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Perception of safety is a prerequisite for the association between neighbourhood green qualities and physical activity: Results from a cross-sectional study in Sweden

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ABSTRACT

In this study, we assess how the Scania Green Score (SGS5), and the five distinct perceived neighbourhood green dimensions within this area-aggregated index (1 km^2 squares), is associated with self-reported physical activity and general health, and if perceived safety and social coherence has a moderating effect. Two independent surveys, both conducted in Scania, Sweden, was used for data on SGS5 and health outcomes (N=28 198 and N=23 693), respectively. SGS5 was more clearly associated with physical activity (OR 1.06; 95% CI 1.02–1.10) than with general health (OR 1.02; 95% CI 1.00–1.04). This association was moderated by safety (p for interaction < 0.001); SGS5 was positively associated with physical activity only among individuals who perceived high safety in their neighbourhood (OR 1.07; 95% CI 1.02–1.11). No moderating effect was seen for social coherence. Among specific dimensions, cultural history was positively associated with both physical activity and general health. Our results suggest that perception of safety is a prerequisite for the positive effects of neighbourhood green qualities.

1. Introduction

There is growing evidence that high quality green spaces in residential environments is of importance for promoting public health, with diverse impact across population groups and individual living conditions (Astell-Burt et al., 2014; de Jong et al., 2012; Hartig et al., 2014; Mitchell and Popham, 2008; Author et al., 2015). Evidence suggest that perceptions of the neighbourhood, e.g. as being green, walkable or noisy, are important for health, also after controlling for objective measures of identical or similar features (Gebel et al., 2011; Prins et al., 2009) and quality of greenness has been indicated to be more important for health than quantity (Francis et al., 2012; van Dillen et al., 2012). Whether the neighbourhood is perceived as safe and socially coherent may be of crucial importance for the positive effects of the use of these green spaces. Number of parks was positively associated with objectively measured physical activity in a recent worldwide study (Sallis et al., 2016) and it has been shown that people tend to be less physically active if the safety of the residential area is perceived as uncertain (Evenson et al., 2012; Foster et al., 2016). In addition, differences in self-rated general health may be related to perception of safety and cohesion (Baum et al., 2009) and the social-environmental quality of the neighbourhood (Stronegger et al., 2010). A positive impact of neighbourhood social cohesion on health has been indicated (Rios et al., 2012) and social support has been suggested as a possible factor relevant for the associations between green space, physical activity and general health (de Vries et al., 2013; Maas et al., 2009; Van Dyck et al., 2013).

Previous studies on green space have often used designs where self-assessments from the same individual are used for data on both exposure and outcome, which introduce a risk for single source bias (de Jong et al., 2011; Author et al., 2015). One way to control for such bias is by using neighbourhood assessments of the environment based on an independent sample from the same study area (Auchincloss et al., 2009; de Jong et al., 2011). Therefore, in this study, we used data

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from two different cross-sectional public health surveys, both conducted in the same geographical area in southern Sweden in year 2008 and 2012. The survey from 2008 provided data on perceived neighbourhood green qualities in 1 km^2 squares, whereas self-reported data on physical activity, general health, neighbourhood safety, social coherence and additional covariates were taken from the 2012 survey. The aim of this study was to assess the association between access to green qualities in close proximity to the residence and a) physical activity and b) general health, and to further assess to which extent this is moderated by the individual perception of safety in the neighbourhood, and, as an additional aim, by the individual perception of social coherence in the neighbourhood. For social coherence, we also investigated its potential mediation on general health. We hypothesized that higher levels of green qualities were associated with more physical activity and a better general health and that these associations were moderated by the individual perception of the neighbourhood as being safe and socially coherent.

2. Method

2.1. Survey participants

This study is using outcome data, i.e. self-reported information on physical activity and general health, from a cross-sectional public health survey conducted in southern Sweden in the end of year 2012. The study population consisted of all inhabitants, aged 18–80 years, registered in the Scania region (Skåne) at that time (n=944,628). A stratified selection sample of men and women (n=47,400) from 56 geographical areas, constituting 56×2 strata, was drawn from the baseline population. An additional sample selection from 17 of the geographical areas was added (n=9 200) in order to increase the likelihood that the final sample would contain enough individuals in socially deprived areas where the response rate is generally low (Fridh et al., 2013). After exclusion of individuals who were no longer part of the study population or could not be reached (n=2350) an extensive questionnaire was mailed to 54,250 individuals in November 2012. Participants were invited to answer the questionnaire either by post or on the internet. After three postal reminders a total of 28,029 participants (52%) had answered the questionnaire.

