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Perceived green qualities were associated with neighborhood satisfaction, physical activity, and general health: Results from a cross-sectional study in suburban and rural Scania, southern Sweden

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ABSTRACT

In this study using cross-sectional survey data from suburban and rural Scania, Sweden ($N=24,847$), we assessed how the recently validated index score of area-aggregated perceived green neighborhood qualities (Scania Green Score; SGS), and the five distinct qualities within this index were associated with three self-reported indicators of well-being: neighborhood satisfaction, physical activity and general health. Effect sizes were compared with objective (GIS-based) assessments of the same five qualities. Area-aggregated SGS was positively associated with neighborhood satisfaction, physical activity and general health. The association with general health was mediated by physical activity and neighborhood satisfaction. Three perceived qualities had salutogenic potential: historical remains (culture), silence such that sounds of nature can be heard (serene) and species richness (lush). Spacious and wild were not appreciated. Some independent positive effects of the GIS-based index were noted, but could not be consistently attributed to specific qualities. Perceived qualities within green areas, not merely quantity, are related to aspects of well-being in suburban and rural areas.

1. Background

Health status has been associated with availability of green or natural areas in nearby neighborhood environments (de Vries et al., 2003; Groenewegen et al., 2006; Maas et al., 2006; Skärbäck, 2007; Stigsdotter et al., 2010). It is thought that interaction with green environments can benefit individuals' health in a direct way via restoration of stress and attention fatigue (Kaplan and Kaplan, 1989; Ulrich et al., 1991; Kaplan, 1995; Grahn et al., 2005; Hartig and Staats, 2006; Berg et al., 2007), and in an indirect way via increased levels of social interaction and physical activity (Maas et al., 2008, Maas et al., 2009a; Sugiyama et al., 2008). Considering these pathways it seems plausible that people are more satisfied with highly green neighborhoods (Lee et al., 2008; Leslie and Cerin, 2008), but also that these effects could be modified by having an own house with a garden (Björk et al., 2008).

Several empirical studies have shown associations between green space and level of physical activity (Hoehner et al., 2005; Björk et al., 2008; Panter and Jones, 2008; Kondo et al., 2009; Prins et al., 2009; Coombes et al., 2010). There is also growing evidence suggesting that perceived environmental attributes may capture health promoting aspects that objective measures do not capture (McCormack et al., 2008; Leslie et al., 2010), and that neighborhood perceptions might stronger correlate with physical activity behavior than objective assessments (Prins et al., 2009). However, to date most studies in this field have used crude measures, such as availability of a green open space or forest area, or quantitative measures such as amount of green space, rather than qualitative measures of neighborhood greenness. A further limitation is that self-reported perceptions, especially in cross-sectional settings, are likely to be more prone to single-source bias, i.e., that the self-reporting behavior is influenced by personal and sociodemographic characteristics and by health status (Kamphuis et al., 2010).

We have previously demonstrated how five distinct qualities of the green neighborhood environment, culture, serene, lush, spacious and wild, can be used in epidemiological studies (Björk et al., 2008; de Jong et al., 2011). The qualities can either be objectively assessed by landscape data and Geographical

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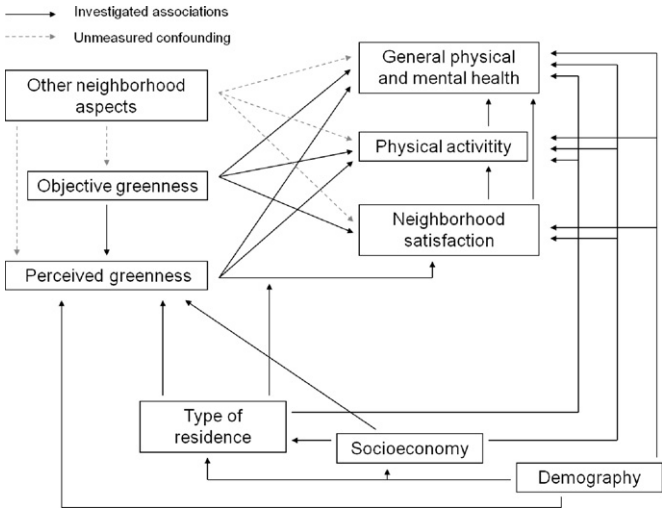

Fig. 1. A graphical overview of the specific associations between green neighborhood quality and indicators of well-being investigated in the present study.

Information Systems (GIS) or self-reported in surveys. To overcome the problem with single-source bias in the self-reports, we have created a novel index score, the Scania Green Score (SGS), based on area-level proportions of perceived availability of these five qualities (de Jong et al., 2011).

