (Subramanian, Lochner, and Kawachi 2003; Halpern 2005; Veenstra, Luginaah, Wakefield, Birch, Eyles, and Elliott 2005; Wen, Cagney, and Christakis 2005; Fagg, Curtis, Stansfeld, Cattell, Tupuola, and Arephin 2008; Kawachi, Subramanian, and Kim 2008a; Stafford, De Silva, Stansfeld, and Marmot 2008; Van Hooijdonk, Droomers, Deerenberg, Mackenbach, and Kunst 2008). In particular, social capital in a neighborhood is

expected to influence individual health. Thus, the role of neighborhood social capital for individual health is an expanding research area in social epidemiology.

Furthermore, existing studies show limitations regarding the measurements of social capital (Fagg, Curtis, Stansfeld, Cattell, Tupuola, and Arephin 2008) or the number of neighborhoods in the sample (Veenstra, Luginaah, Wakefield, Birch, Eyles, and Elliott 2005). A British multilevel study of 239 neighborhoods showed an association between neighborhood social capital and mental health for economically deprived residents (Stafford, De Silva, Stansfeld, and Marmot 2008). Until now, outside the UK and North America, relatively few studies of neighborhood social capital and its association with physical health have been based on a representative sample of neighborhoods while taking into account additional neighborhood characteristics that also might affect people's health. However, not adjusting for the influence on health of relevant social-economic as well as physical neighborhood characteristics may lead to biased conclusions about the effects of neighborhood social capital. Our contribution inquires into the association between neighborhood social capital and individual health while controlling for these characteristics, in particular socio-economic prosperity and physical maintenance of buildings as well as relevant individual characteristics. Our representative sample enables us to test arguments on the difference between the effects of social capital in rural and urban regions. We aim to answer the following questions: *Does neighborhood social capital positively affect individual health? If so, does this effect remain stable when accounting for other relevant socio-economic and physical conditions on both the neighborhood and the individual level? In addition, we want to know whether effects of social capital differ between urban and rural areas in the Netherlands.*

Neighborhood social capital

Neighborhood social capital, or more generally, macro-level social capital, is a resource one can access via membership in a group or community. Social capital on the macro level—as opposed to micro-level social capital, which operates exclusively on the individual level—consists of norms of reciprocity, civic participation, trust in others, and the benefits of membership. Work by Subramanian et al. (2003), Putnam (2000), Kawachi, Kennedy, and Glass (1999), and, in particular, work on the neighborhood level (Lochner, Kawachi, Brennan, and Buka 2003; Drukker, Buka, Kaplan, McKenzie, and Van Os 2005; Wen, Cagney, and Christakis 2005; Poortinga 2006b; Stafford, De Silva, Stansfeld, and Marmot 2008; Van Hooijdonk, Droomers, Deerenberg, Mackenbach, and Kunst 2008) provides examples of this macro level approach to social capital.

Applying this argument to the field of health, one might expect that neighborhood social capital also enhances an individual's health, and that the more neighborhood social capital one can access, the more one's health would be enhanced. In a neighborhood with much social capital, one would be supported even without asking for help, sometimes even without being aware that one is helped by his neighbors. Intriguingly, even relative strangers can benefit from this public good. For example, people—even if they do not belong to the neighborhood—can safely

walk around there at night because the tight community guarantees personal safety (Coleman 1988).

In previous research, the effects of social capital have been established in rather large geographical units, i.e., at the state or country level (Kawachi, Kennedy, and Glass 1999; Folland 2007). However, the argument for the effect of collective social capital can be understood much better at the level of the neighborhood. Moreover, collective social capital can be measured more precisely on relatively smaller geographical units such as neighborhoods. More generally, because individuals spend a large part of their leisure time at home in their neighborhood, it is plausible to expect that they are influenced by their neighbors and their neighborhood environment. According to this reasoning, the density of the population might be of importance. Rural neighborhoods are generally assumed to provide more social capital because people in smaller communities are more likely to know and maintain relationships with each other. However, people in cities share smaller spatial areas and hence, are more aware of and more dependent upon each other. This sharing of smaller areas might result in stronger effects from relationships and social capital, as such. Hence, we can expect that although people in rural areas might create more social capital in their neighborhoods, the returns of social capital, and hence the effects of those returns on health, will be higher in urban areas. Van Hooijdonk et al. (2008) found lower risks for all-cause mortality for urban residents living in neighborhoods with higher social capital, but not for rural residents in high social capital neighborhoods. Until now, we do not have comprehensive information on whether the effects of social capital on self-rated health differ between urban and rural neighborhoods because the research has mainly focused on urban neighborhoods.

We are not the first to study neighborhood social capital and its effect on health (see, e.g., Kawachi, Subramanian, and Kim 2008a). We aim to contribute to the international literature by carefully testing how neighborhood social capital relates to health in the Netherlands, while including socio-economic and physical neighborhood characteristics in the analysis as well as individual characteristics, which are expected to affect health. As already mentioned, our conclusions are based on analysis of large-scale national representative data on individuals and neighborhoods. Moreover, the neighborhoods in this sample are relatively small geographical areas. Lastly, we inquire into the association between social capital and health among urban and rural Dutch areas.

2.2 Data

We use two different data sets for information on individuals and neighborhoods. One data set is the WoON 2006, commissioned by the Ministry of Housing, Spatial Planning and the Environment (VROM). The WoON 2006 survey (n = 64,005) inquires into the housing situation of people in the Netherlands (Van Huijsduijnen, Van Til, Verhoog, Gopal, Ferment, and Van Galen 2007) and contains information on individual-level characteristics, self-rated health, and information on contacts within the neighborhood. It is representative of residents of the Netherlands who are 18 years old and older. The data were collected between August 2005 and March

2006, and the interviews took about 40 minutes, on average. The response rate was 56% (see Van Huijsduijnen, Van Til, Verhoog, Gopal, Ferment, and Van Galen 2007). Under Dutch privacy legislation, for survey research among the general population no research ethics approval was required.

The information on individual neighborhood contacts enabled us to construct our measurement of neighborhood social capital. These data are enriched by a second data set, which contains information on neighborhoods provided by Statistics Netherlands (CBS) and based on aggregated register information. Both data sets were combined by using the 4-digit postcode areas respondents were living in. Table 2.1 provides an overview of the number of respondents and neighborhoods used in the analyses and relates them to the Dutch population. Eighty-two percent of all neighborhoods in the Netherlands are represented in our sample. We also inquired into whether these neighborhoods are selective with regard to prosperity and urbanity, but there were no differences between our data and national statistics.

Table 2.1: Individuals and neighborhoods in this study and in the Netherlands

	Respondents in sample:	Inhabitants of the Netherlands
	WoON 2006	Statistics Netherlands
Individuals	61,235	16,328,160
Neighborhoods (4-digit postal code)	3273	4002
Average number of individuals per neighborhood	18.7	4080
Year	2006	2006

2.3 Measurements

2.3.1 Individual characteristics

The dependent variable is self-rated health. It is measured by respondents' self-rating of their health when asked: "In general is your health…?" with answers on a 5-point scale ranging from 'very bad' to 'very good'. The variable was dichotomized because its distribution was highly skewed. Using self-rated health as an indicator of actual health is well established, and the correlation with objective health measurements is high (Simon, De Boer, Joung, Bosma, and Mackenbach 2005).

We further employed socio-demographic variables that have been shown to be important in the analysis of health or for which it is usually controlled. Generally, we used the same control variables as recommended by other researchers in the field (Harpham 2008, page 59): Sex, coded as a dummy variable; age, measured in years and centered on the average (= 47.6 years); and ethnic background, measured by parents' country of birth (Dutch, Western, and Non-Western) combined with information on whether the respondent is a first or second generation immigrant.

In addition, three indicators of social status were used: Education, employment, and income. Education was coded as the 'highest educational qualification achieved' at the time of the interview. We used a 5-point scale ranging from 1 (primary school or less) to 5 (university degree). Employment groups include employees/self-employed, those without a paid job, pensioners, recipients of social benefits, and students (at all kinds of schools and universities). Of all WoON 2006 respondents, 93.8% gave direct information on their income and the income of their partner. For the remaining 6.2% (3.4% tax information; 2.8% imputation of tax information), income information was obtained from the Dutch tax office and added to the data (see Van Huijsduijnen, Van Til, Verhoog, Gopal, Ferment, and Van Galen 2007). In our analyses, income is measured as 'equivalent monthly household income'. This variable takes into account all kinds of income (per household) like social benefits, pensions, and salaries. It is calculated by weighting, on the one hand, the costs of children and, on the other hand, the benefits of sharing a household (Siermann, Van Teeffelen, and Urlings 2004). If no information about the number of the household members was available, we used unweighted monthly household income (respondents who were not heading a household, such as adult children who participated in the interview, n = 7630, were not asked the questions about household, home ownership, and years of residence). For the analyses, the metric variable is presented in deciles, where 0 = negative income, i.e., the income primarily of entrepreneurs who made investments greater than their income; 1 = income up to 599.99 Euro, 2-9 contain income in steps of 300 Euro, and 10 equals an income of 2700 Euro and higher per month. Decile 5 (1200.00 to 1499.99 Euro) is the median and the reference category.

Furthermore, in many neighborhood studies it has been shown that home ownership matters for a number of outcomes (Ross and Jang 2000; e.g., Harpham 2008). It is argued that home owners, in contrast to renters, usually invest more in the physical and social conditions of their neighborhood (DiPasquale and Glaeser 1999). We also included a measurement for home ownership, while establishing a difference between 'owner', 'renter', and 'not applicable'. Finally, the years of residence at the given address were included at the individual level to control for the length of the influence of the neighborhood context. This was recorded using the question, "How long have you lived at this address?" For the analyses, we constructed five categories (1) '0-5 years', (2) '6-15 years', (3) '16-25 years', (4) '26 or more years', and a category for missing values. Table 2.2 presents the descriptive statistics of variables on the individual level. As it can be seen in Table 2.2, 81% of our respondents rate their health as being good or very good. Furthermore, about 17% have a background other than Dutch, and almost half of the sample is employed or self-employed. Also, approximately half of the sample (47%) owned their home and about 30% lived there between 6 and 15 years.

Table 2.2: Descriptive statistics of individual variables, source: WoON 2006 (n = 61,235 respondents)

		Range	Mean	S.D.	Percent	Missing (n)
Self-rated health:	Not good (0)				19.0%	0
	Good or very good (1)				81.0%	
Sex:	Man (1)				47.0%	0
	Woman (2)				53.0%	
Age in years		18 - 103	47.6	18.65		0
Ethnic background:	Native Dutch				82.7%	0
	Second generation Western				3.9%	
	Second generation Non-Western				1.8%	
	First generation Western				4.0%	
	First generation Non-Western				7.5%	
Education		1 - 5	3.4	1.32		0
Occupation:	No job				5.2%	0
	(Self-) employed				47.2%	
	Pensioner				23.0%	
	Welfare recipient				9.7%	
	Scholar/ student				14.9%	
Income [a] :	Negative income				0.2%	0
	Decile 1				2.5%	
	Decile 2				3.5%	
	Decile 3				13.2%	
	Decile 4				16.8%	
	Decile 5	(= Median)			17.6%	
	Decile 6				14.5%	
	Decile 7				10.8%	
	Decile 8				7.5%	
	Decile 9				4.6%	
	Decile 10				8.8%	
Ownership:	Owner (1)				47.2%	
	Renter (2)				40.3%	
	Not applicable (3)				12.5%	7630
Years of residence:	Not applicable (0)		14.2	12.77	12.5%	7630
	0-5 years (1)				26.4%	
	6-15 years (2)				30.4%	
	16-25 years (3)				14.4%	
	≥ 26 years (4)				16.3%	

[a] Note: In the analyses, deciles 1 and 2 are combined

2.3.2 Neighborhood characteristics

Our main explanatory variable on the neighborhood level is neighborhood social capital. In the WoON 2006 data, 'neighborhood social capital' is measured by five questions on contacts among neighbors. Items inquire into the following:

- contact with direct neighbors;
- contact with other neighbors;
- whether people in the neighborhood know each other;
- whether neighbors are friendly to each other; and
- whether there is a friendly and sociable atmosphere in the neighborhood.

Response categories were 'totally agree', 'agree', 'neutral', 'don't agree', and 'totally don't agree' (thus, ranging from 1 to 5). For the analyses, variables and the resulting scales were coded in such a way that higher values indicate more social capital. Note that the items indicating neighborhood social capital focus straightforwardly on access to neighbors and general contacts in the neighborhood. Many other studies used measurements such as generalized trust. However, this is not necessarily related to local contacts. For the aggregation of our measurement to the level of neighborhoods we applied 'ecometrics' following the work of Raudenbush and Sampson (1999; see the section below on ecometrics).

To take into account the level of income in a neighborhood, we took the percentage of people in the highest income quintile. Hou and Myles (2005) showed that the prosperity of a neighborhood is associated with inhabitants' health, and that this effect is even stronger than the effect of poverty. The data were provided by Statistics Netherlands (CBS). Income includes income from work, one's own company, social benefits, pensions, or financial support for students. Besides inquiring into the effects of prosperity, we also tested the (negative) effects of low income on health while including the percentage of people in the lowest quintile in the analyses, which lead to the same conclusions.

We used the degree of urbanity of the municipality in which a given neighborhood is located. The codes were provided by Statistics Netherlands (CBS), and were based on the number of addresses per km^2 (5 = urban = more than 2499 addresses/km^2; 4 = semi-urban = 1500-2499 addresses/km^2; 3 = intermediate urban-rural = 1000-1499 addresses/km^2; 2 = semi-rural = 500-999 addresses/km^2; and 1 = rural = up to 499 addresses per km^2).

Table 2.3: Descriptive statistics of neighborhood variables

n of neighborhoods = 3273	Data source	Year	N	Mean	SD	Range
Neighborhood social capital	WoON	2006	3495	-0.007	0.716	-3.18 - 2.14
Highest income quintile	Stat. Neth[a)]	1999-2005	3667	14.2	4.927	0 - 42.9%
Urban density of municipality	Stat. Neth.	1999-2005	3667	3.4	1.345	1 - 5
Neighborhood home maintenance	WoON	2006	3495	4.0	0.455	1 - 5

[a)] Stat. Neth. = Statistics Netherlands

Table 2.4: Correlation of coefficients of individual- and neighborhood-level variables (Spearman's rho)

	n_i = 61,235	1	2	3	4	5	6	7	8	9	10	11	12	13
1	Self-rated health[a]	1.00	--	--	--	--	--	--	--	--	--	--	--	--
2	Sex[a] (1 = woman)	**-0.089	1.00	--	--	--	--	--	--	--	--	--	--	--
3	Age	**-0.319	***0.089	1.00	--	--	--	--	--	--	--	--	--	--
4	Ethnic background[a] (1 = Dutch)	**0.033	-0.006	**0.131	1.00	--	--	--	--	--	--	--	--	--
5	Education	**0.260	**-0.098	***-0.275	**0.014	1.00	--	--	--	--	--	--	--	--
6	Occupation[a] (1 = (self-) employee)	**0.269	**-0.146	**-0.314	**0.035	**0.257	1.00	--	--	--	--	--	--	--
7	Income	**0.146	**-0.060	**0.204	**0.137	**0.341	***0.310	1.00	--	--	--	--	--	--
8	Home ownership[a] (1 = owner)	**0.223	**-0.073	**-0.094	**0.152	**0.293	***0.259	**0.467	1.00	--	--	--	--	--
9	Years of residence	**-0.126	**0.023	**0.532	**0.127	**-0.193	***0.189	**0.038	**0.077	1.00	--	--	--	--
10	Neighborhood social capital	**0.153	0.014	0.041	**0.193	0.011	*0.069	**0.130	**0.297	**0.113	1.00	--	--	--
11	Highest income quintile	**0.201	-0.010	0.039	*0.085	**0.178	*0.064	**0.209	**0.180	0.014	**0.105	1.00	--	--
12	Urbanity	*-0.082	-0.016	-0.035	**-0.181	*0.056	-0.042	-0.014	**-0.239	**-0.116	**-0.525	**0.177	1.00	--
13	House maintenance	*0.176	0.013	0.018	**0.152	*0.061	*0.080	**0.109	**0.298	0.024	**0.308	**0.164	**0.188	1.00

n_i = numbers of individuals, *p ≤ 0.05, ** p ≤ 0.01, ***p ≤ 0.001, [a] dichotomous variable. Correlations between variables at the individual level and variables at the level of the neighborhood are calculated via a multilevel regression model.

Finally, we used a measure of home maintenance in the neighborhood in order to control for environmental influences on individuals' health. The variable is aggregated to the neighborhood level. Maintenance was addressed with the question, "Is your house in a bad condition?" Answer categories were on a 5-point scale from 'I totally agree' (1) to 'I totally do not agree' (5). Higher values thus indicate better maintenance, as reported by the respondent.

An overview of the neighborhood variables and their sources is given in Table 2.3. Note that the information on neighborhoods provided by Statistics Netherlands (CBS) was collected between 1999 and 2005 (see Table 2.3), or before 2006, which was the year when self-rated health was measured. Correlation of variables at the individual level and neighborhood level are provided in Table 2.4.

2.3.3 Ecometric-based measurement of neighborhood social capital

To arrive at contextual information from individual data, individual information has to be aggregated to the higher level, which in our case is the neighborhood. The most straightforward procedure of aggregation (see also Cummins, Macintyre, Davidson, and Ellaway 2005) is to calculate for each neighborhood the average or the standard deviation of the items measured at the individual level (Stafford, Bartley, Sacker, Marmot, Wilkinson et al. 2003; see also Cummins, Macintyre, Davidson, and Ellaway 2005). However, this procedure does not solve a number of problems.

First, variables measuring neighborhood social capital are based on individual perception, and it is likely that this perception is influenced by the characteristics of the respondent. For example, older people might compare neighborhood social capital with what they remember from former times and therefore report systematically lower scores of social capital in their current neighborhood than younger people. Another example is women, who on average spend more time in the neighborhood than men and who might thus perceive more neighborhood social capital than their male counterparts.

Second, since the number of respondents differs per neighborhood, the reliability of the aggregated measurement, in our case the social capital measurement, also differs between the neighborhoods.

Third, the items that measure social capital are not independent of each other but nested within respondents; that is, answers on one item are likely to be associated with answers on another item.

In summary, one wants an approach that accounts for individual differences in response to certain items, for differences in numbers of respondents on which the estimation is based, and for dependency among the items that measure social capital. A method that deals with these shortcomings is the recently developed ecometrics approach (Raudenbush and Sampson 1999; see Mujahid, Diez-Roux, Morenoff, and Raghunathan 2007). This approach accounts for the nesting of social capital items within individuals and includes the neighborhood level in the analysis, resulting in a three-level model. One level is for neighborhoods, another is for individuals, and the last is for the items measuring social capital.

We adjusted for seven individual characteristics that can influence the perception of neighborhood social capital, i.e. sex, age, education, income, employment status, home ownership, and years of residence. The ecometric model accounts for differences in the numbers of respondents per neighborhood by shrinking deviating neighborhoods with smaller numbers of respondents to the general average (Hox 2002, page 29). The interdependence of individual responses to items is handled by ecometrics via the separate level for the social capital items in the multilevel model.

In the first step of the analysis, neighborhood social capital is estimated using this three-level model. The residuals of the neighborhood social capital measurement, i.e., the part that cannot be attributed to individual response patterns, constitutes the social capital measurement for the final analyses in the second step, where the hypotheses are tested. In this second step, the ecometric-based social capital measurement is used as an independent variable in a two-level logistic model, with a binary indicator for health as dependent variable.

The model estimating neighborhood social capital is as follows:

$$Y_{ijk} = \gamma_{000} + \sum_{m=1}^{4} \alpha_m D_{mijk} + \sum_{q=1}^{7} \delta_q X_{qjk} + v_{00k} + u_{0\,jk} + e_{ijk} \qquad \text{(Formula 2.1)},$$

where Y_{ijk} is the response to item i of person j in neighborhood k, γ_{000} is the grand mean of neighborhood social capital, m is the number of social capital variables (five in total; one serves as reference), D are item dummies, q is the number of individual-level adjusters (seven in total), X are the adjuster variables, v is the neighborhood variance, u is the individual variance, and e is the item variance.

The most important parameters are the neighborhood-level residuals, v, which indicate the degree to which the social capital of neighborhood k differs from the grand mean, γ_{000} . These residuals constitute the neighborhood social capital measure. Positive values indicate higher-than-average levels of neighborhood social capital.

The reliability of ecometric scales depends on the variance at the three levels, i.e., items nested within respondents, and respondents nested within neighborhoods (Hox 2002, page 170). The reliability of neighborhood social capital is estimated by

$$\lambda_k = \frac{\sigma^2}{\sigma^2 + \frac{\tau^2}{J_k} + \frac{\omega^2}{nJ_k}} \qquad \text{(Formula 2.2)},$$

where σ^2 is the variance on neighborhood level, τ^2 is the variance between individuals per neighborhood, and ω^2 is the variance between the items. J_k is the number of individuals in neighborhood k. Finally, n is the number of items that measure neighborhood social capital.

The average reliability of our ecometric-based neighborhood social capital measurement is 0.620. The interpretation is similar to a Cronbach's alpha in psychometrics scale analysis. The range is from 0 to 1, and a value above 0.600 is considered to be adequate (Moss, Prosser, Costello, Simpson, Patel et al. 1998). The

correlation—performed at the neighborhood level—between an aggregated social capital measure and the ecometrics-based social capital measure is 0.797.

2.4 Analytic strategy

We used the statistical software package MLwiN 2.15 to perform logistic regression analysis. We estimated the models in MLwiN with second order, PQL estimation. All coefficients are expressed in odds ratios (OR), calculated as exp x coefficient. The confidence interval (CI) is established by exp x (coefficient – standard error), and exp x (coefficient + standard error), respectively. For example (Table 2.5, model 4), the OR of sex is -0.156 x exp = 0.86, and the CI of sex are exp x (-0.156 - 0.025) = 0.83, and exp x (0.156 + 0.025) = 0.88. We used a Wald test because in a logistic regression, with its quasi-likelihood estimation, a likelihood ratio test cannot be obtained. The intraclass correlation (*ICC*) was calculated by the following formula for a multilevel logistic model (Snijders and Bosker 1999, page 244):

$$ICC = \frac{\sigma^2}{\sigma^2 + 3.29} \qquad \text{(Formula 2.3),}$$

where σ^2 is the variance on neighborhood level.

We estimated an empty model first to establish the clustering of self-rated health in neighborhoods. Model 1 adds variables on the individual level to measure composition effects. Model 2 adds the first neighborhood level variable: Neighborhood social capital. Model 3 adds the other neighborhood control variables (without neighborhood social capital), and, finally, Model 4 summarizes the full model. These analyses are presented in Table 2.5. In Table 2.6, the equations of model 3 and 4 are repeated for separate categories of urbanity because, as mentioned, we expect differences in the influence of social capital in more urban, as compared with more rural areas.

2.5 Results

Dutch neighborhoods differ in the self-rated health of their inhabitants. In the empty model, neighborhood level variance is 0.120, se = 0.012. The intraclass coefficient is 3.52; in other words, more than 3.5% of the variation in health can be attributed to neighborhood level.

