

EVIDENCE BASED PUBLIC HEALTH POLICY AND PRACTICE

Greenspace, urbanity and health: relationships in England

Richard Mitchell, Frank Popham

J Epidemiol Community Health 2007;**61**:681–683. doi: 10.1136/jech.2006.053553

Objectives: To determine the association between the percentage of greenspace in an area and the standardised rate of self-reported “not good” health, and to explore whether this association holds for areas exhibiting different combinations of urbanity and income deprivation.

Design and setting: Cross-sectional, ecological study in England.

Participants: All residents of England as at the 2001 Census.

Main outcome measures: Age and sex standardised rate of reporting “not good” health status.

Results: A higher proportion of greenspace in an area was generally associated with better population health. However, this association varied according to the combination of area income deprivation and urbanity. There was no significant association between greenspace and health in higher income suburban and higher income rural areas. In suburban lower income areas, a higher proportion of greenspace was associated with worse health.

Conclusions: Although, in general, higher proportion of greenspace in an area is associated with better health, the association depends on the degree of urbanity and level of income deprivation in an area. One interpretation of these analyses is that quality as well as quantity of greenspace may be significant in determining health benefits.

A growing body of evidence suggests that contact with greenspace may convey health benefits.^{1–8} In a recent study Maas *et al.*⁴ demonstrated a positive relationship between the amount of greenspace in people’s living environment and their perceived general health. They also commented on the lack of epidemiological studies investigating this relationship, to which we respond with this short report. Although data available to address this issue in England are at an area level, rather than individual, level, we mimicked the substantive questions posed by Maas *et al.*⁴ We determined the association between the percentage of an area classified as greenspace and the rate of self-reported “not good health”, controlling for the socioeconomic and demographic characteristics of the area’s residents. We then explored whether this relationship holds for areas with different combinations of urbanity and income deprivation.

DATA AND METHODS

Greenspace data

Data describing the quantity of greenspace in an area were obtained from the Generalised Land Use Database 2001.⁹ It classifies land use in England at a fine geographical scale and distinguishes greenspace from other types of land cover (domestic buildings, gardens, non-domestic buildings, road, rail, path, water and other (largely hardstanding)). We used lower level super output areas (LSOA) as our geographical units and calculated the percentage of each LSOA area classified as greenspace. LSOAs are a new geographical unit for reporting small-area statistics in England (<http://www.statistics.gov.uk/>

<http://www.statistics.gov.uk/> geography/soa.asp). The 32 482 LSOAs in England have a minimum population of 1000, a mean population of 1500 and an average physical area of 4 km².

Health data

Respondents to the 2001 UK census were asked whether their health had been “good”, “fairly good” or “not good”, over the past 12 months. Following others^{4 10} we dichotomised responses into good or fairly good and not good. We then calculated the (indirectly) age and sex standardised morbidity rate (SMR) for not good health in each LSOA. An SMR value above 1 denotes a rate higher, and below 1 a rate lower, than the national average.

Area characteristics

We utilised five domains of the 2004 English index of multiple deprivation¹¹ to capture characteristics of an area’s population that were plausibly associated with health: employment deprivation; education skills and training deprivation; barriers to housing and services; crime; income deprivation. The value of each index increases with the proportion of residents who experience the deprivation represented by the domain.

Rurality–urbanity data

Maas *et al.*⁴ explored whether the association between greenspace and health varied according to the degree of urbanity. We used the 2001 urban–rural classification¹² to distinguish rural, suburban and urban LSOAs.

Analyses

Association between greenspace and health was explored in a linear regression model. Following Maas *et al.*⁴ we then explored interaction between urbanity and broad socioeconomic status in the relationship between greenspace and health. Broad socioeconomic status was captured by distinguishing areas of above or below the median level of income deprivation. The size of our dataset (32 482 units) gave us the statistical power to stratify the data rather than using single interaction terms, which can be difficult to interpret. We therefore ran regression models, with the SMR as the dependent variable, stratifying the data by the following combinations of characteristics: urban higher income, urban lower income, suburban higher income, suburban lower income, rural higher income and rural lower income. Such stratification controlled for selection (through which wealthier and healthier populations gain disproportionate access to greener environments). Each model also controlled for the other area population characteristics described above.

RESULTS

Table 1 provides results from the regression models including the standardised regression coefficients (β). Negative coefficients denote an association of more greenspace with lower

Abbreviations: LSOA, lower-level super output areas; SMR, standardised morbidity rate.

Table 1 Regression coefficients for models predicting standardised rates of poor health in English Lower Super Output Areas