2.2. Geographic linking of outcome

In order to enable linking of outcome data to exposure data, i.e. information on neighbourhood green qualities (see Section 2.3 below), the design of the present study requires access to information on residential area of each respondent. The survey of 2012 included a question in which respondents were asked if they consent that the information provided in the survey is to be linked to their exact address coordinate. For those that did not consent to such a linking (n=7375, 31%) their residential area was instead defined by their residential coordinate within a 500 m^2 area. For 4197 respondents the linking of information on neighbourhood green qualities could not be made, because this information was not available for the areas in which they were residing. Additional reasons for exclusion from the study cohort were missing data on both general health and physical activity (n=139). As a result of these exclusions a total of 23,693 participants remained and were included in the present study (Fig. 1).

2.3. Exposure – five neighbourhood green qualities

Exposure data were obtained from a cross-sectional public health survey (n=28,198) conducted in the same age group (18–80 years old) in Scania in year 2008 (Rosvall et al., 2009). This study was independent from the survey from 2012 and used the same sample stratification on sex and geographical area. The survey question on perceived quality of the neighbourhood environment was used to assess

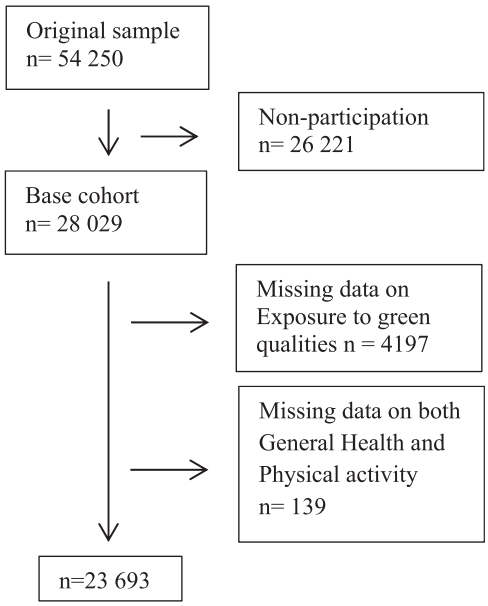

Fig. 1. Flowchart.

exposure with respect to five dimensions (qualities): a) serene, b) wild, c) species richness, d) space and e) cultural history. The survey question was phrased: "Think of nature within 5–10 min walking distance from where you live. For example this can be green spaces, parks or forest areas. Do you agree with the following statements?" Followed by the five statements: "Nature in the area where I live.. a)..is quiet, one can hear nature's own sound, b)..is wild, it has developed without human impact, c)..has a large diversity of animal and plant species, d)..is a large cohesive area, e)..makes you feel the historical heritage, for example ancient monuments, old trees and constructions". In the survey from 2008, five of the qualities, were included. Each of these five items was rated on a 4-graded ordinal scale: "1) Disagree completely, 2) Disagree, 3) Agree, 4) Agree completely". There was also a fifth option, "5) Do not know/cannot say". Answers 3 and 4 were regarded as positive assessments (quality present in the neighbourhood) whereas answers 1, 2, 5 and missing answers were regarded as negative assessments.

2.4. Geographic linking of exposure

Individual perceptions of the five green qualities from the independent survey in 2008 were available from 28,016 respondents residing in 3656 different 1 km^2 areas in Scania. The mean number of respondents per geographical area was eight. The proportion of positive assessments for each quality was estimated in each 1 km^2 area using a random effects logistic regression (ecometric) model with two levels, individual and area. The model was adjusted for sex, age, highest level of education, economic difficulties, country of origin and type of residence. By using this method to calculate proportions, areas with very few individuals obtain a proportion that is similar to the overall mean. The exact modelling details have been previously described (de Jong et al., 2011) and the method used before (de Jong et al., 2011, 2012; Author et al., 2015). We calculated the Scania Green Score (SGS5) as the sum of the five estimated area-level proportions of each quality, standardized (mean=0, standard deviation=1) for each of the 3656 areas. This information was then linked to the respondents of the 2012 survey, as described in Section 2.1. In total the 23,693 participants included in the present study resided in 2474 different 1 km^2 areas with assessments of perceived neighbourhood green qualities in Scania. The 1 km^2 geographical areas represents the neighbourhood level in all analyses.