In the present study we used public health survey data (N=24,847) from rural and suburban Scania in southern Sweden in 2008. Our first aim was to assess how SGS, and the distinct perceived qualities within this score, were related to three self-reported indicators of well-being: neighborhood satisfaction, physical activity level and general health. Additionally we assessed whether neighborhood satisfaction mediated the association between SGS and physical activity level and second whether neighborhood satisfaction and physical activity level mediated the association between the SGS and general health. We also aimed at disentangling effects of perceived and objectively assessed green qualities. Fig. 1 provides a graphical overview of the specific associations investigated in the present study.

2. Methods

2.1. Survey participants

All registered inhabitants of age 18 to 80 of the Scania county in Southern Sweden on 30 June 2008 constituted the study population (N=899,923). The population was stratified by gender and geographical area, resulting in $2\times71=142$ strata. An approximately equal number of participants for each stratum were randomly selected from the population registry. An extensive general health questionnaire was mailed to 52,142 selected individuals in September–October 2008. People had the opportunity to respond via the web and after three reminders a total of 28,198 participants had responded (54%). The response rate was lower among males, age group 18–34, participants with only compulsory education and those born outside Sweden (Rosvall et al., 2009). The current study focused on rural and suburban Scania since available landscape data (see below) did not permit objective assessments in the inner city areas of the four major cities in Scania (Malmö, Helsingborg, Lund and Kristianstad; N=3169 participants excluded). Another 182 participants lacked a valid residential address. The final study sample included 24,847 individuals.

2.2. Assessment of green qualities

Factor analysis based on extensive interview studies conducted in landscape architecture and environmental psychology have revealed eight different qualities (dimensions) that humans appreciate in park environments (Grahn and Berggren-Bärring, 1995; Grahn and Stigsdotter, 2010). Information on perceived availability for five of these green qualities; culture, serene, lush, spacious and wild (see Appendix 1 (a) for the original descriptions) within 5–10 min walking distance from the residence was obtained from the public health survey for each participant individually. The phrasing of the survey questions (translated to English) is given in Appendix 2.

In the present study we used area-aggregated assessments in 1000 m^2 areas for each quality as a measure of green neighborhood quality, reflecting the proportion of participants that perceive the quality being present within 5–10 min walking distance in each area. We also attributed the area-aggregated SGS, the sum score of the five proportions, to all participants in each area. The area-aggregated proportions were obtained from a multilevel (ecometric) model created in MlwiN version 2.19 (Centre for Multilevel Modeling, University of Bristol, U.K.) and described in detail previously (de Jong et al., 2011). In short, the model yields estimated proportions of positive assessments from area-level shrunken residuals for each green quality in each area, all adjusted for sex, age, highest level of education, economic difficulties, country of origin and type of residence. Missing self-assessments were treated as negative (quality perceived as absent). For the area-aggregated SGS we have previously reported convergent validity versus objective assessments and concurrent validity versus perceived availability of green open space (de Jong et al., 2011).

We also used objectively assessed availability (yes/no) of the five green qualities within 300 m distance from the geocoded residential address of each participant. For these assessments we used land use data from the national land survey of Sweden (Lantmäteriet, part of the EU program CORINE) (Bütnner et al., 2002) and regional GIS databases from the county administrative board of Scania. The objective definitions of the five green qualities were elaborated by experts in landscape architecture for a previous study in the same region (Björk et al., 2008) and are given in Appendix 1 (b). The resulting measures of the green qualities and the corresponding sum scores, both perceived (area-aggregated) and objective (GIS-based) measures, were standardized for mean and standard deviation (z-scores) to make the effect estimates comparable.

2.3. Outcome measures

As outcome measures we used information on three self-reported indicators of well-being measured on ordinal scales: neighborhood satisfaction, weekly level of moderate physical activity, and general health, obtained from the public health questionnaire (Appendix 2). Neighborhood satisfaction was reported as, 'very bad', 'rather bad', 'rather good', 'very good', or 'do not know/ not relevant'. Physical activity was reported as hours spent on moderate physical activity in an ordinary week. Answers consist of five categories ranging from 'not at all' to '5 h a week or more', plus one additional category stating 'do not know'. Three or more hours of moderate physical activity per week was considered as meeting the general recommendations formulated by the Nordic Council (Rådet, 2004). We used a single survey question to assess general health (physical and mental health status) with 7 alternatives ranging from 1; 'very bad, could not feel worse' to 7; 'very good, could not feel better'.