Green space and changes in self-rated health among people with chronic illness

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ABSTRACT
This prospective study analyses change in self-rated health of chronically ill people in relation to green space in their living environment at baseline. Data on 1112 people in the Netherlands with one or more medically diagnosed chronic disease(s) were used. The percentage of green space was calculated for postal code area. Multilevel linear regression analysis was conducted. We found no relationship between green space and change in health; however, an unexpected relationship between social capital at baseline and health change was discovered.

INTRODUCTION
Green environments have been linked to several health outcomes.[1–4] The aim of this research is to inquire into the extent to which change in self-rated health of people with chronic illness is related to the amount of green space in their living environment, controlling for other relevant personal and environmental characteristics.
It seeks to contribute to the gap in green space studies where the passage of time is overlooked. We hypothesize that the more green space in the living environment of people with chronic illness, the less deterioration in self-rated health reported over the course of a maximum of 4 years.
We also expected moderator effects of actual use of green space, perceived social capital, disability and age. The rationale behind these moderator effects are the following: actual use indicates active exposure, perceived social capital indicates the social quality of the neighbourhood and age might be related to a smaller action space due to more disabilities at greater age.

METHODS

Health data derive from a Dutch prospective panel study—National Panel of people with Chronic illness or Disability (NPCD).[5] NPCD participants are ≥15 years with a medically diagnosed somatic chronic disease [diagnosed on average 9.7 years (SD = 9.2) before inclusion], who have evaluated several aspects of their health and lifestyle annually. They are a representative sample of the Dutch population of adult non-institutionalized people with a somatic chronic illness.

Respondents selected for the current study were included in 2005 (baseline) and have responded to the survey annually for anywhere from 1 to 3 years after baseline (average follow-up time 2,5 years). Outcome variable is self-rated health, assessed by the 5-item General Health Perception scale of the RAND-36, ranging from 0 (poor) to 100 (excellent health) (Cronbach's α = .823).[6] Individual-level predictors were age, gender, educational attainment, income and disability. Respondents were asked if they used green space, dichotomized into users and non-users. They also evaluated their living environment in 10 questions on social capital with items such as 'I feel connected to this neighbourhood' and 'The people in this neighbourhood know each other well,' combined into a scale score (Cronbach's α = .949) and used at individual level. All independent variables were measured at baseline. Variables at postal code level were percentage of green space, derived from land use data available through the National Land Cover Classification database 2003/2004 and urbanity (number of addresses per square kilometre), retrieved from Statistics Netherlands for 2004.

The Netherlands is divided into 4000 four-digit postal code areas, representing on average 1722 households. In urban regions, these areas correspond with urban neighbourhoods; in rural regions, they may encompass complete settlements. In this study, 1112 respondents (Level 1) lived in 266 different postal code areas (Level 2) with an average of 4.2 respondents.

Multilevel linear regression was used to assess the association between green space and change in self-rated health, controlling for other correlates of health (MLwiN). Baseline health in 2005 and the number of years that each respondent participated (2–4 years) were included as control variables to reflect the longitudinal nature of the data. Self-rated health in the final year of participation was the dependent variable. Level of education was ordinal. Percentage of green space and income were originally continuous and recoded into ordinal variables to redress the skewness of the distributions. Urbanity is based on a continuous variable but provided as ordinal by Statistics Netherlands. They were entered as continuous variables, as linear regression is rather robust to measurement level.

Green space in the living environment was included as independent variable in Model 1 (table 1). Moderator effects were explored through cross-level interactions. Four interactions (modelled as the product of the variables) with percentage of green space were tested: green space use, social capital, presence of a disability and age, in separate models (Models 2–5; table 1).

[TABLE 1]

RESULTS

Supplementary Additional File 1 presents descriptive statistics. Self-rated health at baseline and at final measurement are nearly the same on average, with 57% of

respondents showing an improvement or deterioration of >7 points (more than half the standard deviation).

Baseline self-rated health is a strong predictor of perceived health in the final year. Variance at postal code area was small (3.52; SE = 2.92) compared with patient level (206.3; SE = 8.36). Among people with a chronic illness, older and disabled people experience significantly greater deterioration in self-rated health. People with a higher income report significantly less deterioration. The effect of green space on the change in self-rated health was small and not significant, thus rejecting the hypothesis (Model 1).

The additional models in table 1 show that none of the cross-level interactions with green space were significant. Although this was not the focus of our research, it is noteworthy that the main effect of social capital in Model 5 is significant.

DISCUSSION

Our results suggest that green space in the living environment is not associated with self-rated health change in this study population. An examination of interaction terms for moderating effects revealed that use of green space, presence of a disability, age or individual social capital did not moderate the effect of green space on health. The main effect of social capital on health, however, was striking: perceived social capital is positively and significantly associated with an improvement in self-rated health of chronically ill people over time. This aligns with the literature on neighbourhood social capital and health.[7–9]

This is the first study to investigate the effects of green space in the residential environment for people with a somatic chronic illness. Furthermore, although most research explores the association of green space with health cross-sectionally, the present study is one of the few prospective studies.[4] The effects of green space on self-rated health of people with a chronic disease, as part of quality of life, might be both generic and specific. Physical activity (as a mechanism relating green space to health) is part of self-management of chronic diseases, such as diabetes type 2. It may postpone the start of insulin injections, which prevents side effects of therapy and adds to quality of life. However, because of data limitations, we were not able to assess specific effects for specific chronic conditions. Our study is on the benefits of green space in the residential environment as opposed to nature used in therapeutic settings. In the latter, the kind of contact with nature is crucial but less important when considering green space in the residential environment.

The absence of significant effects of green space in this study might be attributed to the use of four-digit postal code areas as spatial units. It is possible that they are too large and heterogeneous to assess the effect of green space in the living environment on health. In previous cross-sectional studies among the total Dutch population, we used smaller spatial units.[1,2,10] Especially outside urban areas, this may be more accurate. However, we also did not find a main nor interaction effect of use of green space.

In general, in previous studies with larger numbers, the relationship between green space and health was significant but not strong. The sample size in our study was much smaller, making it difficult to find a relationship. Finally, differences between the population in general and our study population of people with a chronic illness might explain our findings. However, if anything, we would expect a stronger relationship in our study rather than a weaker. The reason is that on average people

with a chronic illness and associated disabilities will be more exposed to their direct living environment, compared with the general population.

Supplementary data

Supplementary data are available at *EURPUB* online.

Conflicts of interest:

None declared.

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TABLES

Table 1 Multilevel linear regression analysis of green space on perceived health at final measurement ($n = 1112$)

	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	26.77 (4.518)				
Baseline health 2005 (T_0)	0.74 (0.023)*				
Years participated	−0.56 (0.541)				
Gender (1 = female)	−0.91 (0.877)				
Age	−0.10 (0.031)*				
Income	0.88 (0.367)*				
Education	−0.18 (0.285)				
Disability (1 = yes)	−4.15 (1.010)*				
Urbanity	−0.50 (0.488)				
Green space	−0.02 (0.022)				
Model 1 + green space*age		−0.001 (0.001)			
Model 1 + green space*disabilities			−0.002 (0.02)		
Model 1 + green space use				−0.23 (3.047)	
Green space*green space use				−0.03 (0.049)	
Model 1 + social capital					0.25 (0.097)*
Green space*social capital					−0.00 (0.002)

*$P < 0.01$ Models 2–5 are separate for each interaction and contain the same variables as Model 1; coefficients only slightly vary.