Table 2.5 shows that all odds ratios of the individual variables are in the expected direction (see Model 1). Being female, older than average, non-native Dutch or unemployed all indicate a lower likelihood of reporting a good or very good self-rated health compared to the respective reference group. High education and a high household income predict a better self-rated health. Owning as opposed to renting a house doubles the likelihood of reporting good health. People who moved in the last 5 years have slightly better chances of reporting good health than people who lived between 6 and 25 years at the same address. The odds ratios of all variables on

Table 2.5: Multilevel logistic regression models of neighborhood social capital on individual health (Odds Ratios, 95% Confidence Interval in parentheses)

n_i = 61,235	n_j = 3,273	Model 1		Model 2		Model 3		Model 4	
Intercept		1.435	0.052***	1.458	0.052***	1.470	0.054***	1.484	0.054***
Individual level									
Gender	Women	0.86	(0.84/0.88)***	0.86	(0.84/0.88)***	0.86	(0.83/0.88)***	0.86	(0.83/0.88)***
Age	(centered)	0.96	(0.96/0.96)***	0.96	(0.96/0.96)***	0.96	(0.96/0.96)***	0.96	(0.96/0.96)***
Ethnic background (Ref. = Dutch)	2nd gen. Western	0.81	(0.76/0.86)***	0.81	(0.77/0.86)***	0.81	(0.76/0.86)***	0.81	(0.76/0.86)***
	2nd gen. non-West.	0.83	(0.74/0.93)*	0.85	(0.76/0.95)	0.84	(0.75/0.94)	0.85	(0.76/0.95)
	1st gen. Western	0.88	(0.83/0.93)*	0.89	(0.84/0.94)*	0.88	(0.84/0.94)*	0.89	(0.84/0.94)*
	1st gen. non-Western	0.63	(0.60/0.66)***	0.65	(0.62/0.68)***	0.65	(0.62/0.68)***	0.65	(0.62/0.68)***
Education		1.18	(1.17/1.19)***	1.19	(1.17/1.20)***	1.18	(1.17/1.19)***	1.18	(1.17/1.19)***
Occupation (Ref. = (Self-) employed)	No job	0.59	(0.56/0.63)***	0.59	(0.56/0.62)***	0.59	(0.56/0.63)***	0.59	(0.56/0.63)***
	Pensioner	0.68	(0.65/0.71)***	0.68	(0.65/0.71)***	0.68	(0.65/0.71)***	0.68	(0.65/0.71)***
	Welfare recipient	0.19	(0.19/0.20)***	0.20	(0.19/0.20)***	0.20	(0.19/0.20)***	0.20	(0.19/0.20)***
	Student	0.86	(0.82/0.91)***	0.87	(0.82/0.91)**	0.86	(0.82/0.91)**	0.87	(0.82/0.91)**
Income (Ref. = Decile 5)	Negative income	1.94	(1.26/2.91)	1.91	(1.24/2.93)	1.90	(1.24/2.91)	1.89	(1.24/2.91)
	Decile 1 and 2	0.94	(0.87/1.02)	0.94	(0.87/1.02)	0.94	(0.87/1.02)	0.94	(0.87/1.02)
	Decile 3	0.83	(0.79/0.86)***	0.83	(0.79/0.86)***	0.83	(0.80/0.87)***	0.83	(0.80/0.87)***
	Decile 4	0.86	(0.83/0.89)***	0.85	(0.82/0.89)***	0.86	(0.83/0.89)***	0.86	(0.83/0.89)***
	Decile 6	1.10	(1.05/1.14)*	1.10	(1.05/1.14)*	1.09	(1.04/1.14)*	1.09	(1.05/1.14)*
	Decile 7	1.26	(1.20/1.32)***	1.26	(1.20/1.32)***	1.25	(1.19/1.31)***	1.25	(1.19/1.31)***
	Decile 8	1.53	(1.44/1.61)***	1.53	(1.44/1.62)***	1.51	(1.42/1.60)***	1.51	(1.42/1.60)***
	Decile 9	1.50	(1.40/1.61)***	1.51	(1.40/1.62)***	1.48	(1.37/1.59)***	1.48	(1.38/1.59)***
	Decile 10	1.70	(1.60/1.80)***	1.70	(1.61/1.80)***	1.66	(1.56/1.76)***	1.66	(1.56/1.76)***
Ownership (Ref. = Renter) [a)]	Owner	1.51	(1.47/1.55)***	1.47	(1.43/1.51)***	1.47	(1.43/1.52)***	1.46	(1.42/1.51)***
Years of Residence (Ref. = 0-5 years) [a)]	6-15 years	0.93	(0.90/0.96)	0.93	(0.90/0.96)	0.93	(0.90/0.96)	0.93	(0.90/0.96)
	16-25 years	0.92	(0.89/0.96)	0.92	(0.89/0.96)	0.93	(0.89/0.96)	0.93	(0.89/0.96)
	≥26 years	1.05	(1.01/1.10)	1.05	(1.01/1.09)	1.07	(1.02/1.11)	1.06	(1.02/1.10)

n_i = numbers of individuals, n_j = numbers of neighborhoods, *p ≤ 0.05, ** p ≤ 0.01, ***p ≤ 0.001,

[a)] This variable has a missing category that was included to the models but results are not shown here.

Table 2.5 (continued)

	Model 1	Model 2	Model 3	Model 4
Neighborhood level				
Neighborhood social capital		1.06 (1.05/1.08)***		1.05 (1.03/1.07)**
Highest income quintile			1.01 (1.01/1.01)***	1.01 (1.01/1.01)***
Urbanity of municipality			1.02 (1.00/1.04)	1.02 (1.01/1.04)*
Home maintenance			1.17 (1.12/1.23)***	1.13 (1.08/1.19)**
Variance neighborhood level (se)	0.023 (0.008)**	0.020 (0.007)**	0.015 (0.007)*	0.015 (0.007)*
Intraclass correlation (%)	0.69	0.60	0.45	0.45
Waldtest (R^2)	0.320	0.321	0.322	0.323

n_i = numbers of individuals, n_j = numbers of neighborhoods, *p ≤ 0.05, ** p ≤ 0.01, ***p ≤ 0.001,
[a] This variable has a missing category that was included to the models but results are not shown here.

Table 2.6: Descriptive statistics and odds ratios per urbanity group for the relation between neighborhood social capital and self-rated health

				(A) Without neighborhood control variables[a)b)]		(B) With neighborhood control variables[a)b)]	
Urbanity	n_i/n_j	Good health (average)	Neighborhood social capital, average (range)	Neighborhood social capital, OR (95% CI)	Neighborhood variance, coefficients (standard errors)	Neighborhood social capital, OR (95% CI)	Neighborhood variance, coefficients (standard errors)
5 (urban)	13,622/329	0.79	-1.08 (-3.18/1.27)	1.18 (1.14/1.23)***	0.026 (0.014)*	1.11 (1.06/1.15)**	0.020 (0.013)
4	17,860/648	0.80	-0.61 (-2.73/1.22)	1.02 (0.99/1.06)	0.021 (0.013)	0.96 (0.93/1.00)	0.012 (0.012)
3	12,326/603	0.82	-0.02 (-1.70/2.14)	1.14 (1.10/1.19)***	0.000 (0.000)	1.09 (1.04/1.14)*	0.000 (0.000)
2	9,842/759	0.83	0.34 (-1.65/2.03)	1.00 (0.95/1.06)	0.016 (0.023)	1.02 (0.96/1.07)	0.013 (0.023)
1 (rural)	7,585/934	0.82	0.46 (-1.02/1.90)	1.07 (1.00/1.14)	0.000 (0.000)	1.07 (1.00/1.14)	0.000 (0.000)

[a] Neighborhood-level controls were high-income quintile and home maintenance
[b] All models are adjusted for individual-level gender, age, ethnic background, education, occupation, income, ownership, and years of residence
n_i = numbers of individuals, n_j = numbers of neighborhoods, OR = Odds ratio, CI = Confidence Interval, * p ≤ 0.05, ** p ≤ 0.01, ***p ≤ 0.001

the individual level remain stable across all the models estimated. Compared to the empty model neighborhood level variance is strongly reduced (but still significant) when individual level variables are included. This indicates that the clustering of self-rated health is largely, but not merely, due to social composition.

Model 2 shows that neighborhood social capital has a positive association with individual self-rated health. More generally, the finding indicates that, in addition to the strong composition effects due to individual characteristics, there is also a relationship between health and neighborhood context. In other words, places, contexts, and their characteristics make a difference alongside individual characteristics. There are places, or neighborhoods, where people of all ages and with different levels of prosperity appear to benefit from neighborhood social capital, which is associated with reporting better health.

Model 3 shows that, while controlling for individual income, the percentage of people in the highest income quintile in a neighborhood has a positive association with self-rated health. Furthermore, in model 3 the association of urbanity with self-rated health is on the border of significance. By contrast, better house maintenance in a neighborhood is significantly associated with better self-rated health.

Model 4 shows, in comparison with model 3, that the effect of house maintenance is partially explained by neighborhood social capital. The influence of social capital also remains stable when physical (house maintenance) and socio-economic (relative poverty) neighborhood conditions known to be associated with health are included. If someone lives in a neighborhood with higher than average neighborhood social capital his/her chance of reporting good or very good health is increased by 6%. Thus, other things being equal, collective social capital matters for individual health.

Table 2.6 summarizes the effects of neighborhood social capital on self-rated health separately for the five urbanity categories. Table 2.6 shows that 82% of the people in rural areas report good or very good self-rated health, whereas only 79% of the people in urban areas report feeling healthy. Another finding presented in Table 2.6 suggests that social capital is lower in urban neighborhoods than in rural neighborhoods. Furthermore, Table 2.6 shows the results of multilevel logistic regression analyses. While health of residents of rural areas does not vary at the neighborhood level, there is significant neighborhood variation in other areas (detailed results not presented). However, after including compositional and contextual variables, there is only variation in health at neighborhood level in very urban neighborhoods.

Interestingly, only the urban and the intermediate urban-rural categories show a significant association between social capital and health. Thus, people in urban (and intermediate urban-rural) areas report on average worse health and less social capital than people in rural areas; however, neighborhood social capital does relate to their health, while it is not associated with the health of 'rural' people.

2.6 Discussion

First, our study shows a small but significant clustering of self-rated health in neighborhoods that cannot be explained entirely by social composition. Contextual conditions, or conditions due to the characteristics of the neighborhood such as neighborhood social capital, are also associated with self-rated health. While both socio-economic and physical neighborhood conditions also show a relation with health, the independent effect of social capital remains. However, clustering of health in neighborhoods has been found before in urban or intermediate urban-rural areas, and only in these areas does collective social capital show an independent association with people's health.

Our study has some limitations. First, we cannot completely rule out selection effects. It may be that healthy people move away from low social capital neighborhoods. However, this seems to rarely be the case: A 10-year follow-up study in a Dutch city showed that selective migration hardly contributes to neighborhood inequality in health (Van Lenthe, Martikainen, and Mackenbach 2007). Furthermore, our data allow for ruling out health related moves. In our data, a direct question asking for the most important reasons for the last move to another address showed 'health' as being a relatively marginal reason: Only 7% (n = 89) of those who moved during the last four years mentioned health or health care facilities as being the reason for their moving. Houses, e.g., their size, location, and facilities, were the most important reason for moving. However, health problems might well give rise to other reasons for moving. In order to rule out these potential selection effects we ran two additional analyses. These analyses included one without the eighty-nine people who moved for health-related reasons and one without all of the people that moved; however, the results did not change.

Second, people's willingness to respond to the survey might be related to neighborhood social capital. It could be the case that people who feel better embedded in a neighborhood respond more often to the survey, and those who have fewer contacts refuse to participate. It could also be the case that only healthy people responded, and that those who felt sick did not. If so, then, the variation of both social capital and health will be larger in reality than our results suggest. If these types of biases are present at the same time and variation in the data is lower than in reality, it becomes even more intriguing that health systematically varies with social capital.

The strengths of our contribution are related to the straightforward measurement of neighborhood social capital and the large number of neighborhoods that are studied. First, the way neighborhood social capital is measured is an improvement upon many other studies. In line with theoretical considerations of social capital theory, neighborhood social capital is measured by questions regarding actual interactions between neighbors. Second, we measured neighborhood social capital using ecometrics, which resulted in reliable estimations of neighborhood social capital. Third, we systematically accounted for individual and neighborhood conditions as well, while studying effects of neighborhood social capital.

Our findings are in line with the earlier results of Subramanian et al. (2003) who also established a context effect of neighborhood social capital on health in conjunction with the effects of the composition of individuals in a neighborhood.

Hence, although the social composition in neighborhoods in terms of income, age, or ethnicity is very important in explaining health, there is an effect of places or contexts that cannot be attributed to differences in composition. Instead, this effect has to be attributed to differences in contextual characteristics; in our case, this effect is associated with differences in collective social capital.

We further want to emphasize that our study demonstrates the importance of physical and socio-economic neighborhood conditions for health. Although there is general agreement that neighborhood environment matters for health, many studies do not include neighborhood variables in the analyses (Subramanian, Lochner, and Kawachi 2003; e.g., Poortinga 2006b). Exceptions are Drukker et al. (2005) and Van Hooijdonk et al. (2008). Finally, our results suggested that individuals in urban neighborhoods benefited more from social capital although they actually have less social capital to access. This may be partly because the level of social capital is generally lower in urban areas compared to rural ones, so small increments make a larger difference in urban areas. This finding points to the difference between access and use of social capital, which is sometimes made in the literature on social capital at the individual level (see, e.g., Lin 2000). Having much social capital to dispose of does not imply that one also makes use of it. Perhaps, returns on social capital are greater in cities because people are more aware of each other and are forced to take note of one another. Future research needs to inquire more deeply into this finding as well as the pathways through which neighborhood social capital is effective. A possible mechanism might be related to the availability of amenities and access to health and community services. For example, it is possible that neighborhood social capital improves community capacity to lobby for provision of services within the neighborhood, and this might explain the health differences between neighborhoods. Furthermore, the interaction of micro social capital, i.e., getting support via direct ties, and macro social capital, i.e., getting support via indirect ties and membership, needs to be understood better in the future.

Chapter 3

The influence of social capital on individual health – a consequense of neighborhood social capital or neighbor networks?

This chapter is co-authored by Beate Völker, Henk Flap, S.V. Subramanian, and Peter P. Groenewegen. Under review.

The influence of social capital on individual health – a consequence of neighborhood social capital or neighbor networks?

3.1 Introduction

Previous research on the association between neighborhood-level social capital and health has usually ignored another important type of social capital: Micro-level social capital, or an individual's social network (Moore, Haines, Hawe, and Shiell 2006). Neighborhood-level social capital is a collective good and as such available to *all* members of a community. Several studies have found a positive relationship between this type of social capital and individual health (Poortinga 2006b; Snelgrove, Pikhart, and Stafford 2009). Often, these studies are inspired by scholars in political science, who commonly conceive social capital as consisting of norms of reciprocity, civic participation, general trust, and the benefits of membership in voluntary organizations (Putnam, Leonardi, and Nanetti 1993). In sociology, the focus is usually on returns of micro-level social capital. Micro-level social capital is an individual good and consists of an individual's relations to *specific* others (Lin, Simeone, Ensel, and Kuo 1979; e.g., the network approach, House 1981; Tijhuis, Flap, Foets, and Groenewegen 1995; Berkman and Glass 2000). In health research, both approaches to social capital can be found. However, nowadays it seems more common to consider social capital as a collective (and not as an individual) good. Moore et al. (2006) argued, based on a citation network analysis in 2003, that "network approaches to the study of social capital and health have been lost in the translation of social capital in public health" (op.cit. p, 733). Putnam's work on macro-level social capital has been "absorbed into mainstream thinking in public health" (Moore, Haines, Hawe, and Shiell 2006, p, 731) and dominates public health research on social capital (Putnam, Leonardi, and Nanetti 1993).

The fact that neighborhood- and individual-level social capital are studied in different fields of social science and that health research has focused on macro-level social capital explains why the two types of social capital are rarely combined in one study. However, it is plausible to argue that neighborhood- *as well as* individual-level social capital influence an individual's health. A person's health can be affected by either scenario in which one enjoys a cohesive neighborhood community or has

an active personal network of many social ties. Furthermore, the influence of neighborhood- and individual-level social capital might depend upon each other. A lack of one type of social capital may be compensated by having ample of the other type. For example, people who have few ties to neighbors may nevertheless participate in activities in their neighborhood and therefore benefit from neighborhood cohesion and neighborhood social capital. Another possible argument for an interaction is that the two forms of social capital reinforce one another's influence on health. For example, the influence of neighborhood social capital might become even stronger if one also has a vibrant social network and vice versa. Access to neighborhood-level social capital is guaranteed via such a personal network, (Lin 2001; Carpiano 2008).

While neighborhood-level social capital is related to specific settings, such as the neighborhood, micro-level social capital consists of specific ties, which can be inside or outside of a setting. In our case, they may be inside or outside the neighborhood. We expect that the influence of specific types of ties depends in a different way on macro-level social capital. For example, the consequences of macro-level social capital for an individual's health might be conditioned by relationships within the neighborhood or relationships outside it. More precisely, the influence of neighborhood social capital on health might become stronger if one also has a strong network in that neighborhood. Conversely, it might become weaker if most network members live outside the immediate neighborhood. Moreover, and vice versa, neighborhood social capital might reinforce the effect of relationships with neighbors on health, but weaken the influence of other relationships.

In this article, we analyze the effects of individual- (within and outside the neighborhood) and neighborhood-level social capital on individual health. We also analyze the effects of their combination.

Our research questions are as follows:

1a) To what extent do individual- and neighborhood-level social capital influence individual health?

2a) Is the effect of neighborhood-level social capital for individual health conditioned by individual-level social capital and vice versa?

2b) Is the effect of neighborhood-level social capital on health conditioned by ties within and/or outside the neighborhood and vice versa?

As already mentioned, research inquiring into both the influence of individual- and neighborhood-level social capital on health is scarce. The two main effects, an independent effect of neighborhood-social capital on health and an independent effect of individual-level social capital on health are studied using multilevel analyses by Carpiano (2008), Fujisawa et al. (2009), Eriksson et al. (2011), and Giordano et al. (2011).[26] Fujisawa et al. (2009) found that social capital at both the individual- and the neighborhood-level has a positive influence on health. Next to significant positive effects of individual-level social capital on self-rated health, Carpiano (2008), Eriksson et al. (2011), and Giordano et al. (2011) also found a beneficial effect of

26 The neighborhood-level social capital measurements that were used were the same as the individual-level variables, just aggregated.

neighborhood-level social capital, but not all measurements of neighborhood social capital proved significant.

There is no common neighborhood definition in the current literature. The definitions range from individual perceptions of inhabitants (Wen, Browning, and Cagney 2003; e.g., Hume, Jorna, Arundell, Saunders, Crawford, and Salmon 2009) through neighborhood constructs based on neighborhood networks (see Hipp, Faris, and Boessen 2011) to statistical and contiguous units, such as postcodes (e.g., Poortinga 2006a). To test our hypotheses, we need to find a neighborhood definition that applies to small neighborhood arguments. Overly large neighborhood units might inhibit the development of a neighborhood community feeling.

In our study, neighborhoods are relatively small units, delineated via 4-digit postal codes. They comprise areas between 1-8 km^2 with 2500 - 3000 addresses on average and approximately 4000 residents.[27] We used an 'ecometric' aggregation procedure for the measurement of social capital at the macro level.

3.2 Arguments and hypotheses

3.2.1 Neighborhood- and individual-level social capital – two main effects?

Neighborhood-level social capital is a 'public good' that can be equally accessed by all members of a community and from which all members can benefit. People are presumed to be better off in general, and healthier in particular, when they live in communities with more neighborhood-level social capital - even without having many actual social ties themselves. Coleman (1990) provides an example of neighborhood-social capital with regard to feelings of safety. He wrote in neighborhoods with high social capital, it is "possible for women to walk freely outside at night" (op. cit. page 310). It is not necessary to have individual relationships, i.e., individual-level social capital, to benefit from these macro conditions. Coleman cited social capital as a public good (from which no one can be excluded) because it is a resource that cannot be easily exchanged or saved and because investment is not a necessary condition for enjoying the benefits of that type of good. Applied to our study, it follows that the social capital of a neighborhood is a collective good that affects the health of neighborhood residents - irrespective of their individual social capital or, more specifically, their relations to others within and outside the neighborhood. In other words, one does not need to have individual-level social capital to benefit from neighborhood-level social capital. Both individual- and neighborhood-level social capital have independent effects on individual health.

Consequently, our first hypothesis reads:

Hypothesis 3.1: *The more social capital in a neighborhood, the better the health of its residents – independent of (local or non-local) individual-level social capital.*

27 http://statline.cbs.nl/statweb/.

Similarly, the argument regarding *individual-level social capital* predicts that individual health is positively affected by a person's network, regardless of the neighborhood in which he or she lives. It has been argued that individual-level social capital has both a direct and a buffering effect on individual health (see Hammer 1983); individuals with more individual-level social capital are less often ill and, when they do fall ill, they are better able to cope with diseases. Much empirical research is based on this approach (Uchino, Cacioppo, and Kiecolt-Glaser 1996; Berkman and Glass 2000; Subramanian, Kim, and Kawachi 2002; Kroenke, Kubzansky, Schernhammer, Holmes, and Kawachi 2006; Moore, Haines, Hawe, and Shiell 2006; Kawachi, Subramanian, and Kim 2008b). In line with these results and in addition to the main effect of neighborhood-level social capital, we expect a main effect for individual-level social capital within and outside the neighborhood, leading to the following hypothesis:

Hypothesis 3.2: *The more (local or non-local) individual-level social capital, the better the individual-level health – independent of neighborhood-level social capital.*

3.2.2 Accumulation and Compensation

As already mentioned, the effects of neighborhood-level social capital might be moderated by individual-level social capital and vice versa. For example, a person in a neighborhood with high social capital might access health-related information more easily; in general, people in such neighborhoods care for each other more and may exchange all kinds of information. In this way, neighborhood level social capital strengthens the effect of individual-level social capital. It can also be argued that one benefits even more from collective social capital if one has many ties to neighbors in addition to ample neighborhood-level social capital. In such a case, embeddedness in a network as well as in a community is high, and the actual network provides access to neighborhood-level social capital (Lin 2001; Carpiano 2007).

Besides the argument of *accumulation* or reinforcement, it might also be the case that having a great deal of one type of social capital *compensates* for a lack of the other type. For example, a rich social network might compensate for a lack of neighborhood-level social capital. Furthermore, a person who has only a few social ties and who lives in a neighborhood with a great deal of social capital might nevertheless feel embedded in a community because of the neighborhood's cohesion and therefore have good health.

Kim and Kawachi (2006) are among the very few researchers who have inquired into these types of interactions between the individual and collective levels – however, their collective levels referred to (e.g.) municipalities and U.S. states, and not a neighborhood. They have found mixed results for different social capital indicators. While most cross-level interactions between context and individual-level social capital were not significant, they found a positive interaction – an accumulation effect – between individual-level social trust and social trust at the context level. Further, they found a negative interaction – a compensation effect – between individual religious group involvement and social participation at the context level. Subramanian et al. (2002) used the same data as Kim and Kawachi (2006) and also

found a significant accumulation interaction. For high-trust people, the health-promoting effect of community social trust was significantly greater. To our knowledge, the only study which incorporates cross-level interactions between context- and individual-level social capital while using neighborhoods as the contextual level was done by Carpiano (2008). He found support for the accumulation hypothesis.

Finally, it should be mentioned that different parts of a personal network, i.e., different parts of individual-level social capital, such as the relationships within and outside the neighborhood, might affect the influence of neighborhood-level social capital differently. Effects of neighborhood social capital on health might be weaker if a person has many ties outside the neighborhood.

In summary, our last hypotheses are as follows:

Hypothesis 3.3a: *The more local individual-level social capital people have, the larger the effect of neighborhood social capital on individual health.*

Hypothesis 3.3b: *The effect of neighborhood social capital on health is larger the more non-local individual*-level *social capital people have*.

Hypothesis 3.4: *The effect of individual-level social capital on health is larger the more neighborhood social capital a person has.*

Furthermore, we argue that compensation effects might also occur:

Hypothesis 3.5a: If individuals lack *local individual-level* social capital but have ample neighborhood social capital, effects on health are still positive.

Hypothesis 3.5b: If individuals lack *non-local individual-level* social capital but have ample neighborhood social capital, effects on health are still positive.

Hypothesis 3.6: If individuals *lack neighborhood social capital* but have ample (local or non-local) individual-level social capital, effects on health are still positive.

3.3 Methods

3.3.1 Data

This study used data from WoON 2006, and register information provided by Statistics Netherlands 1999. The data sets were combined on the basis of 4-digit postal codes.

The WoON 2006 data[28] evaluate the physical and social housing conditions of the Dutch population. They were collected under responsibility of the Ministry of Housing, Spatial Planning and Environment (VROM) between August 2005 and March 2006 (Van Huijsduijnen, Van Til, Verhoog, Gopal, Ferment, and Van Galen 2007). In brief, the WoON 2006 data are representative for all Dutch aged 18 years

28 Data can be found online at http://easy.dans.knaw.nl/dms with a search for urn:nbn:nl:ui:13-tcv-dug.

or older. The interviews took approximately 40 minutes on average. The response rate was 56%. *Statistics Netherlands* provided register information on socio-demographic data for 4-digit postal code areas online.[29]

Questions regarding neighborhood social capital were only asked of the heads of the household because it was expected that only they would be able to answer housing-specific questions. Moreover, some cases were lost because of missing values in individual and neighborhood control variables. Therefore, of 64,005 participants in the WoON 2006 data set, we used 53,260 individuals living in 3273 different neighborhoods (on average, 16 respondents per neighborhood).

3.3.2 Measurements

Measurement of individual-level variables:

The dependent variable 'self-perceived health' was measured using the question "In general, how good is your health?" Possible answers were 'very good/ good/ fair/ sometimes good, sometimes not good/ bad'. Subjective health is known to be an indicator for morbidity (Simon, De Boer, Joung, Bosma, and Mackenbach 2005) and mortality (Idler and Benyamini 1997). The original, highly-skewed scale was dichotomized, with 1 representing 'good or very good health', as has been done in other studies (Subramanian, Kim, and Kawachi 2002; Poortinga 2006b; Mohnen, Groenewegen, Völker, and Flap 2011).

The main independent variables on the individual level in this study were two scales of individual-level social capital. One scale comprised individual-level social capital in the neighborhood - contact with fellow residents - and the other measured contact with people outside of the neighborhood. *Individual-level social capital from neighbors* was measured by agreement with two statements: "I have a lot of contact with my direct neighbors," and "I have a lot of contact with my other neighbors.'' Possible answers ranged from 'totally disagree' (1) to 'totally agree' (5). For the analyses, we created a dichotomous variable: Sum scores larger than or equal to 8 have been recoded as 1 and all other values have been recoded as 0.

The second scale for *individual-level social capital* considered contact to friends and family members: "How often do you have contact with friends or with people you know very well (including phone contact)?'' and "How often do you have contact with one or more family members (not in the same household and including phone contact)?" The response categories for both questions were 'almost never' (1), 'less than once per month' (2), 'once per month' (3), '2 or 3 times per month' (4), and 'once per week (5)'. We created a dichotomous variable by recoding the value 5 as 1 and recoding all others values as 0. Although it was not explicitly asked, we assume that 'other contact' have a high likelihood of being located *outside of the neighborhood.* From Dutch network data, we know that 90% of all friends are not also neighbors ("The Survey on the Social Networks of the Dutch", n = 604 Dutch individuals, 2007). A Canadian study showed that only 4% to 7% of respondents live in the same neighborhood as their non-household relatives (Wellman 1979).

29 www.statline.cbs.nl/statweb/ .

We further used socio-demographic variables that have been shown to be important in multilevel analyses on health: S*ex* was coded as a dummy variable, *age* was measured in years and centered on the average (47.6 years), and *ethnic background* was categorized as either Dutch, 2nd generation Western, 2nd generation Non-Western, 1st generation Western, or 1st generation Non-Western. Furthermore, three indicators of social status were added: Education, employment, and income. *Education* was measured as the 'highest school degree so far achieved' at the time of questioning. We used five categories ranging from 1 (primary school or less) to 5 (university degree). *Employment groups* included self-employed individuals and employees, those without a paid job, pensioners, recipients of social benefits, and students (at any kind of school or university). Of all 'WoON 2006' respondents, 93.8% gave direct information on their own income and the income of their partner. For the remaining 6.2% (3.4% tax information; 2.8% imputation of tax information), income information was collected by the Dutch tax office and added to the data set (Van Huijsduijnen, Van Til, Verhoog, Gopal, Ferment, and Van Galen 2007). Income was measured as '*equivalent monthly household income*'. This variable took into account all kinds of income (per household), including social benefits, pensions, and salaries. It was calculated by weighting[30] the costs of children and the benefits of sharing a household (Siermann, Van Teeffelen, and Urlings 2004). For the analyses, income was divided into 10 categories, where 1 = negative income (i.e., income of entrepreneurs who made investments greater than their income), 2 = income between 0 and 599.99 Euro, values between 3 and 9 indicate incremental income differences of 300 Euro and 10 = 2700 Euro and more per month. Category 5 (1200.00 through 1499.99 Euro) was the median and the reference category. Furthermore, in previous neighborhood studies, '*home ownership*' has been shown to be an important condition for some questions (Harpham 2008). Home owners, in contrast to renters, usually invest more in the physical and social order in the neighborhood. We included this variable to mark the difference between 'owner' and 'renter'. Finally, '*years of residence*' in the respondent's current place of living were included on the individual level to control for the length of the influence of the context neighborhood. It was asked straightforwardly, ''how long have you been living at this address?'' In the analyses, we constructed four categories: (1) 0-5 years, (2) 6-15 years, (3) 16-25 years, and (4) 26 and more years.

Table 3.1a provides the correlation table for individual variables and Table 3.1b for neighborhood variables. Interestingly, frequency of contact with neighbors and frequency of contact with others (usually non-residents) are not highly correlated. Furthermore, in rural areas, people have more neighborhood-level social capital compared with people in urban areas. Table 3.2 presents descriptive statistics for the variables on the individual level and on neighborhood level.

30 If no information on the number of the household members was available (n = 7630), we used non-weighted monthly household income.

Table 3.1a: Correlation of Individual Variables (Spearman's rho) (n_i = 53,260)

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Self-perceived health	1.000	--	--	--	--	--	--	--	--	--
2. Sex	-0.081***	1.000	--	--	--	--	--	--	--	--
3. Age	-0.301**	0.056**	1.000	--	--	--	--	--	--	--
4. Ethnic background[a] (1 = Dutch)	0.038**	-0.006	0.143**	1.000	--	--	--	--	--	--
5. Education[b]	0.270**	-0.114**	-0.330**	-0.009*	1.000	--	--	--	--	--
6. Occupation[a] (1 = employed)	0.301**	-0.161**	-0.466**	0.025**	0.283**	1.000	--	--	--	--
7. Income	0.225**	-0.094**	-0.022**	0.137**	0.399**	0.294**	1.000	--	--	--
8. Home ownership	-0.224**	0.074**	0.101**	-0.151**	-0.295**	-0.258**	-0.465**	1.000	--	--
9. Years of residence	-0.120**	0.020**	0.538**	0.122**	-0.186**	-0.190**	0.034**	-0.067**	1.000	--
10. Contact with neighbors	0.008	-0.020	0.066**	0.034**	-0.037**	-0.004*	0.019**	-0.103**	0.092**	1.000
11. Contact with friends and family	0.115**	0.052**	-0.140**	0.054**	0.124**	0.093**	0.094**	-0.103**	-0.061**	0.093**

*p ≤ 0.05, ** p ≤ 0.01, ***p ≤ 0.001, [a] This variable has no order. It was transformed to a dichotomous variable to calculate Spearmans rho. [b] used as metric variable

Table 3.1b: Correlation Coefficients of Neighborhood Variables (Pearson) (n_j = 3273)

	1.	2.	3.	4.
1. Neighborhood social capital	1.000	--	--	--
2. Percentage in lowest income quintile	0.139**	1.000	--	--
3. Urban density of municipality	- 0.562**	- 0.238**	1.000	--
4. Neighborhood home maintenance	0.305**	0.008	0.189**	1.000

*p ≤ 0.05, ** p ≤ 0.01, ***p ≤ 0.001

Table 3.2: Descriptive statistics for individual- and neighborhood-level variables, data source: WoON 2006 (n_i = 53,260, n_j = 3,273)

		Range	Mean	S.D.	Percent
Individual-level controls					
Self-perceived health:	Not good (0)				21.0%
	Good or better (1)				79.0%
Sex:	Man (1)				45.1%
	Woman (2)				54.9%
Age	in years	18 -103	51.2	17.2	
Ethnic background:	Native Dutch (1)				83.3%
	2nd generation Western (2)				3.9%
	2nd generation Non-Western (3)				1.0%
	1st generation Western (4)				4.3%
	1st generation Non-Western (5)				7.5%
Education:	Primary education				13.0%
	Junior secondary vocational education				16.9%
	Junior general secondary education				13.9%
	Senior general secondary education, university preparatory education and senior secondary vocational education				30.0%
	University degree or other forms of higher education				26.3%
Occupation:	No job (1)				5.6%
	Self-employed or employee (2)				48.3%
	Pensioner (3)				26.3%
	Welfare recipient (4)				10.4%
	Student (5)				9.4%
Income [a]:	Negative income (1)				0.5%
	0-599 € (2)				1.6%
	600-899 € (3)				11.4%
	900-1199 € (4)				16.8%
	1200-1499 € (5)				17.9%
	1500-1799 € (6)				15.7%
	1800-2099 € (7)				12.1%
	2100-2399 € (8)				8.5%
	2400-2699 € (9)				5.2%
	2700 € and more (10)				10.0%
Home Ownership:	Owner (1)				54.3%
	Renter (2)				45.7%
Years of residence:	0-5 years (1)				29.8%
	6-15 years (2)				34.9%
	16-25 years (3)				16.6%
	≥ 26 years (4)				18.7%
Contact with neighbors:	Only rarely (0)				60.2%
	Frequently (1)				39.8%
Contact with friends and family:	Less than weekly contact (0)				27.3%
	At least weekly contact (1)				72.7%
Neighborhood level					
Neighborhood social capital		-0.78-0.46	-0.10	0.20	
Percentage in lowest income quintile		11.29-71.43	24.80	3.70	
Neighborhood home maintenance		1-5	3.90	0.30	
Urban density of municipality		1-5	2.70	1.30	

[a] Note: In the analyses, categories 1 and 2 are combined. A category for missing values was included in the analysis (n = 93). n_i = n on individual level, n_j = n on neighborhood level.

Measurement of neighborhood-level variables

The key independent variable on the neighborhood level was *neighborhood social capital*. Neighborhood social capital was measured using three questions about the neighborhood in which the respondent lived. Items inquired into the following areas:

1) whether people in the neighborhood know each other,
2) whether neighbors are nice to each other, and
3) whether there is a friendly and sociable atmosphere in the neighborhood.

The response categories were 'totally agree', 'agree', 'neutral', 'do not agree', and 'totally do not agree', on a range from 1 to 5.

Other neighborhood variables: Three control variables on the neighborhood level were used. First, we included the control variable *the percentage of people in the lowest income quintile in a neighborhood* (source: Statistics Netherlands). Income involves income from work or one's own company, social benefits, pensions, and financial support for students. Next, we added the aggregated information on individual perception regarding *home maintenance*. The WoON 2006 participants were asked whether their house was in bad repair. Answer categories were recorded on a 5-point scale ranging from 'I totally agree' (1) to 'I totally do not agree' (5). Higher values indicate better home maintenance, at least from the residents' point of view. Lastly, the degree of *urban density of the municipality* was taken into account (Statistics Netherlands). The coding of this variable is based on the number of addresses per km^2. It was a five-point scale, where higher values indicate more addresses and hence more urban density.

3.3.3 Ecometric-based measurement of neighborhood social capital

To arrive at contextual information from individual data, individual information has to be aggregated to a higher level. In our case, that higher level is the neighborhood. The most straightforward aggregation procedure is to calculate the average for each neighborhood or the standard deviation of the items measured at the individual level (Stafford, Bartley, Sacker, Marmot, Wilkinson et al. 2003; Cummins, Macintyre, Davidson, and Ellaway 2005). However, this procedure does not solve a number of problems.

First, variables measuring neighborhood social capital are based on individual perception, and it is likely that this perception is influenced by the characteristics of the respondent. For example, older people might compare neighborhood social capital with what they remember from former times and therefore report systematically lower scores of social capital in their current neighborhood than younger people.

Second, because the number of respondents differs per neighborhood, the reliability of the aggregated measurement, in our case, the social capital measurement, also differs between the neighborhoods.

Third, the items that measure social capital are not independent of each other but nested within respondents; that is, the answers on one item are likely to be associated with answers on another item.

In summary, one wants an approach that accounts for individual differences in response to certain items, for differences in the number of respondents on which the estimation is based, and for dependency among the items measuring social capital. One method that meets these requirements is the recently-developed ecometrics approach (see Raudenbush and Sampson 1999; Mujahid, Diez-Roux, Morenoff, and Raghunathan 2007), which is similar to our approach employed in earlier work (Mohnen, Groenewegen, Völker, and Flap 2011). This approach employs a three-level model: One level is for neighborhoods, another is for individuals, and the last level is for the items measuring social capital.

We adjusted for eight individual characteristics that might influence the perception of neighborhood social capital, i.e., sex, age, education, income, employment status, home ownership, years of residence, and self-rated health. The ecometric model accounts for differences in the number of respondents per neighborhood by shrinking deviating neighborhoods with smaller numbers of respondents to the general average (Hox 2002). The interdependence of individual responses to items is handled by ecometrics via the separate level for the social capital items in the multilevel model.

In the first step of the analysis, neighborhood social capital is estimated using this three-level model. The residuals of the neighborhood social capital measurement (i.e., the part that cannot be attributed to individual response patterns) constitute the social capital measurement for the final analyses in the second step, where the hypotheses are tested. In this second step, the ecometric-based social capital measurement is used as an independent variable in a two-level logistic model with a binary indicator for health as the dependent variable.

The model estimating neighborhood social capital is as follows:

$$Y_{ijk} = \gamma_{000} + \sum_{m=1}^{2} \alpha_m D_{mijk} + \sum_{q=1}^{8} \delta_q X_{qjk} + v_{00k} + u_{0\,jk} + e_{ijk} \qquad \text{(Formula 3.1)},$$

where Y_{ijk} is the response to item i of person j in neighborhood k, γ_{000} is the grand mean of neighborhood social capital, m is the number of social capital variables (three in total; one serves as reference), D are item dummies, q is the number of individual level adjusters (eight in total), X are the control variables, v is the neighborhood variance, u is the individual variance, and e is the item variance.

The most important parameters are the neighborhood-level residuals, v, which indicate the degree to which the social capital of neighborhood k differs from the grand mean, γ_{000}. These residuals constitute the neighborhood social capital measure. Positive values indicate higher-than-average levels of neighborhood social capital.

The reliability of ecometric scales depends on the variance at the three levels, i.e., the items nested within respondents, and the respondents nested within neighborhoods (Hox 2002). The reliability of neighborhood social capital is estimated by

$$\lambda_k = \frac{\sigma^2}{\sigma^2 + \frac{\tau^2}{J_k} + \frac{\omega^2}{nJ_k}} \quad \text{(Formula 3.2)},$$

where σ^2 is the variance in neighborhood level, τ^2 is the variance between individuals per neighborhood, and ω^2 is the variance between the items. J_k is the number of individuals in neighborhood *k*. Finally, *n* is the number of items that measure neighborhood social capital. The average reliability of our ecometric-based neighborhood social capital measurement is 0.702.

The intraclass correlation (ICC) for the indication of clustering was calculated by the following formula for a multilevel logistic model (Snijders and Bosker 1999, page 224):

$$ICC = \frac{\sigma^2}{\sigma^2 + 3.29} \quad \text{(Formula 3.3)},$$

where σ^2 is the variance in neighborhood level.

3.3.4 Analytic strategy

To test hypotheses 3.1 and 3.2, we estimated logistic multilevel models (summarized in Table 3.3). Next, we tested hypotheses 3.3a through 3.6 by estimating models that include both individual-level and neighborhood-level social capital measurements and their interactions (Table 3.4 and Figure 3.1). For all multivariate analyses, we used the statistical software package MLwiN 2.15 and applied 2nd order PQL estimation.

3.4 Results

First of all, the intraclass correlation shows that health clusters in Dutch neighborhoods. In the empty model (not presented), the intraclass correlation is 3.72%. Table 3.3, model 1 shows that neighborhood social capital is positively associated with an individual's health, controlled for other relevant characteristics at the individual and neighborhood levels (B = 0.230, $p \leq 0.01$). Model 2 and model 3 in Table 3.3 show that both types of individual-level social capital affect health; more frequent contact with neighbors is beneficial for health (B = 0.081, $p \leq 0.001$), as is weekly contact with friends and family (B = 0.211, $p \leq 0.001$).

Hypothesis 3.1 states that neighborhood social capital positively affects health independent of the level of a person's individual social capital. Models 4 and 5 in Table 3.3 show that the effect of neighborhood-level social capital is indeed independent of the two types of individual-level social capital, confirming this hypothesis. Even if both indicators for individual-level social capital are included in the model, the effects of neighborhood social capital are not ruled out, as shown in Table 3.3, model 6 (B = 0.194, $p \leq 0.05$).

Table 3.3: Multilevel logistic regression models of individual- and neighborhood-level social capital on individual health (coefficients)

(n_i = 53,260, n_j = 3,273)	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	2.079***	2.048***	1.929***	2.054***	1.934***	1.922***
Micro social capital						
Frequent contact with neighbors	--	0.081***	--	0.076***	--	0.051*
At least weekly contact with friends and family	--	--	0.211***	--	0.210***	0.203***
Macro social capital						
Neighborhood social capital	0.230**	--	--	0.203**	0.211**	0.194*
Neighborhood variance	0.018**	0.018**	0.018*	0.018*	0.018*	0.018*
Intraclass correlation (%)	0.54	0.54	0.54	0.54	0.54	0.54
Wald test (R^2)	0.31	0.31	0.31	0.31	0.31	0.31

n_i = n on individual level, n_j = n on neighborhood level; *p ≤ 0.05, ** p ≤ 0.01, ***p ≤ 0.001. All models were controlled for sex, age, ethnic background, education, employment, income, home ownership, and years of residence at the individual level and for income (lowest quintile), urban density of municipality, and home maintenance at the neighborhood level.

Table 3.4: Multilevel logistic regression of the combined effects of individual- and neighborhood-level social capital on individual health (coefficients)

(n_i = 53,260, n_j = 3,273)	Model 1	Model 2	Model 3
Intercept	1.962***	1.845***	1.835***
Micro social capital			
Frequent contact with neighbors	0.065**	--	0.044*
At least weekly contact with friends and family	--	0.178***	0.172***
Macro social capital			
Neighborhood social capital	0.257**	0.406***	0.420***
Interactions			
Macro social capital * Contact with neighbors	-0.135	--	-0.094
Macro social capital * Contact with friends and family	--	-0.294**	-0.283**
Variance in neighborhood level	0.017*	0.017*	0.017*
Intraclass correlation (%)	0.51	0.51	0.51
Wald test (R^2)	0.31	0.31	0.31

n_i = n on individual level, n_j = n on neighborhood level; *p ≤ 0.05, ** p ≤ 0.01, ***p ≤ 0.001. All models were controlled for sex, age, ethnic background, education, employment, income, home ownership, and years of residence at the individual level and for lowest income quintile, urban density of municipality, and home maintenance at the neighborhood level.

Hypothesis 3.2 stated that individual social capital affects individual health independent of neighborhood social capital. Table 3.3, model 4 shows that a high level of contact with neighbors is positively associated with self-rated health when controlling for neighborhood-level social capital (B = 0.076, $p \leq 0.001$). Table 3.3, model 5 shows that, independent of neighborhood social capital, weekly contact with friends and family is positively associated with self-rated health (B = 0.210, $p \leq 0.001$). Hence, independent of neighborhood social capital, frequent contact with neighbors and weekly contact with other network members are positively related with health, confirming hypothesis 3.2.

Hypotheses 3.3a, 3.3b, and 3.4 predict an *accumulating* effect of neighborhood- and individual-level social capital on health. However, none of the interactions presented in Table 3.4 were positive and significant, which would have indicated an accumulation of micro and macro social capital. Therefore, neither hypothesis 3.3a nor hypothesis 3.3b or hypothesis 3.4 is confirmed.

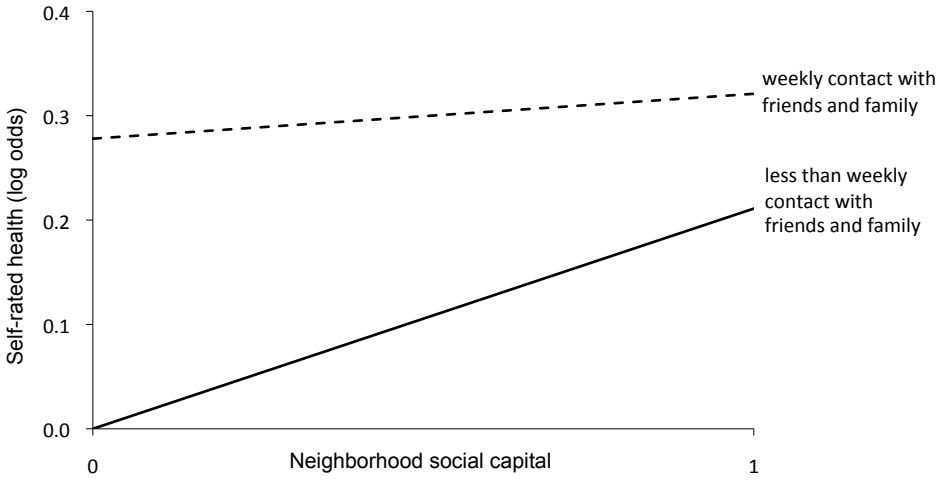


Figure 3.1: Interaction of Individual- (friends and family) and neighborhood-level social capital on self-rated health

Hypotheses 3.5a/b and 3.6 predicted *compensating effects* of neighborhood- and individual-level social capital on health. Table 3.4, model 1 shows that the combined effect of contact with neighbors and neighborhood social capital is not associated with health. Hence, for health effects, a lack of neighborhood social capital cannot be compensated by individual social capital from ties with neighbors (H3.5a is not supported). Table 3.4, model 2 shows that the combined effect of weekly contact with friends or family and neighborhood social capital is negatively associated with health (B = -0.294, $p \leq 0.05$). People who have only a few contacts, presumably, mainly outside the neighborhood, are less likely to be in good health than people with frequent contact. However, their disadvantages can be partly compensated by a high level of neighborhood social capital (Hypothesis 3.5b is supported), as illustrated in Figure 3.1. For Figure 3.1, a new model was calculated. The model is identical to that in Table 3, Model 3 except that neighborhood social capital was

coded as a dummy (two similar groups 0 < -0.0728, 1 > -.0728). This model shows that the micro effect of social capital is stronger than the macro effect. Hypothesis 3.6 is not supported because the influence of weekly contact with friends or family on health is not particularly strong in *low* social capital neighborhoods (Figure 3.1). In other words, weekly contact with friends or family (assumed to be mainly outside the neighborhood) cannot compensate for a lack of neighborhood social capital. However, as shown in Table 3.3, this does not mean that it does not matter if someone has individual-level social capital outside of the neighborhood. Independent of the neighborhood where one lives, people with high individual-level social capital report better health. Figure 3.1 also shows that this individual-level social capital effect does not differ between levels of neighborhood social capital; regardless of the amount of neighborhood social capital, contact with friends and family is positively associated with health. Finally, Table 3.4, model 3 shows that the compensation effect of neighborhood social capital for a lack of contact with family and friends holds (B = -0.283, $p \leq 0.01$) even if it is controlled for neighbor contact at the individual level.

3.5 Discussion

Many previous studies have shown that both neighborhood - and individual-level social capital are positively associated with health, but only rarely have both types of social capital been combined in one analysis. In this contribution, we have shown that individuals benefit from social capital on the neighborhood as well as on the individual level. In particular, frequent contact with neighbors and weekly face-to-face or telephone contact with friends or non-household family members are positively associated with health. Furthermore, independent of individual-level social capital, neighborhood-level social capital in the neighborhood is positively associated with health. Interestingly, neighborhood social capital can also compensate for a lack of individual-level social capital. While holding constant for contact with neighbors, people with less frequent contact with friends and family benefit even more from neighborhood social capital with regard to their health. Our findings are in line with those of Moore et al. (2010), who studied a number of social capital characteristics with regard to their influence on health. Notably, a high level of diversity in the network outside of the neighborhood, indicated by a position generator measurement for individual-level social capital (e.g., Lin 2001), corresponded with better health. Note, however, that in Moore's study, cross-level interaction between individual- and neighborhood-level social capital was not analyzed.

Two limitations of our study should be mentioned. First, as with most research conducted in this area, our analysis cannot rule out issues related to reversed causality because our data are cross-sectional. In addition, the measurements of health and social capital come from the same respondents. We do not know whether people reported good health because of high social capital or whether their good health gave them greater opportunity to build up social capital on both the macro and micro levels. We do know, however, that the neighborhood perception of social

capital was not biased by health because we applied the ecometric procedure to measure neighborhood social capital.

The second limitation of this research is that willingness to participate in the study could have been higher for people who have more social capital and/or are in good health. People in neighborhood with low social capital were probably more skeptical of strangers and therefore less likely to participate in the survey. Unfortunately, response rates by neighborhood are not available.

These limitations aside, the most important strength of our study is that we have shown that neighborhood- and individual-level social capital are both positively associated with health and that they are relatively independent of one another. Hence, it is not the case that one needs ties on the individual level to benefit from neighborhood-level social capital. In other words, individual-level social capital does not necessarily provide access to neighborhood-level social capital. The effect of one type of social capital is not an artifact of the other. Furthermore, we measured social capital by the ecometric procedure (Raudenbush and Sampson 1999; Mujahid, Diez-Roux, Morenoff, and Raghunathan 2007), resulting in a measurement at an appropriate level. Lastly, the delineation of our neighborhoods was on the postal code level, resulting in relatively small areas compared to many other studies. For example, British postal code units incorporate 7000 people on average (Snelgrove, Pikhart, and Stafford 2009), while our units consisted of approximately 4000 people on average. Furthermore, 82% of all Dutch neighborhoods were taken into account in this study.

Besides showing two independent effects of individual- and neighborhood-level social capital, our findings support the compensation hypothesis: people with low individual social capital are more likely to report good health when they live in neighborhoods with high rather than low social capital. The neighborhood community seems to be able to support an unconnected resident with health-related resources. Previously, Carpiano (2008) inquired into cross-level interactions between individual- and neighborhood-level social capital and found support for the accumulation hypotheses. More in line with our findings are Klinenberg's (2002) results. In a qualitative study about the heat wave in 1995 in Chicago, Klinenberg finds that isolated people were better off in well-connected communities. Elderly white people had better chances of survival during the dangerous heat days if they lived in a safe Latin-American neighborhood, where people took care of each other even if they were not a part of the majority ethnic group, than white minority elderly in Afro-American, unconnected and abandoned neighborhoods. It is a task for future research to formulate and test hypotheses on the conditions under which compensation of social capital types or accumulation may occur. So far, we have found no evidence for accumulation.

Our findings might be useful for discussion of the pathways that explain the effects of neighborhood-level social capital. We showed that the resources of neighborhood-level social capital reach people without social ties, echoing Putnam's (e.g., 1993) and Coleman's (1990) interpretations of macro social capital. Still, we do not fully understand the mechanisms through which neighborhood-level social capital takes effect. Plausible pathways might include social control affecting health-related behavior (Hystad and Carpiano 2010) as well as access health-related facilities and

health-related institutions at the neighborhood level (Hendryx, Ahern, Lovrich, and McCurdy 2002). Future research has to inquire more deeply into these pathways. This issue will become even more relevant in the future. It has been shown (Van Tilburg 1998) that elderly people often have less individual-level social capital with friends and more with relatives. Family sizes are declining in modern societies (Office for National Statistics 1999). Understanding the pathways through which neighborhood-level social capital operates helps to ensure access to neighborhood-level social capital for everyone, but especially for those who lack social capital on the micro level.

Chapter 4

You have to be there to enjoy it? Neighborhood social capital and health

This chapter is co-authored by Beate Völker, Henk Flap, S.V. Subramanian, and Peter P. Groenewegen. Under review.

You have to be there to enjoy it? Neighborhood social capital and health

4.1 Introduction

A growing body of literature shows that people who live in neighborhoods with more social capital are healthier (Poortinga 2006b; Van Hooijdonk, Droomers, Deerenberg, Mackenbach, and Kunst 2008; Diez-Roux and Mair 2010; Mohnen, Groenewegen, Völker, and Flap 2011). This study contributes to this literature by combining the social science idea of social capital with the environmental studies concept of exposure to reach a better understanding of the conditions in which neighborhood social capital is beneficial for health.

Neighborhood social capital is the product of a well-connected social context. A neighborhood with a high level of social capital is a place with a friendly atmosphere where people are kind to one another (Mohnen, Groenewegen, Völker, and Flap 2011). Social capital as a neighborhood characteristic acts on the neighborhood-level and must be separated from the individual-level social capital, i.e., the contacts between specific individuals. Social capital theory, based on Coleman (1990) and Putnam (2000), suggests that neighborhood social capital affects all members of the neighborhood. Social capital theory implicitly assumes that the effect occurs immediately.

In disciplines such as public health, epidemiology, or toxicology, the length of time and intensity of the connection between an environment and individuals is important and is studied in terms of *exposure*. Although exposure studies usually focus on environmental hazards, the concept of exposure is neutral in principle. Exposure refers to the "connection between place and bodies" (Mitman, Murphy, and Seller 2004, p. 13) and is not restricted to negative outcomes.

The idea that exposure to neighborhood social capital in terms of length or intensity may be significant is innovative in neighborhood (contextual) social capital research (O'Compo 2003). In the words of Berkman, *"Epidemiologists have studied tobacco exposure so well for so long, we have good understanding of the differential impacts that exposures have on specific disease outcomes. Unfortunately, data on social exposure is much more limited."* (Berkman 2009, page 35). Commonly assumed causal pathways between neighborhood social capital and health, such as norms of health-related behavior (Aarts, Wendel-Vos, Van Oers, Van de Goor, and Schuit 2010; Hystad and Carpiano 2010), psychosocial mechanisms (Diez-Roux and Mair 2010), and access to neighborhood care facilities, (Hendryx, Ahern, Lovrich, and McCurdy 2002) have in common that people benefit more if they are exposed to the same neighborhood for some time. Health-related norms take time to be internalized,

psychosocial mechanisms affect health through long-term increases in levels of stress hormones, and access to care facilities takes time to translate to better health. We differentiate exposure into the duration of residence (= length of exposure) in the same neighborhood and the time people can be assumed to spend in their neighborhood (= intensity of exposure).

In most Western countries, people spend a significant amount of their time outside their neighborhoods due to work or educational demands. Therefore, the effects of neighborhood social capital may be underestimated when analyzing the entire population. Because detailed information on exposure is lacking in most secondary data, we test the intensity of exposure by assuming that social life is more locally oriented for elderly people and for members of households with young children. Elderly people above pension age are likely to spend a larger portion of their time in and around the house. People with young children are locally oriented because young children's playgrounds and elementary schools are often in the immediate area of their parents' home.

This study addresses the following research questions:
(*1) Does the effect of neighborhood social capital on health increase linearly with the number of years people live in the same neighborhood? If not, what is the relationship? (2) Is the effect of neighborhood social capital stronger for people who can be assumed to spend more of their time in the neighborhood?*

4.2 Methods

4.2.1 Data

Individual-level data from the cross-sectional WoON 2009 were collected under the responsibility of the VROM. The data include information on 65,990 individuals (response rate = 59%) age 18 and older. For our study, we chose small areas that were relevant for social interaction between neighbors (Diez-Roux and Mair 2010). A neighborhood was defined by its 4-digit postcode. In the Netherlands, these areas include approximately 4000 people, on average. Because we included all inhabited postal code areas, some neighborhoods were densely populated city neighborhoods with people living within walking distance of each other, while others were rural villages. Individuals in this study lived in 3001 neighborhoods, constituting 75% of all Dutch neighborhoods.

4.2.2 Variables

The *dependent variable* was self-rated health. It was measured by the answer to the question, "In general, is your health…?" on a 5-point scale ranging from 'very bad' to 'very good'. The variable was dichotomized because its distribution is highly skewed (80.1% had good or very good health).

The core independent variable was neighborhood social capital, constructed on the basis of individual responses from the data set WoON 2006 (response rate = 56%). We used an earlier wave of the WoON data set because the questions about self-rated health and the perception of neighborhood social capital were in that case not answered by the same people and the exposure variable was measured before the outcome variable. For each neighborhood, 18.7 inhabitants, on average, answered the three neighborhood social capital questions on contact among neighbors. Items inquired into the following areas: 1) whether people in the neighborhood know each other, 2) whether neighbors are nice to each other, and 3) whether there is a friendly and sociable atmosphere in the neighborhood. Response categories ranged from 'totally don't agree' (1) to 'totally agree' (5). To aggregate the individual information to the neighborhood level, we used ecometrics measurements (Raudenbush and Sampson 1999; Mujahid, Diez-Roux, Morenoff, and Raghunathan 2007), as in Chapter 2 and 3, through multilevel analysis. This approach accounts for the nesting of social capital items within individuals and includes the neighborhood level in the analysis, resulting in a three-level model (neighborhoods, individuals, and the items measuring social capital). We adjusted for eight individual characteristics that may influence the perception of neighborhood social capital: sex, age, education, income, employment status, home ownership, self-rated health, and years of residence. The ecometric model accounts for differences in the numbers of respondents per neighborhood by shrinking deviating neighborhoods with smaller numbers of respondents to the general average (Hox 2002, p. 29). The residuals of the neighborhood social capital measurement (i.e., the part that cannot be attributed to individual response patterns) constitutes the new social capital measurement. Positive values indicate higher than average levels of neighborhood social capital (reliability based on Hox (2002):0.702). To control for the possibility that neighborhood social capital may have changed between 2006 and 2009, we calculated a change score. We calculated neighborhood social capital for 2009 in precisely the same way as for 2006 (reliability based on Hox (2002): 0.633), and we computed the change score by subtracting 2006 neighborhood social capital from 2009 neighborhood social capital. A higher positive value of the change score indicates improvement, and a negative change score indicates a decline in neighborhood social capital. Two-thirds of the neighborhoods did not change, remaining within one standard deviation around the mean of the change score.

For *duration of residence,* we used the number of years respondents said they lived at the same address, or the former address, if it was in the same neighborhood (here, neighborhood was defined subjectively). The variable was used as a metric as well as a categorical variable in the multilevel analyses, as explained in the results section.

Due to the lack of actual time-diary measures in our data set, we used proxy measures to assess the *intensity of exposure* to neighborhood social capital. First, we distinguish between elderly (≥65 years) and younger people, with the assumption that elderly people have more exposure to neighborhood social capital. Second, we distinguish between people who live in households with children under the age of

12 and those without. We chose this age because these children are still in primary school, which is usually close to their homes. We assumed that respondents with small children were more locally oriented and thus had more exposure to neighborhood social capital.

We used *individual control variables* that have been shown to be important in the analysis of health or that are usually controlled for (Harpham 2008, p. 59):

- *Sex*, coded as a dummy variable;
- *Age*, measured in years and centered on the mean of 51 years;
- *Ethnic background*, measured by parents' country of birth (Dutch, Western, and Non-Western) combined with information on whether the respondent is a first- or second-generation immigrant.
- *Education* was coded as the highest educational degree attained, in five categories ranging from 1 (primary education) to 5 (university degree or other form of higher education).
- *Employment* was measured with two questions: "Are you employed for at least one hour per week?" and "How many days do you work per week?" We combined these answers into a 5-category employment variable: not employed, employed less than 2.5 days, employed 2.5 to less than 4 days, employed 4 or more days, and employed for an unknown number of days. Note that 'not employed' does not include only unemployed people, but also housewives, students or pensioners, if they do not work at least one hour per week.
- *Income* was not asked in the interview but was added later by Statistics Netherlands from tax information (available in 99% of all cases; imputation was used for the remaining 1% (Meuwissen 2010)). We transformed the income variable into 'equivalent monthly household income' by weighting for the costs of children and the benefits of sharing a household (Siermann, Van Teeffelen, and Urlings 2004). We used income categories where 0 = negative income[31], 1 = income up to 299.99 Euro, 2-9 = income in steps of 300 Euro, and 10 = income of 2,700 Euro and higher.
- *Home ownership* was controlled for because home owners, in contrast to renters, usually invest more in the physical and social conditions of their neighborhood (DiPasquale and Glaeser 1999).

The following neighborhood level variables were used as controls:

- *Prosperity of the neighborhood.* Level of income in a neighborhood, especially prosperity (2005), is significant for health (Bird, Seeman, Escarce, Basurto-Dávila, Finch et al. 2010). Statistics Netherlands provided income data at the 4-digit postcode level. We used the percentage of residents in the highest income quintile per neighborhood (≥ 5,200 Euro in 2006).

31 Negative income is the income primarily of entrepreneurs who made investments greater than their income.

- *Urban density of municipality* in which a neighborhood was located, provided by Statistics Netherlands, based on the number of addresses per km^2 (1 = rural = up to 499 addresses per km^2; 2 = semi-rural = 500-999 addresses/km^2; 3 = intermediate urban-rural = 1000-1499 addresses/km^2; 4 = semi-urban = 1500-2499 addresses/km^2; and 5 = urban = more than 2499 addresses/km^2).
- State of maintenance of the houses in the neighborhood was added as a control variable to indicate the physical environment, as often addressed in environmental health studies (Diez-Roux and Mair 2010). Maintenance was measured in WoON 2006 with the question, "Is your house in bad condition?" Answers were on a 5-point scale from 'I totally agree' (1) to 'I totally do not agree' (5), and were aggregated to the neighborhood level. Higher values indicate a better state of maintenance of the houses in a neighborhood.

4.2.3 Modeling strategy

The data were analyzed using multilevel logistic regression analyses with the statistical software package MLwiN 2.21 (using 2nd order PQL estimation). The regression coefficients are presented as odds ratios. We first estimated a null model to estimate the neighborhood variance in self-rated health in an unadjusted model. The research questions assume an interaction between exposure and neighborhood social capital. We separately modeled the cross-level interactions of neighborhood social capital and duration of residence, elderly, and households with small children. For duration of residence, two models were estimated: first, with duration of residence as a continuous variable (not presented in a table) and second, with duration in categories (presented Table 4.2, model 1). A significant cross-level interaction is illustrated in the Figure 4.2.

4.3 Results

Table 4.1 presents a descriptive overview of the individual-level variables and the bivariate relationship with self-rated health. To test the interaction of duration of residence (as a metric variable) and neighborhood social capital, we performed a multilevel logistic regression analysis (not shown in a Table).

Table 4.1: Descriptive statistics

		Range	Mean	S.D.	Frequencies[a)]	Health[b)]
Individual level variables (n = 65,990)						
Self-rated health	Not good				21.5%	--
	Good or very good				78.5%	--
Sex	Man				43.9%	81.7%
	Woman				56.1%	76.0%
Age centered		-33.11–55.89	0	16.73		--
Ethnic background	Native Dutch				81.8%	79.8%
	Second generation Western				5.3%	79.4%
	Second generation Non-Western				1.5%	85.7%
	First generation Western				3.6%	73.6%
	First generation Non-Western				7.8%	64.8%
Education	Primary education				9.1%	51.4%
	Junior secondary vocational education				14.4%	67.4%
	Junior general secondary education				13.5%	75.1%
	Senior general secondary education, university preparatory education, and senior secondary vocational education				33.0%	83.3%
	University degree or other forms of higher education				30.0%	88.4%
Employment	Not employed				41.5%	62.2%
	< 2.5 days				5.3%	90.5%
	2.5 to 3.9 days				7.6%	90.6%
	4 days or more				35.6%	90.0%
	Number of days unknown				10.1%	89.7%
Income categories	Negative income				0.2%	88.2%
	1-299 €				0.7%	89.2%
	300-599 €				1.7%	86.2%
	600-899 €				5.0%	61.2%

[a)] Column = 100%. Example: 78.5% of all respondents report good or very good health. [b)] Row = 100%. Example: 76.0% of all women report good or very good health and 81.7% of men.

Table 4.1 (continued)

		Range	Mean	S.D.	Frequencies[a)]	Health[b)]
Income categories (continued)	900-1199 €				11.7%	58.6%
	1200-1499 €				14.2%	70.9%
	1500-1799 €				15.0%	78.2%
	1800-2099 €				13.8%	82.5%
	2100-2399 €				11.1%	84.5%
	2400-2699 €				8.0%	87.4%
	2700 € and more				18.6%	89.9%
Ownership	Owner				56.6%	86.9%
	Renter				43.4%	67.5%
Measurements of exposure duration						
Duration of residence	(metric)	0–92	14.6	12.81		
Duration of residence	0-6 years				34.3%	84.3%
	7-22 years				43.0%	77.4%
	≥23 years				22.7%	71.8%
Measurement of exposure intensity						
Children < 12 years in the household	Yes				19.4%	89.7%
	No				80.6%	75.8%
Age	Elderly (> 65 years)				23.4%	62.6%
	Younger (< 65 years)				76.6%	83.4%
Neighborhood variables (n = 3001)						
Neighborhood social capital		-0.78–0.46	0.00	0.18		
Neighborhood social capital change score		-0.52–0.60	0.00	0.14		
Percentage of residents in highest income quintile		0–42.86	14.23	4.94		
Urban density of municipality		1–5	2.67	1.35		
State of maintenance of the houses		1–5	4.01	0.43		

[a)] Column = 100%. Example: 78.5% of all respondents report good or very good health. [b)] Row = 100%. Example: 76.0% of all women report good or very good health and 81.7% of men.

The interaction was not significant; thus, an additional year of residence does not imply a greater effect of neighborhood social capital on self-rated health. Nevertheless, the effect of neighborhood social capital on health might be affected nonlinearly by duration of residence. Therefore, a multilevel analysis of the interaction of duration squared and neighborhood social capital was performed. The results are presented in Figure 4.1. Figure 4.1 illustrates the association of neighborhood social capital and duration squared with self-rated health for high-, average- and low-level social capital neighborhoods on a scale of 0 to 53 years of duration. A long duration shows stronger effects of neighborhood social capital on self-rated health than a short or very long duration. The line describing the association of neighborhood social capital with self-rated health for those with low neighborhood social capital crossed the line describing the association of neighborhood social capital with self-rated health for those with the highest neighborhood social capital at an exposure duration of 6 years. The peak of the association was reached at 22 years of residence (for those with the highest neighborhood social capital; low neighborhood social capital peaked 6 years later). Based on Figure 4.1, we collapsed the respondents into three categories: short duration (0-6 years), long duration (7-22 years), and very long duration (23 or more years).

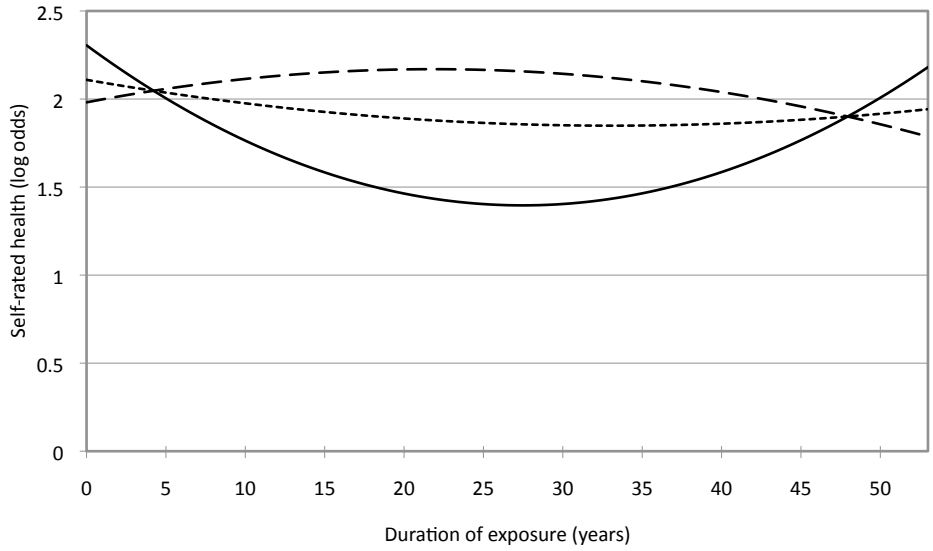


Figure 4.1: Interaction of neighborhood social capital and duration square on self-rated health

- Neighborhood with highest value of neighborhood social capital
- Average neighborhood social capital
- Neighborhood with lowest value of neighborhood social capital

Table 4.2 presents the analyses to test the interaction between neighborhood social capital and duration of residence (model 1) and intensity of exposure (model 2-3) on self-rated health. Both neighborhood social capital and an increase in neighborhood social capital in the previous three years are positively associated with

self-rated health. Model 1 in Table 4.2 tests whether a short, long or very long duration of residence in combination with neighborhood social capital is significantly associated with health. High neighborhood social capital in combination with very short or very long durations of residence have a significant and negative association with health compared to the reference category, which combines high neighborhood social capital and long duration. Thus, people residing in the same neighborhood between 7 and 22 years have more health benefits from neighborhood social capital than people who have lived for a shorter or longer period in the same neighborhood.

Table 4.2, model 2 shows that the effect of neighborhood social capital is not stronger for elderly people than for younger people; the interaction was not significant. Table 4.2, model 3 shows much larger health benefits from neighborhood social capital for members of households with young children than for the reference group. This interaction is presented in Figure 4.2, which shows that the health of members of households with children younger than 12 is better, in general, than the health of the other respondents. Furthermore, the positive effect of neighborhood social capital on health is stronger for respondents with young children.

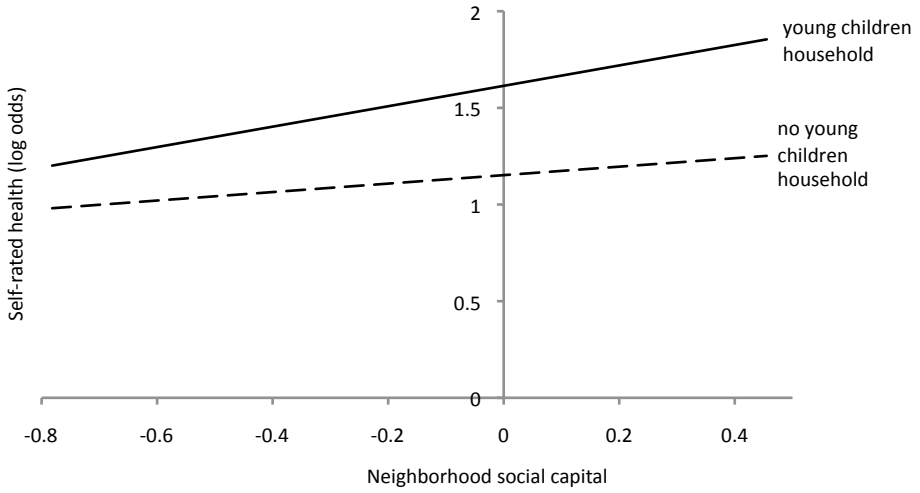


Figure 4.2: Interaction of neighborhood social capital and intensity of exposure on self-rated health (based on Table 4.2, model 3)

4.4 Discussion

This study is the first to analyze the effect of the length and intensity of exposure to neighborhood social capital. A minimum duration of exposure is needed to benefit from neighborhood social capital with regard to health. The positive effect is visible after people live in the same neighborhood for more than 6 years and disappears if people live in the same neighborhood longer than 22 years. The effect of neighborhood social capital might also depend on the intensity of exposure, but our results

Table 4.2: Multilevel logistic regression models of self-rated health controlling for individual and neighborhood level variables – testing exposure to neighborhood social capital (Odds Ratios, 95% Confidence Interval in parentheses)

		Duration of residence		*Intensity* of exposure			
		Model 1		Model 2		Model 3	
Intercept		***1.750		***2.018		***1.754	
Individual level (n = 65,990)							
Gender	Women	0.90	(0.88/0.92)	0.93	(0.91/0.95)	0.89	(0.89/0.89)
Age	(centered)	0.98	(0.98/0.98)	--	--	0.98	(0.96/1.00)
Ethnic background	2nd gen. Western	0.93	(0.88/0.97)	0.95	(0.91/1.00)	0.93	(0.92/0.93)
(Ref. = Dutch)	2nd gen. non-West.	0.85	(0.77/0.94)	1.20	(1.09/1.33)	0.84	(0.80/0.88)
	1st gen. Western	0.79	(0.75/0.84)	0.78	(0.74/0.82)	0.79	(0.71/0.87)
	1st gen. non-Western	0.55	(0.53/0.58)	0.64	(0.62/0.67)	0.52	(0.49/0.54)
Education	Primary education	0.64	(0.62/0.66)	0.54	(0.52/0.56)	0.64	(0.49/0.84)
(Ref. = senior general secondary education, university preparatory education, and senior secondary vocational education)	Junior secondary vocational education	0.75	(0.72/0.77)	0.68	(0.66/0.70)	0.74	(0.72/0.77)
	Junior general secondary education	1.02	(0.99/1.05)	0.93	(0.90/0.96)	1.02	(0.99/1.05)
	University degree or other forms of higher education	1.24	(1.20/1.28)	1.21	(1.17/1.25)	1.24	(1.20/1.29)
Employment	Not employed	0.37	(0.36/0.39)	0.00	(0.00/0.00)	0.38	(0.36/0.39)
(Ref. = 4 days or more)	< 2.5 days	1.02	(0.96/1.09)	1.02	(0.95/1.08)	1.00	(0.97/1.03)
	2.5 to 3.9 days	0.98	(0.93/1.04)	0.96	(0.91/1.02)	0.92	(0.87/0.99)
	Number of days unknown	0.97	0.92/1.01)	0.93	(0.89/0.98)	0.94	(0.89/1.00)
Income (Ref. = 1800-2099 €)	Negative income	1.65	(1.25/2.16)	1.83	(1.39/2.40)	1.65	(1.59/1.72)
	1-299 €	1.53	(1.31/1.78)	2.41	(2.07/2.82)	1.71	(1.63/1.79)
	300-599 €	1.33	(1.20/1.47)	1.93	(1.75/2.13)	1.44	(1.23/1.68)
	600-899 €	0.62	(0.58/0.65)	0.77	(0.73/0.81)	0.62	(0.56/0.68)
	900-1199 €	0.70	(0.68/0.73)	0.72	(0.69/0.75)	0.69	(0.65/0.73)
	1200-1499 €	0.88	(0.85/0.92)	0.90	(0.86/0.93)	0.87	(0.84/0.91)
	1500-1799 €	0.94	(0.90/0.98)	0.95	(0.91/0.99)	0.93	(0.89/0.97)

n_j = neighborhood; n_i = individuals; *p ≤ 0.05, ** p ≤ 0.01, ***p ≤ 0.001; Intra class correlation in all models = 0.5% and Waldtest (R^2) = 0.26. The neighborhood level variance in self-rated health in the null model was 0.127 (s.e. 0.011). Some 85% of this variation was explained by individual and neighborhood variables in models 1-3.

Table 4.2 (continued)

			Duration of residence		*Intensity* of exposure			
			Model 1		Model 2		Model 3	
Income (continued)		2100-2399 €	1.0	(0.95/1.04)	0.98	(0.94/1.03)	1.00	(0.96/1.04)
		2400-2699 €	1.15	(1.09/1.21)	1.13	(1.07/1.19)	1.17	(1.12/1.23)
		2700 € and more	1.30	(1.25/1.36)	1.26	(1.20/1.31)	1.34	(1.27/1.41)
Ownership (Ref. = Renter)		Owner	1.76	(1.71/1.80)	1.82	(1.78/1.87)	1.68	(1.61/1.75)
Neighborhood level (n = 3001)								
Highest income quintile			1.01	(1.01/1.01)	1.01	(1.00/1.01)	1.01	(0.98/1.03)
Urban density of municipality			1.03	(1.02/1.04)	1.03	(1.01/1.04)	1.03	(1.03/1.03)
State of maintenance of the houses			1.04	(1.00/1.09)	1.02	(0.98/1.07)	1.03	(1.02/1.05)
Main effects and interaction								
Neighborhood social capital			1.74	(1.55/1.95)	1.30	(1.17/1.44)	1.25	(1.20/1.31)
Change of neighborhood social capital			1.61	(1.46/1.77)	1.52	(1.38/1.67)	1.55	(1.40/1.71)
Duration	(metric)		--	--	1.00	(1.00/1.00)	1.00	(1.00/1.01)
Duration categories	0 to 6 years		1.09	(1.06/1.13)				
(ref. 7-22 years)	23 years and more		1.14	(1.11/1.18)				
Neighborhood social capital *0 to 6 years			0.57	(0.50/0.64)				
Neighborhood social capital *23 years and more			0.69	(0.61/0.78)				
Elderly (ref. younger than 65 years of age)	65 and older				0.99	(0.96/1.02)		
Neighborhood social capital *elderly					1.02	(0.91/1.13)		
Young children family member							1.59	(1.59/1.59)
Neighborhood social capital *Young children family member							1.36	(1.30/1.42)
Variance neighborhood level (se)			**0.018		***0.019		***0.019	

n_j = neighborhood; n_i = individuals; *p ≤ 0.05, ** p ≤ 0.01, ***p ≤ 0.001; Intra class correlation in all models = 0.5% and Waldtest (R^2) = 0.26. The neighborhood level variance in self-rated health in the null model was 0.127 (s.e. 0.011). Some 85% of this variation was explained by individual and neighborhood variables in models 1-3.

are mixed. One category of the population that can be assumed to have more exposure to neighborhood social capital is the elderly. However, their assumed higher intensity of exposure was not substantiated by a stronger effect of neighborhood social capital. For adults with small children, we found that self-rated health was more strongly affected by neighborhood social capital compared to all other adults.

Our study confirmed previous studies that found a positive effect of social capital on health (Poortinga 2006b; Van Hooijdonk, Droomers, Deerenberg, Mackenbach, and Kunst 2008; Diez-Roux and Mair 2010; Mohnen, Groenewegen, Völker, and Flap 2011). An unexpected side result is that (short-term) changes in neighborhood social capital also affect self-rated health. We used change in neighborhood social capital as a control variable because our measure of neighborhood social capital came from a data set collected three years before the (comparable) data set that measured the outcome variable and the individual level controls. This side result suggests that it might be interesting to further investigate the effect of changes in neighborhood social capital on health. Changes over a decade might be more interesting than the short-term changes observed in this study.

Two study limitations need to be discussed. First, our study has a cross-sectional design. Life course information, especially information on neighborhood social capital during childhood, might be of interest because childhood experiences are known to influence adults' lives (Timberlake 2007; Berkman 2009). Second, to test the intensity of exposure, future research should employ time-use data (Van der Ploeg, Merom, Chau, Bittman, Trost, and Bauman 2010). We could only assume that elderly people or people with young children spend more time (and thus have more intensive exposure) in their neighborhoods. However, variations in the intensity of exposure might be underestimated by the categories that we compared. Elderly people in a modern society (like Dutch society, for instance) might have heterogeneous and changing social lifestyles (Van Tilburg 1998), and elderly people might not have a smaller geographical radius of activities than younger people as we had assumed. Therefore, our study should be regarded as a first step toward further studies on intensity exposure and neighborhood social capital.

Our study contributes to knowledge on the effect of exposure to neighborhood social capital on health, a subject that has been neglected in neighborhood health studies (Chaix 2009). At best, duration of residence has been used as a control variable (Harpham 2008). Although evidence on duration of exposure in neighborhood research has been lacking, evidence about the influence of exposure to 'country' (as another social environment) exists in the field of immigrant health research. With a longer duration of residence, immigrants internalize the norms of the host country, with effects on health behavior and health outcomes (e.g., an increase of BMI in the U.S.) (Goel, McCarthy, Phillips, and Wee 2004; Park, Neckerman, Quinn, Weiss, and Rundle 2008). Shared norms might function as a pathway between neighborhood social capital and health, and should be studied in more detail in future research.

Chapter 5

Health-related behavior as a mechanism behind the relationship between neighborhood social capital and individual health – a multilevel analysis

This chapter is co-authored by Beate Völker, Henk Flap, and Peter P. Groenewegen. Under review.

Health-related behavior as a mechanism behind the relationship between neighborhood social capital and individual health – a multilevel analysis

5.1 Introduction

Contextual social capital and, in particular, small-area social capital (such as neighborhood social capital) affect health (Wen, Browning, and Cagney 2003; Poortinga 2006a; Poortinga 2006b; Van Hooijdonk, Droomers, Deerenberg, Mackenbach, and Kunst 2008; Mohnen, Groenewegen, Völker, and Flap 2011). Neighborhood social capital can be defined as the access to resources that are generated by relationships between people in a friendly, well-connected and tightly knit community. Such communities are often referred to as 'cohesive communities'. Neighborhood social capital is the outcome of a cohesive community; in Coleman's formulation, it is the resource that "inheres in the structure of relations between actors" (Coleman 1988, page S98). For example, enjoying a clean and safe playground that was organized and is supervised by the neighborhood is a resource produced by a cohesive neighborhood. One person alone would not have been able to achieve the same goal, even with a high level of human or financial capital. Neighborhood social capital is a public good and is available to all members of a community (Coleman 1988, page S98). Neighborhoods differ in regard to this public good, which explains some aspects of differences in health between neighborhoods. Although scholars have found a positive association between neighborhood social capital and individual health, the mechanism explaining this direct effect is still unclear. Until now, it has been uncertain how neighborhood social capital affects an individual's health (Hawe and Shiell 2000; Harpham, Grant, and Thomas 2002).

Activities undertaken to satisfy daily needs and leisure activities both start in the neighborhood; for example, the daily commute begins in the neighborhood. Daily needs can also be met entirely in the neighborhood, as by buying groceries in a neighborhood shop or by bringing children to a kindergarten in the neighborhood. At the end of a day, the neighborhood can be the site of recreational activities such as walks or gardening. These daily behaviors might explain how neighborhood social capital 'gets under the skin' (Taylor, Repetti, and Seeman 1997) of inhabitants. Figure 5.1 illustrates a possible mediator effect in a traditional Baron and Kenny (Baron and Kenny 1986) path diagram. The direct effect presented in Figure 5.1 is as follows: the more neighborhood social capital, the better one's health (c). The

mediator is the positive influence of neighborhood social capital on health-related individual behavior (a), which results in improved health, as in path (b).

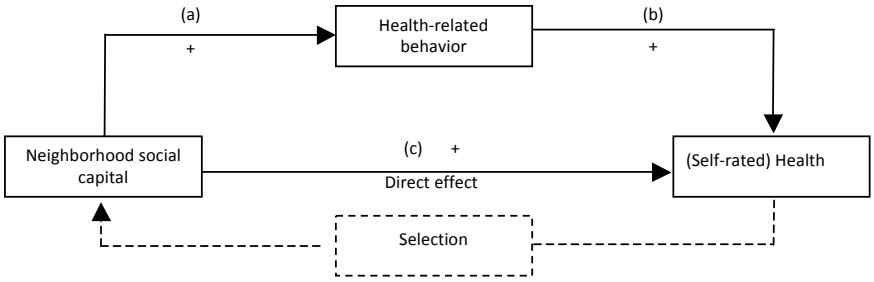


Figure 5.1: Model of how neighborhood social capital may affect self-rated health

Until now, few studies have focused on path (a). We present evidence from studies on subjects that diverge from our research interest because the data on this subject are rare. Cited studies thus differ in regard to the context, the operationalization of social capital, whether contextual social capital was measured at the neighborhood level or only at the individual level, and the health outcome variable.

Some studies indicate an association between contextual social capital and smoking (Lindström 2003; Patterson, Eberly, Ding, and Hargreaves 2004). A Swedish study found a negative association between individual-level social capital (operationalized as social participation in formal or informal groups in society) and daily smoking (Lindström 2003). A multilevel study on 10,617 adults living in 19 urban and rural geographical areas (larger in size than our neighborhood units) in Minnesota, U.S.A., found evidence for a negative relationship between smoking and community social cohesion (Patterson, Eberly, Ding, and Hargreaves 2004). That study used measurements of social cohesion that were similar to our neighborhood social capital measurements.

Some studies link contextual social capital to alcohol consumption (Blomgren and Martikainen 2004; 2005). On the individual and contextual levels (27,687 students in 119 US colleges), Weitzman and Chen (2005) showed that social capital (measured as voluntarism) was significantly negatively associated with several kinds of alcohol misuse. Another study showed that contextual social capital (voting behavior; 1.1 million people in 84 Finnish regions) decreases the risk of alcohol-related mortality (Blomgren and Martikainen 2004).

Neighborhood social capital has been shown to stimulate physical activity in adults (Fisher, Li, Michael, and Cleveland 2004; Wendel-Vos, Van Hooijdonk, Uitenbroek, Agyemang, Lindeman, and Droomers 2009; Ball, Cleland, Timperio, Salmon, Giles-Corti, and Crawford 2010) and children (Carver, Salmon, Campbell, Baur, Garnett, and Crawford 2005; Singh, Kogan, Siahpush, and Van Dyck 2008; Cradock, Kawachi, Colditz, Gortmaker, and Buka 2009; Hume, Jorna, Arundell, Saunders, Crawford, and Salmon 2009; Aarts, Wendel-Vos, Van Oers, Van de Goor,

and Schuit 2010). A study from Melbourne, Australia (1405 women in 45 suburban neighborhoods with an average of 4000-30,000 inhabitants) showed that women who participated in local groups or events and (less consistently) women living in neighborhoods where residents trusted one another were more likely to participate in leisure-time physical activities (Ball, Cleland, Timperio, Salmon, Giles-Corti, and Crawford 2010). A study on elderly people in Portland, U.S.A., also showed promising results (582 elderly in 56 neighborhoods). Neighborhood social cohesion, in conjunction with other neighborhood-level factors, was significantly associated with increased levels of neighborhood physical activity (Fisher, Li, Michael, and Cleveland 2004). A study using data on the Dutch city Eindhoven and its surrounding areas (4785 individuals in 213 small neighborhoods) showed no linear association between lack of participation in sports and neighborhood social cohesion measured on the individual level (Kamphuis, Van Lenthe, Giskes, Huisman, Brug, and Mackenbach 2008). However, people living in medium social cohesion neighborhoods were more likely to participate in sports than inhabitants of low or high social cohesion neighborhoods. A study on 6470 children in four Dutch cities showed that neighborhood social capital (measured at the individual level) was positively associated with outdoor play (Aarts, Wendel-Vos, Van Oers, Van de Goor, and Schuit 2010). A study on 15 neighborhoods in Amsterdam found that inhabitants of neighborhoods where people do not know each other well tend to bicycle less often than people in other neighborhoods (Wendel-Vos, Van Hooijdonk, Uitenbroek, Agyemang, Lindeman, and Droomers 2009). In summary, some research has already focused on the neighborhood as context and indicated that contextual social capital stimulates different kinds of health-related behavior.

To our knowledge, only three studies (Mohan, Twigg, Barnard, and Jones 2005; Poortinga 2006a; Hystad and Carpiano 2010) have used behavior as the mediating factor (Figure 5.1, paths (a) and (b)) to explain the effect of contextual social capital on health (Figure 5.1, path (c)). First, Mohan et al. (2005) showed that the direct effects of several different small-area measurements of social capital on mortality became weaker once health-related behaviors were included in the models. As the authors note, however, mortality might be an insufficiently sensitive indicator of individual health. Subjective health (self-rated health) is a broader measure. Self-rated health is well established as an indicator of morbidity (Simon, De Boer, Joung, Bosma, and Mackenbach 2005) and a predictor of mortality (Idler and Benyamini 1997), and it is more responsive to recent events than other measures. Furthermore, to understand the mediating effect of health-related behavior, behaviors should not be considered all together, as in the study by Mohan et al. (2005). Neighborhood social capital might influence different health behaviors in different ways. For example, large quantities of alcohol are often consumed in groups; a well-connected neighborhood might give more opportunities for group drinking than un-connected neighborhoods. At the same time, a well-connected community might disapprove of smoking. The second study that tested behaviors as mediators also considered all behavior mediators together (Poortinga 2006a). Poortinga studied the association between neighborhood social capital and self-rated health using a British data set and found no mediation effect. The third study (Hystad and Carpiano 2010) analyzed behaviors separately. While changes in exercise, smoking or weight loss

were positively associated with individual-level community belonging, changes in alcohol consumption and taking vitamins were not. Some limitations of this study are the measure of community belonging solely on the individual level and the focus on changes in behavior, rather than behavior itself. Moreover, large regions (up to 2.5 million people per region) were used.

In conclusion, it is not clear whether different kinds of health-related behaviors are mediators of the association between contextual-level social capital and individual health. Physical activity seems to be a promising mediator because evidence on the effects of contextual social capital on physical activity is, in comparison to research on other mediators, the best studied; however, it has not yet been studied as a mediator in a neighborhood study on health. Our study answers the research question: *Do health-related behaviors explain the association between neighborhood social capital and individual health?*

5.1.1 Neighborhood social capital and individual behavior

Neighbors live close to each other, and therefore, it is likely that neighbors observe and learn from each other's behavior (Bandura 1977; 1986), especially if the individuals involved are strongly socially connected. It can be argued that personal contacts might be easier in the countryside, where every individual knows everyone else from childhood and by name. Behavior that does not conform to the norms of the community might be sanctioned more efficiently in the countryside than in cities because rural inhabitants have fewer alternative opportunities for social contacts. Urban people, however, can also be affected by social capital. Neighbors in cities have more opportunities for daily contacts because they live very close to each other. People who live close might provide 'feedback', which is essential for developing social behaviors (1983). Norms of behavior are provided by a community, rather than only by one or two close friends (Taylor, Repetti, and Seeman 1997, page 421). Behavior is a result of internalized community norms, imitation, and social feedback.

If neighborhoods differ in regard to their level of social capital, the effects of norms on inhabitant's behavior will differ between neighborhoods as well. As argued above, focusing on specific behaviors is a necessary strategy to identify how contextual factors may improve health. This approach is especially valuable for prevention strategies and promotion of healthy lifestyles. This study distinguishes five health-related behaviors associated with a healthy lifestyle (Belloc and Breslow 1972; Strine, Okoro, Chapman, Balluz, Ford et al. 2005). Individual health is related to smoking, drinking, sleeping, and eating habits as well as to physical activity. Neighborhood communities might differentially affect these behaviors because a given behavior may be more common in some neighborhoods than in others. Moreover, some behaviors might be easier to disapprove of than other behaviors. We assume that health-related behavior is beneficially affected by neighborhood social capital. For example, a well-connected community with a common sense of health-related norms might disapprove of smoking. Second, a community with a high level of social capital might intervene or report underage drinking to the parents (Kawachi 1999). Third, people's sleeping rhythms may adjust to coincide with the time when the lights are switched off in their neighbors' houses. Fourth,

patterns of food consumption might also be influenced by the neighborhood (e.g., through the smell of dinners being prepared). Fifth, physical activity might be affected by neighborhood norms as well (Fisher, Li, Michael, and Cleveland 2004). Physical activity refers not only to sports (e.g., soccer or jogging) but also to walking and biking for relaxation or transportation.

We are aware that the positive influence of a well-connected community on behavior is only an assumption. We exclude the possibility that behavior might also be negatively affected by neighborhood norms. For instance, a cohesive neighborhood might provide more opportunities for alcohol consumption, and if community norms trivialized risky behaviors such as driving under the influence of alcohol, the risk of an alcohol-related accident or alcohol addiction would be increased. Norms are difficult to measure and were not included in the data used in this article. In an attempt to compensate for this gap in our knowledge, we tested in pre-analyses whether the religiosity – as an indicator for norms of moderateness – of a neighborhood is an indicator for healthy behavior. We did not find a religiosity effect on health-related behavior, and no interaction of religiosity with neighborhood social capital as influence on health was found. Therefore, we present our analysis without an indicator for health-related norms. To analyze the mediation effect of behavior, we test for each health-related behavior separately whether *more neighborhood social capital is associated with more of that health-related behavior.*

5.1.2 Behavior resulting in health

The extent to which neighborhood social capital affects health via behavior depends on the degree of influence behavior has on health (Figure 5.1, path (b)). Fortunately, a wealth of research confirms that certain behaviors affect health. Tobacco consumption, for example, is associated with morbidity and mortality. A British longitudinal study on physicians showed that non-smokers had a 10-year longer life expectancy than smokers (Doll, Peto, Boreham, and Sutherland 2004). Moderate alcohol consumption is positively associated with subjective health in contrast to no or excessive alcohol consumption (Poikolainen and Vartiainen 1999). A review by Alvarez and Ayas (2004) showed that a daily sleep routine of 7 to 8 hours promotes health, as measured by all-cause mortality. Irregular breakfasts have been shown to be an important risk factor for overweight and obesity in adolescents (Croezen, Visscher, Ter Bogt, Veling, and Haveman-Nies 2007). One warm meal per day is also advised (Van Lindert, Droomers, and Westert 2004). Regular physical activity is associated with lower morbidity and mortality rates (Haskell, Lee, Pate, Powell, Blair et al. 2007). In summary, the literature shows that *non-smoking, moderate alcohol consumption, seven or eight hours of sleep per night, regular breakfasts, daily warm meals, and physical activity are related to good health.*

The direct effect shown in Figure 5.1 might be explained by behavior and its effect on individual health. The mediation might emerge fully or only partly because, along with behavior, other mechanisms (e.g., psycho-biological explanations or access to facilities) are also responsible for shaping health. To answer our research question, we analyze whether *the effect of neighborhood social capital on health is (partly) mediated by health behaviors.*

In this article, the moderation hypothesis illustrated in Figure 5.1 was tested step-by-step. First, the effect of neighborhood social capital on five different health-related behaviors was tested. If a relationship was found, the strength of the behavior's association with self-rated health was reported. Finally, each of these behaviors was tested for whether it weakened the associations between neighborhood social capital and health.

5.2 Methods

5.2.1 Data

This study used three different survey data sets, as well as register information. The individual data set was from the 'health interview' in the DNSGP-2, 2002 (Westert, Schellevis, De Bakker, Groenewegen, Bensing, and Van der Zee 2005), which was designed by the Netherlands Institute for Health Services Research (NIVEL) and the National Institute for Public Health and Environment (RIVM). We combined these individual-level data with two data sets from the 'Dutch housing demand survey' (WBO, 1998 and WoON, 2002), which were collected under the supervision of the former VROM, and statistical register information collected by Statistics Netherlands (1995 - 1999). The data sets were merged based on the respondent's 4-digit postal code (neighborhoods). In the Netherlands, 4-digit postal codes are relatively small units; they comprise areas between 1-8 km^2, with on average 2500 - 3000 addresses and about 4000 residents. In our study, we used postcodes ranging from 140 to 31,620 inhabitants (on average 6908, s.e. 4558).

The 'health interview' is a 5% random sample of listed patients in 104 Dutch general practices (12,699 individuals; response rate of 65%). In the Netherlands, nearly all people are on the list of a specific general practitioner or practice, irrespective of their health status. Practices were sampled according to region, urban status, and practice type. The "health interview" in the DNSGP-2 contains several health and health-related measurements. Interviews were conducted at the homes of the respondents.

The WBO 1998 data set evaluates physical and social aspects of housing in the Netherlands. WBO 1998 is representative of all Dutch people 18 years or older. Sample selection was conducted using municipal registration information, and the data thus cover 117,569 people (response rate = 78%). Questions regarding neighborhood social capital were only asked of the heads of the household because it was expected that only they would be able to answer housing-specific questions.

To include the information on whether social capital has changed over time, the WoON 2002 data set, also a cross-sectional survey and the successor of the WBO 1998, was used. It incorporates the same neighborhood social capital variables as the WBO 1998. WoON 2002 includes data on 75,043 individuals (response rate = 61%).

Statistics Netherlands offers free register information on socio-demographic information regarding Dutch 4-digit postal code areas.

Of the 12,699 respondents of the DNSGP-2 data set, only 9684 were adults. Moreover, we lost cases because of missing values in individual control variables (n = 33) or in behavior variables (n = 42). The neighborhood-level analysis caused further case loss (neighborhood social capital, n = 184; neighborhood income, n = 172). In this study, 9253 respondents from the DNSGP-2, living in 672 neighborhoods, were used. Analyses have shown (in data not presented here) that the cases lost did not change the representative quality of the adult data sample.

5.2.2 Measurements

Individual variables

All individual variables were generated from the DNSGP-2 'health interview'.

The main outcome variable was 'self-rated health', with the following possible answers: 'excellent/ very good/ good/ fair/ bad'. The original, skewed scale was dichotomized, with (1) representing excellent to good health and (0) representing fair or bad health.

The *Individual control variables* were sex, age, nationality, and social status. *Women* were indicated by (1) and men by (0). *Age* was measured in years and centered on the mean (48.9). *Nationality* was a dummy variable, with Dutch (1) and Non-Dutch (0) nationality as answer categories. Social status was measured by education, employment, and income. *Education* was measured by the highest level of education attained, in three categories: low (1), middle (2), and high (3). *Employment* was measured with six possible answer categories: 'student', 'housewives/-men and others', 'registered unemployed', '(self-) employed', 'incapable of working', and '(invalidity) pensioner'. *Income* was presented as the household equivalent income per person, collapsed into three categories from low (1) to high (3), with a category for 'missing values'.

Five measurements of *health-related behavior* were considered in this study. First, the three-category variable smoking status was collapsed into non- and ex-smoker (1) versus current smoker (0). Second, 'alcohol intake' was measured by asking separately the alcohol intake in number of glasses during the week and during the weekend. The answers were summed up to a week-score of alcohol intake in glasses per week. The relationship between alcohol consumption and self-rated health is curve-linear; the more alcohol an individual consumed, the better his or her health, until the trend reverses and the relationship becomes negative. No alcohol intake is suboptimal for health; moderate alcohol intake is optimal, and a high alcohol intake is negatively associated with health (Poikolainen, Vartiainen, and Korhonen 1996). We studied this particular relationship using our own data. As a result, we collapsed the number of glasses of alcohol consumed in the last week into no or almost no alcohol intake (0-3 glasses per week), moderate alcohol intake (4-11 glasses per week), and high alcohol intake (12 or more glasses per week). Third, sleep duration was measured by the survey question "How many hours do you sleep?" We tested the association between sleep and self-rated health and found (in

accordance with existing literature (Alvarez and Ayas 2004)) that fewer or more than 7 or 8 hours is negatively associated with health. Sleep duration was collapsed into a healthy sleep duration of 7 to 8 hours (= 1), and two unhealthy sleep durations of less (= 0) or more than 7 to 8 hours (= 2). Next, nutrition habits were measured by asking two questions: the respondent was asked how many days per week he or she had breakfast and whether the respondent had at least one warm meal per day. Nutrition habits were considered healthiest if breakfast was eaten '5 to 7 times per week' and if the respondent consumed one warm meal per day. Most Dutch people have one warm meal a day. Nutrition habits were added as a dummy variable, where (1) indicates the consumption of one warm meal per day and breakfast more than four times per week; otherwise, nutrition habits are coded as (0).

Finally, *physical activity* was measured by asking: "On how many days do you do 'activity X' for at least thirty minutes?" Physical activities included biking, doing odd jobs, gardening, sports, or other physical activities (Van Lindert, Droomers, and Westert 2004, p. 47). In general, physical activity is positively associated with self-rated health. For adults, it is advised that they be physical active for at least thirty minutes, five days a week (Haskell, Lee, Pate, Powell, Blair et al. 2007). Additional analysis of our own data had confirmed the soundness of this health advice. Thus, five or more days of thirty minutes of activity was coded with (1); less physical activity was coded with (0).

Neighborhood variables

The core independent variable is the neighborhood social capital, as determined from the WBO 1998 data set. An average of 29 respondents per neighborhood were used to estimate the neighborhood social capital. Neighborhood social capital is measured by three questions pertaining to contact among neighbors. The questions ask 1) whether people in the neighborhood know each other, 2) whether neighbors are nice to each other, and 3) whether there is a friendly and sociable atmosphere in the neighborhood. Response categories were 'totally agree', 'agree', 'neutral', 'don't agree', and 'totally don't agree' on a scale of 1 to 5. To aggregate the individual information to the neighborhood level, we use ecometric measurements (Raudenbush and Sampson 1999; Mujahid, Diez-Roux, Morenoff, and Raghunathan 2007; Steenbeek 2011), as in earlier work (Mohnen, Groenewegen, Völker, and Flap 2011), by performing a multilevel analysis. This approach accounts for the nesting of social capital items within individuals and includes the neighborhood level in the analysis, resulting in a three-level model (neighborhoods, individuals, and the items measuring social capital). We adjusted for seven individual characteristics that may influence the perception of neighborhood social capital: sex, age, education, income, employment status, home ownership, and years of residence. The ecometric model also accounts for differences in the numbers of respondents per neighborhood by shrinking deviating neighborhoods with smaller numbers of respondents to the general average (Hox 2002, page 29). The residuals of the neighborhood social capital measurement, i.e., the part that cannot be attributed to individual response patterns and measurement error, constitutes the social capital measurement. Positive values indicate higher than average levels of neighborhood social capital (reliability based on Hox (2002):0.707).

We argued above that the outcome variable of the main analysis (self-rated health) is very sensitive to recent developments. Neighborhood social capital might have changed between the time it was last measured, in 1998, and when self-rated health was measured in 2002. To control for the possibility of an increase or decrease in the level of social capital in a neighborhood over these four years we calculated a change score. Fortunately, the same measures of neighborhood social capital used for 1998 are available for 2002. We first calculated neighborhood social capital for 2002 in precisely the same way as for 1998 (reliability based on Hox (2002): 0.720). Subsequently, we computed a change score by subtracting neighborhood social capital in 1998 from neighborhood social capital in 2002. A positive value of the change score indicates an improvement, and a negative change score indicates a decline in neighborhood social capital. Two-thirds of the neighborhoods had not changed, staying within one standard deviation from the mean (0.08) of the change score.

Three control variables at the neighborhood level were used. To take into account the level of income in a neighborhood, we used the percentage of people in the *highest income quintile*. Hou and Myles (2005) showed that the prosperity of a neighborhood is positively associated with the inhabitants' health and that this effect is even stronger than the effect of poverty. The data from 1997 were provided by Statistics Netherlands. If information was missing, we used data from 1995 or 1999 instead.

Next, we used the degree of *urban density of the municipality* in which a given neighborhood was located in 1999. The codes were provided by Statistics Netherlands and were based on the number of addresses per km^2 (1 = rural = up to 499 addresses per km^2; 2 = semi-rural = 500-999 addresses/km^2; 3 = intermediate urban/rural = 1000-1499 addresses/km^2; 4 = semi-urban = 1500-2499 addresses/km^2; and 5 = urban = more than 2499 addresses/km^2).

Finally, we used a measure of *home maintenance in the neighborhood* to control for aesthetic/physical environmental influences on health. The variable is aggregated (via the mean) to the neighborhood level. On average, 29 people per neighborhood answered this question. Maintenance was addressed in the WBO 1998 with the question, 'Is your house in a bad condition?'. Answers were on a scale from 'I totally agree' (1) to 'I totally do not agree' (5). Higher values thus indicate better maintenance, as reported by the respondent.

5.2.3 Analytic strategy

To test the association and mechanism of association between neighborhood social capital and self-rated health, we performed multilevel logistic regression analyses. We estimated the models with the statistical software package Stata 11, using the command *xtmelogit*. Our study design is in the tradition of Baron and Kenny (1986), and it meets the requirements of a multilevel mediational model (Krull and MacKinnon 2001). The first multilevel logistic regression analyses were used to determine whether social capital has an effect on healthy behavior (Table 5.2). Two of these analyses had to be ordered because the dependent variables had three instead of two categories. We report only the coefficient of interest, the category we expect to be health-improving. Next, analyses were conducted to determine whether these

behaviors improve health (Table 5.3, model 1-2). When we had found that these behaviors were related to health and that they were also significantly positively associated with neighborhood social capital, we conducted multilevel logistic regression analyses to determine whether these mechanisms mediate the relationship between the neighborhood social capital and health (Table 5.3, model 4-5). The direct link between the neighborhood social capital and health is also presented in Table 5.3 (model 3). This neighborhood social capital effect on self-rated health, presented in model 3, can be compared with the neighborhood social capital variable presented in models 4 and 5. A decrease in the coefficient of the neighborhood social capital variable indicates a mediator effect of the tested health-related behavior. We tested the significance of the mediation with the product-of-coefficients approach (Preacher and Hayes 2008), also called the Sobel test (Sobel 1982). We used Preacher's Sobel test webpage (Preacher and Leonardelli 2011), which also meets the requirements to test a multilevel mediation effect (Krull and MacKinnon 2001).

5.3 Results

Table 5.1 shows that more than 80% of the Dutch reported good or very good self-rated health. The sample shows an overrepresentation of housewives/-men in comparison to the percentage in the Netherlands as a whole (8% in 2006). Regarding the characteristics of the study population and the neighborhoods, Table 5.1 shows that two-thirds of those surveyed reported themselves to be non-current smokers. More than 20% of the respondents drank alcohol in moderation. Two-thirds of the participants slept 7 or 8 hours per night, and even more reported healthy eating habits. Furthermore, 58% of the participants reported being physically active five to seven days per week for at least 30 minutes per day.

5.3.1 Neighborhood social capital and health-related behavior

Table 5.2 shows the results of analyses for different health-related behaviors; each model has a different behavior as the dependent variable. Table 5.2, model 1 shows that the association between neighborhood social capital and being a non-smoker is positive; this association is significant. Model 2 shows that the likelihood of moderate alcohol intake is slightly but not significantly reduced by high neighborhood social capital. Model 2 and model 3 were based on an ordered regression. Models 3 and 4 in Table 5.2 suggest that healthy sleep patterns and eating habits are not affected by the neighborhood's level of social capital. The strongest association between the neighborhood social capital and a health-related behavior is presented in model 5, Table 5.2. People living in neighborhoods with a high level of social capital have a 118% greater chance of being physically active than people living in low social capital neighborhoods.

The mechanism (a) from Figure 5.1 applies to two behaviors: the more neighborhood social capital, the more physically active the residents are and the more likely it is that they are non-smokers. The other three behaviors cannot serve as

Table 5.1: A descriptive table of individual and collective variables

n_i = 9253., n_j = 672		*Range*	*Mean*	*S.D.*	*Valid Percent*
Individual level					
Self-rated health:	Good or better				81.2%
	Not good				18.8%
Gender:	Woman				55.5%
Age in years		18 - 97	48.9	17.1	
Nationality:	Dutch				98.1%
	Non Dutch				1.9%
Education:	Low				48.8%
	Middle				26.5%
	High				24.7%
Having a paid job:	Student				4.2%
	Housewives /-men				20.8%
	(Self-) employed				50.4%
	Registered unemployed				1.4%
	Incapable of working				5.5%
	(Invalidity) pensioner				17.7%
Income:	Missing category				6.7%
	Low				32.1%
	Middle				33.8%
	High				27.4%
Health-related behavior					
Smoking status:	Smoker				31.2%
	Ex-/ Never smoker				68.8%
Alcohol intake: (glasses per week)	(Almost) never (0-3)				57.4%
	Moderate (4-11)				21.4%
	High (> 11)				21.2%
Sleep duration:	≤ 6 hours				19.8%
	7-8 hours				69.5%
	≥ 9 hours				10.8%
Nutrition:	1 warm meal/day & ≥ 5 x breakfast per day				76.0%
	Less often				24.0%
Physical activity:	≥5 times per week 30 min.				57.7%
	Less often				42.3%
Neighborhood level					
Neighborhood social capital		-0.77 - 0.54	-0.08	0.214	
Neighborhood social capital change 2002-1998		-0.61 - 0.56	0.08	0.175	
Percentage of rich residents (in %)		5 - 54	17.61	7.205	
Home maintenance		2 - 5	3.95	0.388	
Urban density of municipality		1 - 5	3.35	1.288	

Note: n_j = neighborhood; n_i = individuals; 13.8 people per neighborhood (range 1-277).

Table 5.2: Multilevel logistic regression analyses of neighborhood social capital on five health-related behaviors (Odds Ratios, 95% Confidence Interval in parentheses)

n_i = 9253, n_j = 672	Model 1	Model 2 (ordered)	Model 3 (ordered)	Model 4	Model 5
Dependent variables	Non-smoker[a]	Moderate alcohol intake[b]	7 or 8 h sleep duration[b]	Healthy nutrition pattern[c]	≥5 times per week 30 min. physical activity[d]
Neighborhood social capital	1.54 (1.08/2.19)	0.96 (0.93/1.00)	1.02 (1.00/1.05)	1.27 (0.86/1.86)	2.18 (1.26/3.80)
Neighborhood variance (estimate)	0.026 (0.014)	0.028 (0.019)	0.00 (0.000)	0.036 (0.020)	0.342 (0.049)
ICC, %	0.8	0.01	0.0	1.1	9.4

Note: n_j = neighborhood; n_i = individuals. All models are controlled for individual (age, sex, nationality, and SES) and neighborhood (highest income quintile, urban density of municipality, home maintenance in the neighborhood) level characteristics as well as change of neighborhood social capital between 1998 and 2002. [a]Reference category: ex- or current smoker. [b]An ordered logistic regression multilevel analysis was performed. [c]Reference category: unhealthy pattern. [d]Reference category: less often.

Table 5.3: Multilevel logistic regression analyses of the mediator effect of health-related behavior, dependent variable self-rated health (Odds Ratios, 95% Confidence Interval in parentheses)

n_i = 9253, n_j = 672	Model 1	Model 2	Model 3	Model 4	Model 5
Neighborhood social capital			1.75 (1.10/2.78)	1.71 (1.08/2.72)	1.58 (1.01/2.47)
Non-smoking	1.25 (1.10/1.42)			1.24 (1.09/1.41)	
Physical activity		1.95 (1.73/2.19)			1.94 (1.73/2.18)
Variance neighborhood level (estimates and s.e.)	0.068 (0.030)	0.047 (0.028)	0.057 (0.029)	0.056 (0.029)	0.038 (0.026)
Intra class correlation (%)	2.0	1.4	1.7	1.7	1.1

Note: n_j = neighborhood ; n_i = individuals. Variance of the empty model was 0.161 (0.036). All models are controlled for individual (age, sex, nationality, and SES) and neighborhood (highest income quintile, urban density of municipality, home maintenance in the neighborhood) level characteristics. Model 3 to 5 are additionally controlled for change of neighborhood social capital between 1998 and 2002.

mediators because of the non-significant association with neighborhood social capital. We continued our analysis with only these two behaviors.

5.3.2 Non-smoking, physical activity and better health

Table 5.3, model 1 shows that non-smoking status is positively associated with self-rated health. Physical activity is similarly, but more strongly, associated with self-rated health (Table 5.3, model 2). The likelihood of 'good' or 'very good' health is almost doubled by physical activity.

5.3.3 The mediating effect of health-related behavior

Table 5.3, model 3 shows that neighborhood social capital is positively associated with health. This finding is the direct effect of neighborhood social capital on self-rated health. Table 5.3, model 4 shows that this direct effect is only slightly reduced by the variable 'non-smoking'; the Sobel test shows that non-smoking status is not a significant mediator ($p = 0.740$). The most interesting finding from Table 5.3 is presented in model 5: the direct effect presented in model 3 is considerably attenuated by physical activity; the Sobel test shows that physical activity is a significant mediator ($p = 0.007$). Mechanisms (a) and (b) from Figure 5.1 are associated with this behavior: the more physical activity, the better the self-rated health is and the less strong the direct effect of the neighborhood social capital is on self-rated health.

5.4 Discussion

In neighborhoods with a high level of social capital, people are more physically active and more likely to be non-smokers. These behaviors have a positive effect on self-rated health. Moderate alcohol intake, nutrition, and sleep habits did not explain why neighborhood social capital is associated with self-rated health.

Physical activity is the behavior that is most sensitive to the influence of the characteristics of the neighborhood. This association might be strongest because physical activity usually occurs in a public space, while eating breakfast and dinner as well as sleeping are private, indoor activities. Drinking and smoking happen both indoors and outdoors, making them both visible and invisible to neighbors. Therefore, these behaviors are not particularly strongly linked to the neighborhood context. Furthermore, the ease of interpreting behavior as healthy may depend on the kind of behavior. While it is common knowledge that non-smoking and regular physical activity are healthy, it might not be clear how many hours of sleep promote health. Healthy behaviors that are less clearly defined are more difficult to promote or evaluate.

The results of our study are consistent with the previously mentioned British study (7394 adults, 720 neighborhoods) with regard to only one effect: neighborhood social capital has a positive effect on non-smoking status (Poortinga 2006a). None of the behavioral variables in Poortinga's study (2006a) functioned as a mediating variable and the direct association between community social capital and

health even increased instead of decreased. Poortinga had lumped together all available behaviors as mediators, including those with no significant association with social capital. A separate test of each behavior might have shown different results. Furthermore, only significant and positive associations (Figure 5.1, mechanism (a)) should be used as mediators. In an additional analysis (not shown), we found that adding alcohol consumption (which was negatively and non-significantly associated with neighborhood social capital) to the model as a single behavioral mediation variable increased the association between neighborhood social capital and health.

Our findings are consistent with the findings of Mohan et al. (2005), who found that the direct effect of small-area social capital on mortality was attenuated by health-related behaviors. We built on these findings by using self-rated health as a dependent variable, observed values of social capital instead of estimates, separate analyses for each behavior instead of analyzing all behavior mediators at once, and finally, data from the Netherlands (instead of Great Britain, as in (Mohan, Twigg, Barnard, and Jones 2005) and (Poortinga 2006a)).

In contrast to the existing literature (Blomgren and Martikainen 2004; 2005) and to our predictions, our study does not confirm that the contextual social capital is significantly and positively associated with moderate use of alcohol.

Our study has a limitation in regard to a possible third neighborhood factor that might influence both neighborhood social capital and physical activity. For instance, a neighborhood can be built in such a way that it promotes both physical activity *and* social interaction (Cohen, Inagami, and Finch 2008). Lund (2002) studied the effect of the built environment on health by comparing two different neighborhood types in the U.S. city of Portland, Oregon. The more walk-friendly neighborhood showed a greater sense of community. However, Lund's study was limited because only two neighborhoods were compared. Cohen et al. (2008) had found that "parks within various distance to one's tract" (page 201-2; tract = neighborhood) were positively associated with collective efficacy on the individual level. The authors had interpreted the collective efficacy as an indicator of neighborhood social capital. The study analyzed data on 65 neighborhoods in Los Angeles, California. Cohen's work indicates that parks have the potential to increase inhabitants' health in multiple ways: parks in the neighborhood provide incentives for physical activity and social interaction, and the green-space itself might increase well-being and lower stress (Maas, Verheij, Spreeuwenberg, and Groenewegen 2009). Recent studies on *neighborhood walkability* have shown that the built environment affects physical activity; it can also be assumed that a 'walk-able' neighborhood that stimulates, for example, walking for recreation (Owen, Humpel, Leslie, Bauman, and Sallis 2004), might also affect the social environment.

Independent of whether a third environmental factor might be involved, it cannot be ruled out that social capital be increased *by* physical activity. Neighbors who go for a walk with the dog or play with their children at the playground have more meeting opportunities than inactive inhabitants.

Most research conducted in this area cannot rule out reversed causality between the dependent variable and the main explanatory variable. It might be that bad health would hinder interaction with neighbors; systematically, this effect could result in fewer chances to build neighborhood social capital. For this study,

longitudinal individual data were not available to test reversed causality; however, neighborhood social capital, the influencing variable, was measured before the dependent health variable. A further limitation is that it might be possible (and impossible to account for in this study) that people who like physical activity (who, for example, do their grocery shopping by bicycle) chose neighborhoods with particular physical characteristics (Van Dyck, Cardon, Deforche, Owen, and De Bourdeaudhuij 2011). Future research will determine to what extent the sense of community in the neighborhood, the built environment, the clustering of physically active inhabitants, or neighborhood selection affects health via the mediation factor "physical activity".

Our study is an important contribution to research on mechanisms explaining associations between effects at the micro and macro level. Until now, few studies inquire into multilevel mediation effects. Moreover, our study advances the empirical literature on social capital and health. One advantage of using more than one data source is that this study does not suffer from a 'single -source bias'. The data source used to measure health was not the same as the source used for social capital. Therefore, a third individual factor (e.g., a psychological link) cannot be the underlying cause for the association between social capital and health.

Our study differs from previous examinations of this subject because the curvelinear associations between health and sleeping, as well as health and drinking behavior, were studied; categories were chosen carefully, and ordered logistic multilevel regression analyses were done when needed. By means of these approaches, our study improves upon existing literature (Poortinga 2006a), which used dichotomized mediating variables; such variables might have been too crude as measurements because of the inherent loss of reliable information and consequent difficulties with interpretation of the data.

This study showed that the relationship between neighborhoods and health is only partly explained by physical activity. Aside from physical activity, other mechanisms are also discussed in the literature. For instance, a well-connected neighborhood might lobby more effectively for a walk-friendly (Sundquist, Eriksson, Kawakami, Skog, Ohlsson, and Arvidsson 2011) and green neighborhood (Maas, Van Dillen, Verheij, and Groenewegen 2008) or access to health care facilities (Hendryx, Ahern, Lovrich, and McCurdy 2002) and healthy food (Shaw 2006). The feelings of 'belonging to a (friendly) community' might also benefit health via a psycho-biological pathway. For example, such feelings might lower blood pressure, decreasing the chance of coronary artery diseases and susceptibility to infectious diseases (Taylor, Repetti, and Seeman 1997).

Ultimately, we would like to frame our findings on physical activity as a mediator in terms of health environment research. For years, research on physical activity had been limited to individual characteristics (Li, Fisher, Bauman, Ory, Chodzko-Zajko et al. 2005). Recently, more attention has been given to the broader context (the physical and, even more recently, the social environment) in which the physical activity of individuals occurs (McNeill, Kreuter, and Subramanian 2006). Our study bolsters the importance of the social component of this ecological perspective (Sallis and Owen 2002), i.e., social capital.

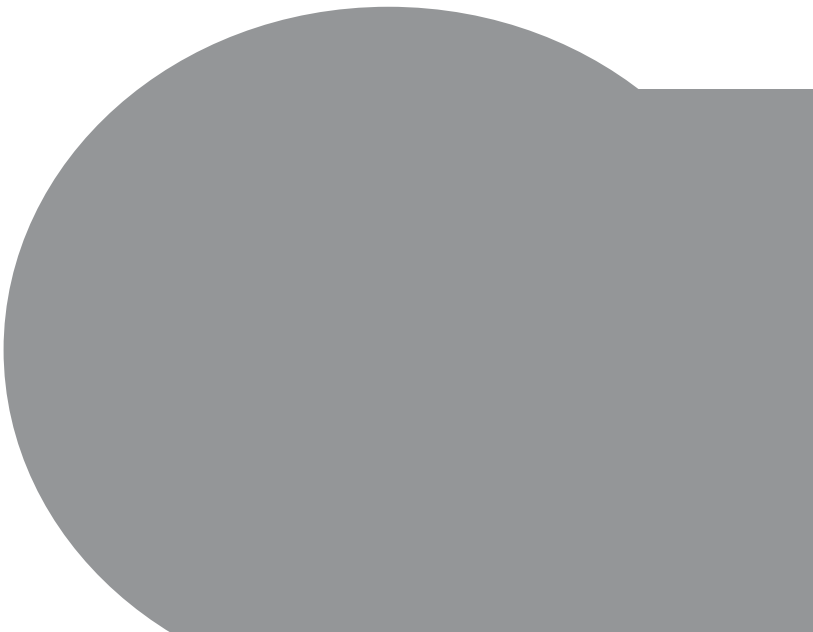
To conclude, it seems that cohesive neighborhoods share health-related norms that are related to physical activity and that this characteristic explains much of the

direct effect of neighborhood social capital on health; however, we cannot exclude the possibility that neighborhoods generate a high level of social capital *because* the residents are active and thus are more frequently in public spaces. Such an effect would suggest that it is not social capital but the collective physical activity that causes health differences between neighborhoods. Other mechanisms such as 'well-being', feeling attached to a neighborhood, and better access to facilities would not then play a role in differences in health between neighborhoods. These mechanisms were not tested in this study; however, these alternative mechanisms cannot be excluded because the direct effect was not completely explained. Future research should study not only alternative mechanisms but also alternative health outcome variables. The mediator 'physical activity' might be more or less significant in attenuating the direct effect between neighborhood social capital and, for example, mental health, than self-rated health.

Interventions aiming to increase both social interaction and physical activity are likely to be successful at improving health. Interventions should be accompanied by evaluations to disentangle the directions of causality.

Chapter 6

Summary of findings and suggestions for further research



Summary of findings and suggestions for further research

In the beginning of this dissertation, the question was raised as to why health clusters in neighborhoods and how we can explain this phenomenon. In addition to traditional explanations, this dissertation was mainly focused on a social environmental feature: neighborhood social capital. The overarching research question of this dissertation was:

> *'Does contextual social capital affect individual health, and if so, under which circumstances, and how does contextual social capital affect individual health?'*

To answer this question, in chapter 1, hypotheses were formulated concerning social capital theory. Chapters 2 through 5 tested these hypotheses. A summary of the hypotheses and findings is presented in this chapter, in Table 6.1. In Section 6.2, the contributions of this dissertation are summarized for each of the elements of the overarching research question of this dissertation: (1) Does neighborhood social capital affect health? (2) Under which circumstances does neighborhood social capital affect health? (3) How does neighborhood social capital affect health? Section 6.3 reports the limitations of this dissertation and offers suggestions for future research.

6.1 Findings

This dissertation contributes to the understanding of the relationship between neighborhood social capital and individual health. Hypothesis 2.1 tested whether neighborhood social capital is associated with health. Hypotheses 3.1 and 3.2 tested whether neighborhood social capital and individual-level social capital are independent factors that affect health. Hypotheses 3.3a through 3.6 tested interaction effects of individual- and neighborhood-level social capital. It was hypothesized that social capital effects of both levels might accumulate or compensate for each other. Hypotheses 4.1 and 4.2 studied whether the time or intensity of exposure to neighborhood social capital increases the effect of neighborhood social capital on health. Finally, it was hypothesized that health-related behavior moderates the association between neighborhood social capital and self-rated health (Hypothesis 5.1).

The findings of the preceding chapters are summarized in Table 6.1 and are illustrated in Figure 6.1. While Table 6.1 presents all the hypotheses and the results related to these hypotheses, Figure 6.1 briefly and visually summaries the relevant relationships between the hypothesized effects.

Table 6.1: Summary of findings

Hypothesis		Hypothesized effect	Found effect	Test evaluation
H2.1:	The more neighborhood social capital, the better one's individual health–independent of relevant socioeconomic and physical conditions at both the neighborhood and individual levels and independent of the urban density of the municipality.	+	+	The independent effect of neighborhood social capital on health remains while controlling for other contextual and compositional effects. However, clustering of health in neighborhoods has previously been found in urban or intermediate urban-rural areas, and only in these areas does collective social capital show an independent association with people's health.
H3.1:	The more social capital in a neighborhood, the better the health of its residents–independent of (local or non-local) individual-level social capital.	+	+	Individuals benefit from social capital on the neighborhood and individual levels.
H3.2:	The more (local or non-local) individual-level social capital, the better the individual-level health–independent of neighborhood-level social capital.	+	+	At the individual level, individuals benefit from both local and non-local social capital.
H3.3a:	The more local individual-level social capital people have, the larger the effect of neighborhood social capital on individual health.	A	O	No support was found for the accumulation hypotheses. Thus, neighborhood social capital is a context effect that is independent of the individual-level social networks. In other words, neighborhood social capital is a public good with unrestricted access.
H3.3b:	The effect of neighborhood social capital on health is larger the more non-local individual-level social capital people have.	A	O	
H3.4:	The effect of individual-level social capital on health is larger the more neighborhood social capital a person has.	A	O	

+ = positive association; - = negative association; A = accumulation; C = compensation; O = non-significant association; + /O = an association is partly positive and partly non-significant

Table 6.1 (continued)

Hypothesis		Hypothesized effect	Found effect	Test evaluation
H3.5a:	If individuals lack local individual-level social capital but have ample neighborhood social capital, effects on health are still positive.	C	O	
H3.5b:	If individuals lack non-local individual-level social capital but have ample neighborhood social capital, effects on health are still positive.	C	C	Support was partly found for the compensation hypothesis: people with only a few contacts with friends and relatives are better off in a neighborhood with a high level of social capital with regard to health.
H3.6:	If individuals lack neighborhood social capital but have ample (local or non-local) individual-level social capital, effects on health are still positive.	C	O	
H4.1:	The longer one is exposed to a high level of neighborhood social capital, the better one's health is.	+	+/O	The relationship is not linear but curvilinear. Neighborhood social capital does not affect newcomers' self-reported health until an exposure of approximately 6 years. The association vanishes after approximately 22 years.
H4.2:	The more time one spends in the neighborhood, the more one is exposed to neighborhood social capital, and the better one's health.	+	+/O	People with young children, who are assumed to spend more of their time in the neighborhood, have greater health benefits. Surprisingly, the elderly, whom I also expected to spend most of their time in the neighborhood, are not affected differently by social capital than younger (< 65 years) people.
H5.1:	The more neighborhood social capital, the more informal social control, and thus, the better the health-related behavior and, ultimately, individual health.	+	+/O	Physical activity mediates to an important part of the association between neighborhood social capital and individual health.

+ = positive association; - = negative association; A = accumulation; C = compensation; O = non-significant association; + /O = an association is partly positive and partly non-significant

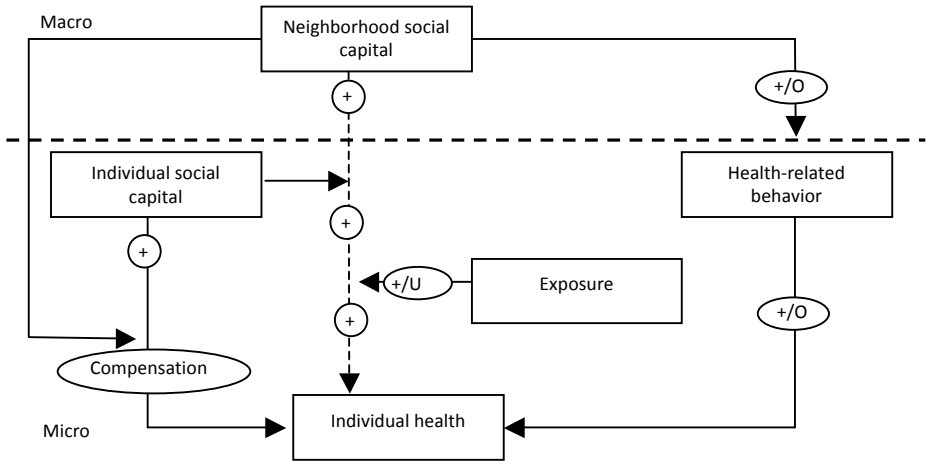


Figure 6.1: Illustration of the dissertation's findings
+ = positive association; +/O = partly positive and partly non-significant association; +/U = partly linear positive and partly positive curvilinear association.

Table 6.1 shows that the expected positive effect of social capital on health was confirmed for hypotheses 2.1 through 3.2 and partly confirmed for hypotheses 4.1 and 5.1. Support was found for the compensation hypotheses but not for the accumulation hypotheses of chapter 3. First, these results show that neighborhood social capital is constantly and positively associated with health. Different waves of WBO/WoON as well as the DNSGP's health interview were used to test this association. The results of this dissertation showed a stable association between neighborhood social capital and health. The more neighborhood social capital, the better individual health was, independent of control variables for both individual and neighborhood levels of social capital (H2.1) as well as independent of individual-level social capital (H3.1). Controls for the individual level differed by chapter, but all chapter included at least age, sex, nationality, and SES. In all chapters, the analysis controlled for socio-economic wealth/poverty, urban density of the municipality, and home maintenance at the neighborhood level. Individual-level social capital was measured via questions regarding the frequency of contact with neighbors (local capital) and the frequency of contact with friends and non-household family members (most likely non-local capital).

A main finding of this dissertation is that individual health can be enhanced through neighborhood social capital without contacts with specific others (H3.3a/b). The findings that neighborhood social capital is, first, not an artifact of individual-level social capital (H3.1) and, second, an independent phenomenon (H3.3a/b), imply that social capital is a public good with nonrestrictive access. Neighborhood social capital has explanatory power on its own and has to be separated from individual-level social capital.

Next, the association between neighborhood social capital and individual health was further investigated. The results show that neighborhood social capital is especially valuable for people with low non-local individual-level social capital (H3.5b). Furthermore, the length and intensity of exposure to social capital matters (H4.1 and H4.2). The results of this dissertation indicate that longer exposure to social capital is not necessarily better. A curvilinear association resulted from testing hypothesis H4.1. Intensity of exposure seems to increase the impact of neighborhood social capital on health (H4.2).

Finally, this dissertation presents one out of five possible health-related behaviors as a significant mediating factor for the association between neighborhood social capital and individual health (H5.1). Several health-related behaviors were tested: non-smoking, moderate alcohol intake, nutrition habits, sleep habits, and physical activity. Only physical activity significantly attenuated the association between neighborhood social capital and self-rated health.

The associations studied in the empirical chapters of this dissertation are illustrated by the arrows in Figure 6.1. The directions of the associations are integrated into the Figure with surrounding circles.

6.2 Contributions of this dissertation

This dissertation is the first work that tests the effect of neighborhood social capital on individual health in a multilevel design while using data representative for a whole country and a number of control variables for both levels. WBO and the successor WoON are high-quality cross-sectional data sets with a large number of respondents at both levels (individuals and neighborhoods).

This dissertation used multilevel analyses to determine which part of individual self-rated health can be attributed to the neighborhood level and which part can be attributed to the individual level. Most recent studies have also used multilevel analyses; however, these studies have often used only individual-level controls. Moreover, previous multilevel analyses were used to properly account for the nested structure of the data, but not for the testing of substantive cross-level hypotheses (such as chapter 3, micro/macro social capital, or chapter 4, neighborhood social capital and exposure).

Furthermore, an advantage of this dissertation over the existing literature is its sophisticated measurement of neighborhood social capital using an ecometric method (Raudenbush and Sampson 1999; Steenbeek 2011). To my knowledge, only a few other studies (Browning and Cagney 2003; Mujahid, Diez-Roux, Morenoff, and Raghunathan 2007; Chaix, Lindström, Rosvall, and Merlo 2008; Pruitt, Jeffe, Yan, and Schootman 2010) have also used ecometrics in public health research while aggregating individual information regarding social capital to the neighborhood level. Correlations of the two different methods for aggregating individual perception to the neighborhood level were not very high, indicating the adequacy of the ecometric method. In chapter 2, I used the WoON 2006 data set (3273 neighborhoods) to perform the correlation (0.797**). I did the same with the WoON 2009 data set and the neighborhoods used in chapter 4 (3001 neighborhoods), resulting in a correlation

of 0.808**. Thus, even the same variables have been aggregated; the correlations differ between the two methods of aggregation. In other words, the methods of aggregation matters, at least with the data used in this dissertation.

6.2.1 Does neighborhood social capital affect individual health?

In the introductory chapter of this dissertation, I presented recent evidence on contextual social capital, in particular neighborhood social capital and self-rated health (section 1.2). While findings for levels larger than neighborhoods were mixed, studies that focused only on the neighborhood level and that used neighborhood-related social capital measurements mostly found a beneficial effect of social capital on health. However, previous research lacked control variables at the neighborhood level. Despite the 17 articles that investigated research questions comparable to the ones studied in this dissertation, neighborhood social capital has not yet been established in health research. This might be due to doubts that neighborhood social capital is a factor on its own. It was not clear whether social capital or social networks caused health differences between neighborhoods.

In the introductory chapter of this dissertation, social capital was introduced as an alternative explanation for health clusters in neighborhoods. Social capital was presented as independent contextual factor, in addition to the neighborhood's level of socio-economic wealth and the quality of building environments. To establish neighborhood social capital, this dissertation raised and tested questions concerning the conditions and mechanisms of the association between neighborhood social capital and health.

This dissertation complements recent studies by using small-areas as neighborhood units and neighborhood social capital measurements directed at its residents (questions about inhabitants and their neighborhood). The effect of neighborhood social capital on health was studied in chapter 2; further tests were explored in chapters 3 through 5.

As result, this dissertation adds to the existing literature evidence of a positive association between neighborhood social capital and self-rated health while also considering alternative explanations at the individual- and the neighborhood-level (chapter 2). Other things being equal, collective social capital matters for individual health. Because of the cross-sectional design of the data set, changes in health caused by neighborhood social capital could not be studied. Nevertheless, the association seems to indicate that neighborhood social capital affects health (and not the other way around) because I used social capital data that were collected *before* the health information was gathered (chapter 4 + 5).

In chapter 3, the association between neighborhood social capital and individual health was further established through a test of whether neighborhood social capital is only an artifact of individual level-social capital. Only a few studies have tested this research question before. Chapter 3 adds to these an individual-level social capital measure that was divided into neighborhood-related and most likely not neighborhood-related relations. An analysis of the interaction effects between the micro and macro level was also novel. This dissertation shows that, in addition

to individual-level social capital, the social capital of a neighborhood has a positive and independent impact on individual health.

In comparison to other neighborhood health studies, this dissertation also shows that composition effects have a greater impact than context effects on health. The neighborhood variance of the empty model was explained to a great extent by individual characteristics that cluster in neighborhoods. People with similar characteristics live in the same neighborhoods. These characteristics affect health and are responsible for health differences between neighborhoods. I do not deny that composition effects explain a larger part of the variance in health between neighborhoods than neighborhood social capital (all chapters); nor do I deny that individual-level social capital has a greater effect on individual health than neighborhood social capital (chapter 3). However, from this dissertation, it can be concluded that neighborhood social capital plays an independent role in improving health.

6.2.2 Under which circumstances?

This dissertation is one of the first to study some of the circumstances under which neighborhood social capital is (especially) valuable for health. Regarding the association between neighborhood social capital and individual health, I have been interested in whether the effect is stronger for particular groups of people. Regression analysis separated for particular groups (chapter 2) or cross-level interactions were estimated to analyze conditions of neighborhood social capital (chapter 3 and 4).

As a result, I found that living in urban and intermediate urban-rural neighborhoods is a condition for the effect of neighborhood social capital (chapter 2). Neighborhood social capital has no impact on health for the general rural population. This result might be due to better average levels of health in rural neighborhoods. Nevertheless, it might be that for particular groups of people living in the countryside, neighborhood social capital is of value for their health. Therefore, individuals of all urbanity categories were part of further analyses in this dissertation; however, urbanity was always controlled for.

Chapter 3 tested whether having individual-level social capital is a condition for being affected by neighborhood social capital. The findings indicate that 'access' to neighborhood social capital via a specific neighbor, friend, or relative is not a necessary condition. Neighborhood social capital has an independent effect on individual health, unconditioned by individual-level social capital. Through this finding, this dissertation adds empirical evidence to the assumption that contextual social capital is a 'public good'.

A further condition studied in this dissertation was the length of time that individuals lived in a particular neighborhood (chapter 4). By including this condition, this dissertation introduced a new question into contextual social capital research—the question of exposure. The finding that newcomers and long-time residence are not affected by neighborhood social capital is crucial for health interventions that are applied at the neighborhood level and that aim to improve health with neighborhood social capital. A further novel question was whether the effect of neighborhood social capital is stronger for people with high exposure. People with young children or the elderly were assumed to be at home often and thus to have

higher exposure. For people with young children in the household, an increased effect of social capital on health was found; there was no such finding for the elderly. Thus, chapter 4 of this dissertation showed that effects are stronger when the duration and intensity of exposure are higher.

6.2.3 And how?

Studies on neighborhood social capital have, until now, mostly focused on studying the existence of an association between social capital and health, but have rarely attempted to explain the relationship. In my own experience from presenting my work at conferences, the doubts of scholar concerning the contextual factor of neighborhood social capital were based on a lack of understanding of the relationship. In addition to a lack of a consensus of a definition of neighborhood social capital, the mechanisms are unclear.

To shed light on this weakness of neighborhood social capital research, three different mechanisms were presented in the introductory chapter. First, neighborhood social capital might increase health because of a 'Bio-psychological mechanism' (The more neighborhood social capital, the greater one's well-being is, the better one copes with stress, and the better one's health is). Second, a further mechanism could be the 'lobby mechanism' (The more neighborhood social capital, the better the access to health-related facilities and social services are and the better individual health is). Third, the 'Norm-and-control mechanism' is discussed in current literature (The more neighborhood social capital, the more informal social control there is, and thus, the better the health-related behavior and, ultimately, individual health are).

Because of data and time restrictions, only the third mechanism was tested. The study design was a mediation test, in the tradition of Baron and Kenny (1986). Norms and social control were not measured directly; however, behaviors of inhabitants (outcomes of norms) were studied. Behaviors were assumed to moderate the effect of neighborhood social capital on health.

The positive association between neighborhood social capital and physical activity (for example, using a bike or gardening) and non-smoking, which is less often studied in current literature, was replicated. Unlike in previous studies, these factors were used as mediators. All things being equal, an adult person is more likely to have 30 minutes of physical activity at least five days per week when he or she is living in a nice neighborhood with friendly people who know each other well compared with an inhabitant of a low social capital neighborhood. Moreover, non-smoking was positively associated with neighborhood social capital. Physical activity as well as non-smoking are beneficial for self-rated health. Physical activity significantly reduced the direct effect of neighborhood social capital on health. It seems that cohesive neighborhoods share health-related norms related to physical activity, and this explains the direct effect of neighborhood social capital on health.

6.3 Limitations and suggestions for future research

In this section, the limitations of this dissertation are briefly discussed. On the basis of these limitations and the contributions of this dissertation, I present several ideas for future research on neighborhood social capital and self-rated health, ordered by methodological and theoretical improvements. I close the section with a brief discussion of how the creation of neighborhood social capital can be stimulated.

6.3.1 Methodological improvements

How to delineate neighborhood units?

Most studies cited in this dissertation used conventional administrative units, such as 4-digit postcodes, to measure neighborhoods. Administrative units are used by municipalities and statistics offices. Statistics Netherlands, CBS, offers several control variables at the 4-digit postcode level. The research questions of this dissertation required stable and rich neighborhood units, rich with control variables.

However, using administrative units has some drawbacks. Inhabitants would not think in terms of 4-digit postcode areas when they think of their neighborhood. It is also possible to let inhabitants draw their neighborhood on a map or keep the definition unspoken. Scholars who used only individual neighborhood definitions were not able to perform multilevel analyses because the way in which individuals cluster into neighborhoods was unclear.

Future research on the use of health-related facilities in neighborhoods might be interested in analyzing what parts of the neighborhood people actually go to. This is in line with Coleman's broad definition of social capital: "Social capital is defined by its function" (Coleman 1990, page 302). The underlying idea is that people define their neighborhood according to the facilities, such as shops or parks, that they use. Studies monitoring people's daily activities with GPS tracking, for example, to study the amount of physical activity[32] are also interesting with respect to social capital.

An alternative way to define neighborhoods is to combine the presence of social ties and the physical distance between residents. Hipp and colleagues (2011) posit a new way to create neighborhoods through combining geographic data and survey questions by using a geographic information system (GIS). People were asked with whom they had contact and how far away those contacts lived. The underlying idea is that people define their neighborhoods in terms of the social contacts that they have. A limitation of this approach is that it requires information on many social ties between residents within a community. Moreover, the neighborhoods studied by Hipp et al. are not suitable for measuring contextual social capital because they are based on specific relations such as individual-level social capital and not on community feelings.

Other than the few examples for neighborhood units presented here, there might be more alternative and new neighborhood unit measurements. However, I think future research will be able to answer most new research questions in

32 See, for example, the Amsterdam study "Park or Flowerbed" (Maas 2011).

neighborhood health research by continuing to use administrative units. Beyond practical reasons (e.g., easy access to data, match with statistical control variables, and multilevel design), administrative units have also another advantage: it is possible that a neighborhood space with a low level of cohesion exists. The neighborhood units of Hipp and colleagues are based on individual contacts and therefore cannot exist without relations. Administrative units have additional advantages over non-administrative neighborhood units. Changes over time can be studied. The effect of long-term exposure to social capital on health is easier to study if the context is stable than if it is fragile. In conclusion, an improvement on measuring neighborhood units would be to simply keep using the administrative units. I believe further research will be able to answer most questions in health research related to neighborhoods with administrative neighborhood units.

In addition, future research might be further improved when smaller administrative units are used, as done in this dissertation. The effect of neighborhood social capital on individual health is probably underestimated because researchers have used neighborhood unit measurements that are too large. Neighborhoods were measured with 4-digit postcodes. On average, 4000 people live in these small areas. Smaller units such as CBS neighborhoods[33] might be more homogeneous.[34] Unfortunately, information at this level was not available for this dissertation. Future research that does take CBS neighborhoods into account will probably find stronger effects of neighborhood social capital because the smaller units are more homogeneous. However, it is interesting that even when using an imperfect measurement, such as 4-digit postcodes, to determine the impact of neighborhood social capital, neighborhood social capital still had clear effects on health.

How to measure neighborhood social capital?

Some scholars might criticize the measurement of social capital that was used in this study. The definition of contextual social capital in general is vague, and thus, there are diverse ways to measure social capital. If social capital is defined by Putnam, other features should be taken into account as well. In particular, some social capital researchers might criticize this study for not taking into account the level of organizational participation. In this dissertation a measurement of social capital was chosen with a focus on social cohesiveness of the neighborhood. In addition to these measurements, which should also be used in future research, one might also ask, 'Are your neighbors active in neighborhood organizations?' However, researchers should be not ask, 'Are you a member of an organization?' because this would not be a neighborhood-related measure. Based on this dissertation, further research should use measurements related to the small-area argumentation of neighborhood

33 CBS neighborhoods are small area units that are almost equal to 5-digital postcodes. CBS used municipality and land register (in Dutch: kadaster) information to generate these neighborhoods. CBS neighborhoods are 8-digital numbers and called in Dutch 'buurten' (not 'wijken', a sum of a few 'buurten' is called 'wijken' (CBS 2010).

34 "When defining the boundaries of neighborhoods, nearly all definitions create boundaries that maximize homogeneity of the residents within a neighborhood, and maximize the degree of heterogeneity across neighborhoods."(Hipp, Faris, and Boessen 2011, page 2)

social capital theory and measurements that are related to the neighborhood in which inhabitants live.

Different effects of social capital on health?

It is possible that effects of social capital on health differ between neighborhoods. To inquire into this, one can allow random slopes in the multilevel regression models. It is a limitation of this dissertation that random slopes were not included in the multilevel regression models, and consequently, we do not know whether the effect of social capital on health is the same in all neighborhoods. However, this dissertation focused on testing hypotheses concerning average neighborhood effects; therefore, the inclusion of random slopes was not straightforward. To get a better understanding of the mechanisms through which social capital becomes effective, the inclusion of random slopes might be an appropriate next step.

How do conditions relate to each other?

Another limitation of this dissertation is that there were no tests for interaction among the conditions for health we have controlled for. For example, effects of the length of exposure to social capital on health might differ for inhabitants in rural or urban neighborhoods, or for people with children. In addition to these new research ideas, the findings for the conditions presented in this dissertation need to be replicated in further studies because they are among the first in this field.

Are there more important contexts?

Future research on contextual social capital must incorporate more than only one context of the environment. Kwan (2009) is correct when criticizing an underlying assumption of most neighborhood studies, that the neighborhood is the only and most relevant context. People are exposed to more than one context (Coleman 1988, page S109), and the neighborhood might not play the most important role. If exposure to the neighborhood context were to be combined with, for instance, exposure to the work context, health differences could perhaps be explained more substantially. Kwan also criticizes the assumption that all residents are simultaneously and equally exposed. The empirical chapter 4 of this dissertation did indicate that people are differently exposed. Future research should analyze time-use data or, as Kwan[35] (2009) claims, real-time tracking technologies, such as GPS, to find out when, where, and what a person was exposed to.

35 Kwan (2009) expounds on the problems of "erroneously ascribing attributes of an aggregate unit (the neighborhood of residents) to individuals." (page 1312). To face this ecological fallacy problem, Kwan suggests that "context need to be operationalized through individualized measures that allow exposure level to vary even for individuals within the same neighborhood or place" (Kwan 2009, page 1312).

Is there a causal association?

In neighborhood social capital research, the 'time' component has to date been insufficiently studied. Research, based on cross-sectional data such as those utilized in this dissertation, has not been able to study people's health from a life-course perspective. One can only be sure of the direction of the association of neighborhood social capital and health when health has changed over time. Therefore, future studies should use long-term data to study health changes *caused* by neighborhood social capital.

In addition to health, neighborhood social capital can also change over time. The change in the level of neighborhood social capital during a period of 3 years, a side effect presented in chapters 4 and 5, proved to be a predictor of health. An increase in neighborhood social capital was beneficial for health. Chapter 4 showed that the length of exposure matters. A limitation of this dissertation is that information concerning the current neighborhood but not the neighborhoods respondents formerly lived in was taken into account. Childhood experiences (with neighborhood social capital) in particular might have affected childhood health-related behavior (Berkman 2009). What a child learned at a young age is very likely to affect his or her adult behavior and health (Telama 2009). If it would be possible to measure the exposure of a life-long effect of neighborhood social capital on health, effects would likely be stronger. Thus, it is likely that in future research, improved measurements of individuals' exposure to neighborhood social capital will reveal stronger effects than those demonstrated in this dissertation. It is especially interesting that it was possible to detect neighborhood social capital as a factor that influences health while only using cross-sectional data sets.

Other outcomes of neighborhood social capital?

A limitation of this study is the use of only one subjective health measure. Future research needs to investigate different health measurements, such as mortality, mental health, or specific diseases and health risk factors. In addition to subjective health measurement, objective health measurement should be used because of it is a more valid measure of health.

Neighborhood social capital might have consequences for outcomes other than health at the individual level. Neighborhoods do not only differ in regard to health but might also differ in regard to wealth. After having shown that neighborhood social capital affects health, other domains, such as education or economic success, should be investigated to determine the range of impact of the effects of neighborhood social capital.

6.3.2 Theoretical improvements

How many free-riders?

This dissertation showed that neighborhood social capital is a public good. A public good is accessible to inhabitants of the neighborhood. This unrestricted access allows inhabitants who do not invest in the neighborhood community (free riders)

to benefit from neighborhood's social capital. It is unclear how many free riders a neighborhood can 'carry'. It is also unknown how many active neighborhood inhabitants are needed to create a cohesive neighborhood. Future research might also take social norms into account when exploring the 'free-rider problem.' Social norms might sustain the interest of the community (Putnam, 2000, page 349), which might in turn decrease the number of free-riders.

What are the conditions for compensation and accumulation?

A further limitation of this dissertation is that not all possibilities of compensation were tested. Specifically, studying compensation for the lack of another form of capital through neighborhood social capital would have been of interesting. Future research might study other groups with low health prospects and whether neighborhood social capital might compensate this disadvantage. For example, whereas neighborhood social capital does not matter for people, on average, in rural neighborhoods, it might be of importance for poor people living in rural neighborhoods. These people might compensate for their low health prospects caused by a lack of economic capital through neighborhood social capital. For public health in particular, it would be relevant that people can compensate for a lack of individual-level economic capital with highly cohesive neighborhoods.

A further limitation is that the test of accumulation effects was only limited to micro and macro social capital accumulation. However, other factors, known for their beneficial effects on health, might accumulate with neighborhood social capital. For example, on the individual level, psychological motivation for health-related behavior, higher education, or income might increase the effects of neighborhood social capital on health. Moreover, future research should also invest in studying accumulation processes between neighborhood social capital and building environments or health-related facilities. For example, a green park might be used more frequently for exercise if social capital is high in the park's surrounding area. Additionally, researchers could study whether governmental (health) campaigns are more beneficial in neighborhoods with a high level of social capital than in unconnected neighborhoods.

What are the mechanisms of the association of neighborhood social capital and health?

One mechanism of the association between neighborhood social capital and health discussed above is the norms that affect behavior. Chapter 5 of this dissertation studied this mechanism while only focusing on behavior. Future research might investigate the actual neighborhood norms to understand how social capital affects health. Physical activity was affected by neighborhood social capital. The association between neighborhood social capital and health is almost, though not completely, explained by this mediator. Mechanisms such as well-being and better access to facilities may play a role in differences in health between neighborhoods.

In addition to the mechanisms discussed in this dissertation and in recent literature, other mechanisms should be addressed in further research.

6.3.3 How can the creation of neighborhood social capital be stimulated?

After the link between neighborhood social capital and self-rated health is established, the practical implications of this finding must elaborated. While social capital at the micro level has already been established as a health-improving factor, macro-social capital and, in particular, neighborhood social capital and its stimulation are rather new in public health. Coleman suggested that "… most forms of social capital are created or destroyed as *by-products* of other activities." (Coleman 1988, page S118) Therefore, arranging a neighborhood soccer field, a street festival, a neighborhood BBQ, or a social meeting point is not always intended to link people and create social capital at the neighborhood level, but such activities could potentially have that effect. Chapter 5 of this dissertation concluded that neighborhood social capital affects the health of inhabitants through physical activity. Therefore, interventions focusing on the creation of new social relations and physical activity seem to be a very promising way to improve health.

This dissertation does not provide an overview of the evidence for the practical implications of neighborhood social capital because of its focus on studying underlying associations and mechanisms. This dissertation aimed to clarify conditions and mechanism of a health improving factor, with the goal that its results could be used by policymakers and neighborhood workers. These people often have to argue that neighborhood work matters. The difficult part is not only arguing that the context neighborhood matters but also that the people living in the neighborhoods and their interrelation matter.

To return to the beginning of this dissertation, it does matter where someone lives. Health differs between small areas such as neighborhoods. Despite modernization and globalization, the local environment still affects individuals' health in the 21st century. This dissertation showed that social capital is an independent condition on the contextual level that explains differences in health between neighborhoods. The effect of social capital on health is furthermore depending on one's exposure to social capital. Last but not least, this dissertation elucidated the association between neighborhood social capital and health because we now know that most of the positive association is moderated by physical activity.

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Samenvatting in het Nederlands

Buurtcontext en gezondheid: Hoe sociaal kapitaal in buurten individuele gezondheid beïnvloedt

De bevinding dat je woonbuurt invloed heeft op je gezondheid staat aan de basis van dit proefschrift. Maar hoe kan het nu dat Nederlandse buurten verschillen wat betreft gezondheidskansen, hoe zijn deze verschillen te verklaren? Tot op heden werd vaak naar individuele kenmerken gezocht om de kans om ziek te worden te verklaren. Zo hebben slimme, rijke en jonge mensen een minder grotere kans om ziek te zijn dan anderen. Dat de buurt waar iemand woont ook een rol speelt, is nog niet zo vaak onderzocht. Uit dit proefschrift blijkt inderdaad dat onafhankelijk van iemands opleidingsniveau, inkomen of leeftijd, de buurt een effect heeft op de gezondheid van haar bewoners. Dit effect staat los van het feit dat mensen met gezondheidsbevorderende of -nadelige kenmerken in bepaalde buurten clusteren (een zogenaamd 'compositie effect'). In het eerste hoofdstuk van dit proefschrift worden drie verklaringen gegeven voor gezondheidsverschillen tussen buurten: verschillen in de (1) sociaal-economische (2) esthetische en (3) de sociale condities van de buurt. De sociaal-economische en de esthetische verklaringen, die ervan uitgaan dat rijke en aantrekkelijke buurten de gezondheidskansen van mensen verhogen, zijn al eerder onderzocht. Het feit dat ook de sociale condities in een buurt gezondheidsverschillen zouden kunnen verklaren, is vooralsnog onderbelicht gebleven. Met de 'sociale condities' van een buurt wordt in dit proefschrift de mate van 'sociaal kapitaal in buurten' bedoeld, de hulpbronnen die ontstaan doordat buren in hun buurt aan elkaar gehecht zijn. Als buren aardig met elkaar omgaan, spreekt men van een cohesieve buurt. De samenhang tussen de mate van sociaal kapitaal in buurten en de gezondheid van de bewoners in deze buurten is het hoofdonderwerp van dit proefschrift. De onderzoeksvragen van dit proefschrift zijn: *Heeft het sociaal kapitaal van de buurt een effect op individuele gezondheid, en als dit het geval is, door welke condities wordt dit effect versterkt? Tot slot, hoe kan de samenhang tussen sociaal kapitaal op buurtniveau en gezondheid van het individu verklaard worden?*

In hoofdstuk 1 worden het begrip 'sociaal kapitaal in buurten' en de theoretische mechanismen geïntroduceerd. Daarnaast wordt een overzicht van de eerdere literatuur over dit onderwerp gegeven. Vervolgens worden de toetsbare hypothesen geformuleerd, samen met een uitleg over de datasets en de belangrijkste analysemethoden zoals gebruikt in dit proefschrift. Deze hypothesen worden vervolgens empirisch getoetst in hoofdstuk 2 tot en met 5. In hoofdstuk 6 zijn de bevindingen samengevat en wordt antwoord gegeven op de overkoepelende onderzoeksvragen. Net zoals andere proefschriften heeft ook dit proefschrift tekortkomingen en deze worden in hoofdstuk 6 besproken. Zowel de tekortkomingen als de bevindingen van dit proefschrift zijn gebruikt om nieuwe onderzoeksvragen te formuleren voor toekomstig onderzoek.

Vorig onderzoek en gebruikte data

In het eerste hoofdstuk zijn 17 wetenschappelijke artikelen gepresenteerd met een vergelijkbare onderzoeksvraag als die van dit proefschrift. In een aantal artikelen (maar niet allemaal) wordt een samenhang gevonden tussen sociaal kapitaal in buurten en individuele gezondheid; indien deze samenhang wordt gevonden, is er altijd sprake van een positief verband. In vergelijking met ander gezondheidsonderzoek is 17 artikelen een zeer gering aantal. De studies zijn daarnaast ook slecht te vergelijken: de definitie van 'een buurt' varieert en staat soms geheel los van de veronderstelde onderliggende mechanismen; de meting van sociaal kapitaal varieert sterk; en de studies onderzoeken verschillende populaties. Derhalve wordt in het eerste hoofdstuk van dit proefschrift de definitie van de buurt (de 4-cijferige postcode) en de meting van sociaal kapitaal duidelijk uitgelegd en in hoofdstuk 2 tot en met 5 consequent gebruikt. Dit proefschrift biedt ook een betere toets van de hypothesen dan eerdere studies, omdat datasets worden gebruikt die representatief zijn voor een geheel land (onder volwassenen). Sociaal kapitaal is betrouwbaar gemeten, omdat een relatief groot aantal buurtbewoners is ondervraagd: gemiddeld hebben circa 20 buurtbewoners per buurt in het Woningbehoefteonderzoek (WBO) (sinds 2006 WoningOnderzoek Nederland (WoON) genoemd) aangegeven hoe gezellig zij hun buurt ervaren. Net als in eerdere studies zijn in hoofdstuk 2 en 3 de metingen van sociaal kapitaal en de afhankelijke variabele over individuele gezondheid afkomstig uit dezelfde dataset. Een nadeel hiervan is dat een derde kenmerk wellicht zowel de individuele gezondheid als de inschatting van het sociaal kapitaal in buurten veroorzaakt, waardoor een samenhang tussen gezondheid en sociaal kapitaal een schijnverband is. Om die reden kwam de informatie over sociaal kapitaal en de gezondheidsvraag in de daarop volgende twee empirische hoofdstukken uit twee onafhankelijke datasets (in hoofdstuk 5 is bijvoorbeeld de 'Tweede nationale studie' gebruikt om gezondheid te meten).

Hangt het sociaal kapitaal in buurten samen met de gezondheid van bewoners?

Dit proefschrift laat inderdaad zien dat er een positieve samenhang bestaat tussen sociaal kapitaal in buurten en de gezondheid van bewoners. In hoofdstuk 2 blijkt dat deze positieve samenhang onafhankelijk is van de invloed van buurt- of persoonskenmerken. Dat wil zeggen, een cohesieve buurt verhoogt de kans op gezondheid van de buurtbewoners, onafhankelijk van andere buurtkenmerken zoals het gemiddelde inkomen. Ook wanneer rekening wordt gehouden met de persoonskenmerken (de buurtcompositie), zoals individueel inkomen en opleidingsniveau, blijft de positieve samenhang tussen sociaal kapitaal in buurten en individuele gezondheid overeind.

Dat sociaal kapitaal op buurtniveau een context effect is, en dat het samenhangt met individuele gezondheid, komt niet alleen naar voren in hoofdstuk 2 van dit proefschrift, maar ook in alle andere hoofdstukken. Hierbij moet wel gezegd worden dat er geen longitudinale data zijn gebruikt; de gezondheid van mensen is niet gevolgd op meerdere tijdspunten. Daarom kan men niet met zekerheid spreken van een causaal verband. Wel is door dit proefschrift 'reversed causality' uit te sluiten. Een omgedraaide causaliteit (reversed causality) zou betekenen dat het verband tussen sociaal kapitaal en individuele gezondheid wordt gevonden, omdat de

gezondheid van individuele buurtbewoners een effect heeft op het sociaal kapitaal in de buurt. Van dergelijke omgedraaide causaliteit is echter geen sprake, omdat in hoofdstukken 4 en 5 sociaal kapitaal enkele jaren eerder is gemeten dan de individuele gezondheid. Daarnaast blijkt dat een verbetering van sociaal kapitaal over de tijd een positieve invloed heeft op gezondheid.

In hoofdstuk 3 wordt getest of het gaat om de *buurt* als geheel of alleen om bepaalde *buren*. Dit proefschrift is een van de eerste die sociaal kapitaal zowel op buurtniveau als op individueel niveau in één model heeft getoetst. Er wordt tegelijkertijd gekeken naar individueel sociaal kapitaal in de buurt (het contact met directe of andere buurtbewoners), individueel sociaal kapitaal buiten de buurt (het contact met mensen die grotendeels buiten de buurt wonen, zoals vrienden en familieleden die niet in hetzelfde huishouden wonen), en sociaal kapitaal op buurtniveau. Naast een invloed van individueel sociaal kapitaal (het contact met buren of mensen buiten de buurt) blijkt het sociaal kapitaal op buurtniveau ook een invloed op gezondheid te hebben. Kortom, sociaal kapitaal in buurten verhoogt gezondheidskansen van buurtbewoners, onafhankelijk van individueel sociaal kapitaal.

Onder welke condities wordt het effect van sociaal kapitaal in buurten versterkt?

Deze dissertatie is één van de eerste studies naar de omstandigheden die de invloed van sociaal kapitaal op gezondheid versterken. Bijvoorbeeld, voor sommige groepen mensen zou het effect van sociaal kapitaal op individuele gezondheid misschien sterker kunnen zijn dan voor andere groepen mensen. In hoofdstuk 2 zijn daarom bepaalde groepen mensen apart geanalyseerd, en in hoofdstuk 3 en 4 zijn kruisniveau interacties onderzocht (dat wil zeggen, interacties tussen buurt variabelen en individuele variabelen).

In hoofdstuk 2 is onderzocht of de invloed van sociaal kapitaal in buurten op individuele gezondheid afhangt van de stedelijkheid van de gemeente. Voor de gemiddelde plattelandsbewoner heeft het sociaal kapitaal van de buurt geen invloed op zijn eigen gezondheid. Dat komt misschien omdat plattelandsbewoners gemiddeld genomen heel gezond zijn. Misschien is de 4-cijferige postcode ook minder geschikt voor buurtonderzoek in niet-stedelijk gebieden.

Zoals gezegd draagt dit proefschrift bij aan de huidige literatuur door het toetsen van interacties tussen micro en macro sociaal kapitaal. Zo profiteert men misschien alleen van sociaal kapitaal in buurten als men een aardige directe buur heeft, door wie men in contact komt met de buurt. Een dergelijke hypothese baseert zich op het idee dat sociaal kapitaal een 'goed' is waartoe men toegang moet verkrijgen. Hoofdstuk 3 bevestigt deze hypothese echter niet. Integendeel, sociaal kapitaal in buurten blijkt juist een 'openbaar goed' te zijn, waar iedereen vrije toegang tot heeft – onafhankelijk van eigen 'investeringen' in de buurt. Wel wordt gevonden dat sociaal kapitaal in buurten het gebrek aan contact met vrienden kan compenseren. Iemand met weinig vrienden en contact met familieleden heeft lagere gezondheidskansen dan iemand die meer contact met deze mensen heeft. Hoofdstuk 3 laat zien dat eenzame mensen enigszins betere gezondheidskansen hebben als zij in een gezellige buurt wonen.

Dit proefschrift toont aan dat het uitmaakt hoe lang iemand wordt blootgesteld aan sociaal kapitaal in buurten. Tot nu toe is men ervan uitgegaan dat het niet

uitmaakt voor de gezondheid of iemand één of twintig jaar in aanraking komt met het sociaal kapitaal van de buurt. Hoofdstuk 4 heeft echter laten zien dat men niet van een onmiddellijk meetbaar effect van sociaal kapitaal kan uitgaan. Een nieuwe buurtbewoner moet een paar jaar in de buurt wonen voordat een effect op zijn gezondheid meetbaar is. Het positieve effect van een gezellige buurt op gezondheid verdwijnt echter weer naarmate men langer in de buurt blijft wonen.

Het aantal jaren dat iemand in een buurt woont, is nog geen indicatie van de tijd die men in de buurt doorbrengt. Sommige mensen brengen namelijk het grootste gedeelte van hun dag door op school of op het werk, en niet in hun woonbuurt. Vanwege hun leefstijl is er vanuit gegaan dat mensen met jonge kinderen en mensen ouder dan 65 veel tijd in hun buurt doorbrengen en daarom ook veel blootgesteld worden aan het sociaal kapitaal van de buurt. Dit proefschrift wijst uit dat mensen met jonge kinderen sterker van een cohesieve buurt profiteren dan mensen zonder jonge kinderen. Oudere mensen blijken niet in sterkere mate door sociaal kapitaal beïnvloed te worden dan jongere mensen. Samengevat blijkt sociaal kapitaal een sterker effect te hebben op de gezondheid bij een langere woonduur en waarschijnlijk ook bij meer aanwezigheid overdag in de buurt.

Hoe kan de samenhang tussen sociaal kapitaal op buurtniveau en individuele gezondheid verklaard worden?

Eerder onderzoek heeft vooral geprobeerd een samenhang tussen sociaal kapitaal in buurten en individuele gezondheid empirisch vast te stellen. Mogelijke verklaringen zijn alleen bediscussieerd maar bijna nooit echt getoetst. In dit proefschrift ligt de focus op 'gedrag' als mogelijke verklaring voor het verband tussen sociaal kapitaal in buurten en individuele gezondheid. Van bepaald gedrag, zoals niet roken, matig alcohol consumeren, genoeg slapen, een gezond eetpatroon en voldoende lichamelijke beweging, is natuurlijk al bekend dat het leidt tot betere gezondheid. Daarom is getoetst in hoeverre deze gedragingen een mediator zijn voor het verband tussen sociaal kapitaal in buurten en individuele gezondheid. Beïnvloedt een gezellige buurt bijvoorbeeld lichamelijke beweging, en daarmee individuele gezondheid? Uit dit proefschrift blijkt empirisch dat cohesieve buurten de kans op roken verminderen en de kans op bewegen verhogen. Van deze twee significante mediatoren, blijkt lichamelijke beweging grotendeels de samenhang tussen sociaal kapitaal in buurten en gezondheid te verklaren. Dit proefschrift laat dus zien dat mensen die in cohesieve buurten wonen een grotere kans hebben om veel te bewegen wat weer een positieve invloed heeft op hun zelfgerapporteerde gezondheid.

Het boek sluit af met een discussie over methodologische en theoretische verbeterpunten. Omdat het hoofddoel van het proefschrift was om het verband tussen sociaal kapitaal in buurten en individuele gezondheid empirisch vast te stellen, zijn geen concrete praktijkgerichte aanbevelingen geformuleerd. Met dit proefschrift weten beleidsmedewerkers echter wel dat eventuele pogingen om buurtsaamhorigheid te verhogen ook van belang is voor de gezondheid van de buurtbewoners. Toekomstig onderzoek kan de bevindingen uit dit proefschrift gebruiken om praktijkgerichte interventies te ontwerpen met als doel het sociaal kapitaal in een buurt te stimuleren.

Deutschsprachige Zusammenfassung[1]

Nachbarschaftskontext und Gesundheit: Wie nachbarschftliches Sozialkapital individuel Gesundheit beeinflusst

Hat Nachbarschaftsgemeinschaft einen Einfluss auf individuelle Gesundheit? Dieser Fragestellung wird in der vorliegenden Dissertation nachgegangen. Unter Nachbarschaftsgemeinschaft versteht man nicht nur die direkte Nachbarschaft, zu der man Kontakt hat, sondern alle Bewohner in relativ unmittelbarer physischer Nähe. In Städten kann die Nachbarschaftsgemeinschaft ein Stadtteil sein, auf dem Land kann es ein ganzes Dorf umfassen. Auf Grund der Postleitzahlvergabe ist es in den Niederlanden möglich, auf kleinräumigem Niveau soziale Gemeinschaften zu erforschen. Die ersten vier Zahlen einer Postleitzahl definieren die Nachbarschaften. Mit Hilfe dieser Ziffern kann man aus vielen verschiedenen Register- und Fragebogenquellen Daten zusammentragen und analysieren.

In der soziologischen Nachbarschaftsforschung wird davon ausgegangen, dass innerhalb dieses kleinräumigen Nachbarschaftsbereichs eine gegenseitige Beeinflussung bewusster und unbewusster Art besteht. Das hat zur Folge, dass nicht nur die bebaute Umgebung oder der Wohlstand einer Nachbarschaft für einen Bewohner ausschlaggebend sind, sondern auch die sozialen Beziehungen zwischen Bewohnern, die in seiner Nachbarschaft bestehen oder nicht bestehen. Nachbarschaften können sich hinsichtlich ihres Gemeinschaftsgefühls unterscheiden. Während in manchen Nachbarschaften kaum ein Wort gewechselt wird, wird in anderen viel kommuniziert und es herrscht ein allgemein freundliches Sozialklima, was in der Medizinsoziologie als kohäsive Nachbarschaft bezeichnet wird. Diese Verbundenheit zwischen Nachbarn und das Gemeinschaftsgefühl werden in der Soziologie als ein Kapital angesehen, das ähnlich wertvoll ist wie finanzielles Kapital oder durch Lernen erworbenes Humankapital. Ein großer Unterschied besteht allerdings darin, dass sich Sozialkapital nicht im ‘Besitz eines Einzelnen’ befinden kann. Sozialkapitel steckt in den Beziehungen der Menschen und es lebt von und stirbt mit der Gemeinschaft. Die Auswirkungen von Sozialkapital und im Speziellen von nachbarschaftlichem Sozialkapital auf die individuelle Gesundheit ist bisher kaum erforscht. Nachfolgend wird eine knappe Zusammenfassung der wichtigsten Ergebnisse dieser Dissertation gegeben.

1 Für ihre hilfreichen Kommentare auf diese Zusammenfassung bin ich Anke Woll und Andrea Fischbach zu Dank verpflichtet.

Kapitel 2: Besteht ein Zusammenhang zwischen nachbarschaftlichem Sozialkapital und individueller Gesundheit?

Dieser Frage wird im zweiten Kapitel, wie auch weiterführend in den drei darauf folgenden Kapiteln dieses Buches, nachgegangen und der Zusammenhang eindeutig bestätigt: Es besteht eine positive Beziehung zwischen individueller Gesundheit und nachbarschaftlichem Sozialkapital. Positiv bedeutet, dass Bewohner einer Nachbarschaft mit viel Sozialkapital eine größere Chance haben, sich gesund zu fühlen, als Bewohner mit weniger Sozialkaptial in der Nachbarschaft. Um andere Erklärungsmechanismen auszuschließen, werden Kontrollvariablen (auf individuellem und nachbarschaftlichem Niveau) in die Analysen einbezogen.

Sekundärdaten zu rund 80% der niederländischen Nachbarschaften werden analysiert. In vergleichbaren Studien standen meist nur Daten mit einer begrenzten Anzahl und meist städtischen Nachbarschaften zur Verfügung. Besonders interessant ist es daher, dass in diesem Kapitel nicht nur städtische, sondern auch nichtstädtische Nachbarschaften untersucht werden und man erstmalig einen Unterschied feststellen kann. Nachbarschaftliches Sozialkapital scheint vor allem die städtische Bevölkerung anzusprechen. Die städtische Bevölkerung weist durchschnittlich eine schlechtere Gesundheit bei gleichzeitig durchschnittlich weniger Sozialkapital in der Nachbarschaft auf.

Kapitel 3: Sozialkapital und Gesundheit – ist es die Nachbarschaftsgemeinschaft oder sind es Beziehungen zu bestimmten Nachbarn?

Im dritten Kapitel wird erforscht, ob es wirklich die Nachbarschaftsgemeinschaft oder nur die direkten Nachbarn sind, die einen Einfluss auf die Gesundheit des Einzelnen haben. Der dahinterliegende Gedanke ist, dass, wenn man Bewohner 'ihre Nachbarschaft' einschätzen lässt, diese vielleicht nur die Nachbarn, die im gleichen Haus oder nebenan/gegenüber wohnen, miteinbeziehen. Das würde bedeuten, dass die Gemeinschaft nicht relevant ist, sondern das Sozialkapital des Einzelnen mit bestimmten einzelnen Nachbarn. In der Soziologie wird ein Unterschied gemacht zwischen dem Sozialkapital, das auf spezifischen Kontakten zu bestimmten Dritten basiert (= individuelles Sozialkapital) und Sozialkapital, das auf der Zugehörigkeit zu einer Gemeinschaft beruht, z.B. der Nachbarschaft (= nachbarschaftliches Sozialkapital). Nur selten wurde dieser Unterschied in einem gesundheitswissenschaftlichen Beitrag herausgearbeitet.

Kapitel 3 erforscht den Grad des Einflusses beider Sozialkapitale auf Gesundheit, sowie deren Wechselwirkung. Darüber hinaus wird ein Unterschied gemacht zwischen indivuellem Sozialkapital zu Nachbarn und zu Nicht-Nachbarn. Beide individuellen Sozialkapitalindikatoren sind positiv und unabhängig von der Nachbarschaft verbunden mit Gesundheit. Darüber hinaus kann nachbarschaftliches Sozialkapital von beiden individuellen Sozialkapitalindikatoren mit einem eigenständigen Effekt auf Gesundheit deutlich abgegrenzt werden. Kapitel 3 zeigt weiterhin, dass vereinsamte Menschen mit nur sehr wenig Kontakt zu Familie und Freunden ihre mäßigen Gesundheitschancen durch eine kohäsive Nachbarschaft verbessern können. Die negative Interaktion zwischen individuellem und nachbarschaftlichem Sozialkapital zeigt darüber hinaus, dass man keinen 'redseligen'

Nachbarn benötigt, um vom nachbarschaftlichen Sozialkapital profitieren zu können. Nachbarschaftliches Sozialkapital ist ein 'öffentliches Gut', das allen Bewohner (auch den isolierten) gleichermaßen zur Verfügung steht.

Kapitel 4: Muss man in der Nachbarschaft anwesend sein, um in den 'Genuss' von nachbarschaftlichem Sozialkapital zu kommen?

In der bisherigen Nachbarschaftsforschung zu Sozialkapital hat man sich mit dem Faktor Zeit nur unzureichend auseinandergesetzt. In der Epidemiologie hingegen ist grundsätzlich die Frage relevant, wie lange man einem Umweltfaktor ausgesetzt ist. Die Epidemiologie hat wiederum die sozialen Aspekte der Umwelt selten in den Fokus der Forschung gestellt. Das vierte Kapitel geht der Frage nach: Wie lange sind Bewohner dem Sozialkapital ihrer Nachbarschaft ausgesetzt und sieht man mit einer steigenden Anzahl an Jahren einen stärkeren Effekt auf die Gesundheit? Im vierten Kapitel wird gezeigt, dass man nicht von einem unmittelbaren Effekt ausgehen kann. Nachbarschaftliches Sozialkapital braucht seine Zeit: ungefähr fünf bis sechs Jahre. Bei sehr langer Wohndauer in der gleichen Nachbarschaft verliert es seine Wirkung jedoch wieder.

Im vierten Kapitel wird neben der Wohndauer in Jahren auch die Zeit, die jemand in seiner Nachbarschaft tatsächlich verbracht hat, berücksichtigt. Ein Großteil der Bevölkerung verlässt tagsüber seine Nachbarschaft, um schulischen und beruflichen Verpflichtungen nachzukommen. Es kann davon ausgegangen werden, dass junge Eltern oder Rentner auf Grund ihres Lebensstils viel Zeit in der Nachbarschaft verbringen und sie deshalb einer langen Zeit ihrem nachbarschaftlichen Sozialkapital 'ausgesetzt' sind. Das vierte Kapitel zeigt, dass Menschen mit jüngeren Kindern im Haushalt in einem höheren Maße von einer kohäsiven Nachbarschaft profitieren als Menschen mit älteren oder keinen Kindern im Haushalt. Menschen, älter als 65 Jahre, zeigen keinen signifikanten Unterschied in dieser Art. Zusammenfassend kann festgestellt werden, nachbarschaftliches Sozialkapital hat einen größeren Effekt bei mittellanger Wohndauer, wobei höchstwahrscheinlich die Länge der Anwesenheit in der Nachbarschaft im Tagesverlauf mitentscheidend ist.

Kapitel 5: Erklärt gesundheitsrelevantes Verhalten den Zusammenhang zwischen nachbarschaftlichem Sozialkapital und individueller Gesundheit?

Die ersten vier Kapitel dieser Dissertation konzentrieren sich auf die Frage, ob ein Zusammenhang besteht und unter welchen Bedingungen dieser Effekt besonders hervortritt. Die Frage, wie man den Zusammenhang erklären kann, wird im letzten empirischen Kapitel erforscht. In der bestehenden Fachliteratur wurden mögliche Erklärungsmechanismen bisher nur diskutiert, aber kaum getestet. Das fünfte Kapitel untersucht, ob nachbarschaftliches Sozialkapital einen Einfluss auf das Verhalten von Bewohnern hat und ob dieses Verhalten wiederum deren Gesundheit beeinflusst. Es wurden Verhaltensarten ausgewählt, von denen bereits bekannt ist, dass sie gesundheitsförderlich sind. Diese wären: Tabakabstinenz, gemäßigter Alkoholkonsum, ausreichend Schlaf, regelmäßige Essgewohnheiten sowie ausreichend körperliche Bewegung. In einem sogenannten Mediatormodell

wird getestet, ob der in dieser Dissertation erforschte Zusammenhang durch gesundheitsrelevantes Verhalten erklärt werden kann. Es stellt sich heraus, dass kohäsive Nachbarschaften Tabakabstinenz und ausreichende körperliche Bewegung stimulieren. Als einziger signifikanter Mediator wurde körperliche Bewegung identifiziert. Unter körperlicher Bewegung versteht man Rad fahren, spazieren, Gartenarbeiten, sich sportlich betätigen oder kleine Gelegenheitsarbeiten verrichten, die körperliche Betätigung erfordern. All diese Tätigkeiten sind wahrscheinlicher in Nachbarschaften mit gutem Gemeinschaftsgefühl.

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About the author

Sigrid M. Mohnen was born in Bitburg, Germany, on August 1st, 1981. In 2001, she completed her secondary education at the vocational grammar school of health and welfare in Trier, Germany. She studied sociology at Ruprecht-Karls University, Heidelberg, Germany. She obtained a Diploma degree (equivalent to a Master's degree) in sociology, with focus on medicine, policy, and law, in 2007. During her studies in Heidelberg, she worked as student assistant at the Research and Epidemiology section of the Orthopaedic University Hospital and at the German Cancer Research Center (Unit Cancer Prevention/ WHO Collaboration Centre Tobacco Control).

This book is the result of her Ph.D. research conducted at the Interuniversity Center for Social Science Theory and Methodology (ICS) at Utrecht University in the Netherlands. In 2010 she carried out a two-month research traineeship at the Harvard School of Public Health, Department of Society, Human Development and Health, Boston, M.A., U.S.A. Since September 2011 Sigrid is working at the National Institute for Public Health and the Environment (RIVM) in Bilthoven, the Netherlands. Her current research activities focus on the effects of the bundled payment system on the macro costs of health care for the chronically ill in the Netherlands.

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