	All areas		Urban high income		Urban low income		Suburban high income		Suburban low income		Rural high income		Rural low income	
	β	p Value	β	p Value	β	p Value	β	p Value	β	p Value	β	p Value	β	p Value
Greenspace (%)	-0.021	<0.000	-0.05	<0.000	0.014	0.448	0.044	<0.000	0.032	0.092	-0.06	0.002	0.032	0.092
Income deprivation	0.243	<0.000	0.566	<0.000	0.535	<0.000	0.693	<0.000	0.478	<0.000	0.558	<0.000	0.478	<0.000
Employment deprivation	0.495	<0.000	0.268	<0.000	0.292	<0.000	0.235	<0.000	0.276	<0.000	0.295	<0.000	0.276	<0.000
Education, skills and training deprivation	0.170	<0.000	0.024	<0.000	-0.09	<0.000	-0.05	<0.000	-0.1	<0.000	-0.07	<0.000	-0.1	<0.000
Barriers to housing and services	0.006	0.018	0.113	<0.000	0.039	0.017	0.021	0.105	0.021	0.266	0.055	0.003	0.021	0.266
Crime	0.067	<0.000	0.589	<0.000	0.481	0.017	0.797	0.105	0.405	0.266	0.055	0.003	0.405	0.266
Urbanity	-0.028	<0.000	1.3873	<0.000	1.661	0.017	1.490	0.105	0.405	0.266	0.055	0.003	0.405	0.266
R ²	0.8398													
No of areas	32482													

Greenspace coefficients in bold are those that demonstrate lower rates of poor health associated with higher levels of greenspace. Those in italics demonstrate higher rates of poor health associated with higher levels of greenspace

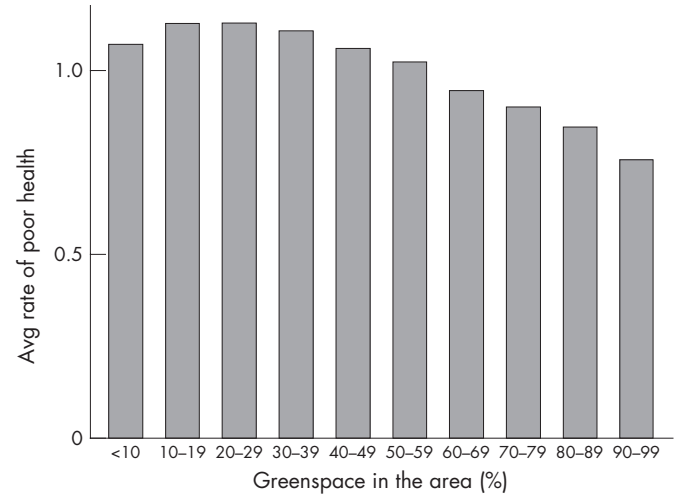


Figure 1 Relationship between the amount of greenspace in an area and rate of perceived poor health, derived from a regression model*, *Model controlling for per cent of greenspace, employment deprivation, education, skills and training deprivation, barriers to housing and services, crime and income deprivation (All areas model, table 1).

rates of poor health. Coefficients are not comparable between models.

Figure 1 shows the average predicted SMR for LSOAs grouped by their percentage of greenspace, derived from the All areas model (table 1). Higher percentage of greenspace in an area was generally associated with lower SMR.

DISCUSSION

In general, a greater proportion of greenspace was associated with better health, as measured by the SMR. However, the association varied according to the combination of area income deprivation and urbanity. It held in all urban areas and rural low-income areas, but there was no significant association between greenspace and health in higher income suburban and higher income rural areas. One possible explanation is that these residents have their own domestic gardens, and municipal greenspace is thus less important to them. Overall, the associations between greenspace and area SMR were relatively weak compared with those between area SMR and other area characteristics.

We hypothesised that pleasant visual or physical contact with greenspace brings health benefits. The fact that greater quantity of greenspace was associated with worse health in low-income suburban areas was therefore surprising. However, limited evidence suggests that lower income suburban areas may have a larger proportion of poor-quality greenspace, which is not accessible and aesthetically poor.^{13 14} Lower income suburban areas also tend to have greater than average levels of poor health. There are thus at least two possible explanations for the association between greenspace and poor-health: the health benefits of poor quality greenspace, albeit in large quantities, are not sufficient to negate the health problems of the resident population; or poor-quality greenspace is actually detrimental to health. However, we cannot know from this study which (if either) explanation is correct.

Study limitations

The study used ecological rather than individual-level data and we cannot rule out the potential impact of the ecological fallacy.¹⁵ Although we can know the proportion of greenspace in an area, we cannot assume the area's population has equal access to it. Furthermore, it is possible that the greenspace variable is acting as a proxy for other aspects of the

What is already known

- A number of studies have suggested that greenspace is positively associated with several different measures of health.
- A recent study from the Netherlands suggested that greenspace is associated with health in both urban and rural areas, and may partly explain urban–rural differences in health.

What this paper adds

- This study found a generally positive association between greenspace and self-reported health in England, but that the nature of the relationship is dependent on both the level of urbanity and income deprivation in the area.
- In low-income suburban areas, a higher quantity of greenspace is associated with worse health.

Policy implications

- This research adds to the growing body of evidence that greenspace is good for population health.
- However, it also suggests that the value of the greenspace may be different for richer and poorer, and more or less urban, populations.
- Increasing the quantity of greenspace alone may not bring health benefits.

environment (eg, air quality), which are not well captured by the broad three-category urban, suburban and rural classification of areas.

These data are cross-sectional and although we have controlled for some area characteristics, selection bias operating through other characteristics cannot be discounted. There was also some weak association between the area characteristics controlled for, and the measure of urbanity–rurality. Associations shown in table 1 may therefore be conservative.

Lastly, the greenspace data were generated through automated analysis of maps and this process was unable to distinguish the quality of open space.

CONCLUSION

Although, in general, a higher proportion of greenspace in an area is associated with better health, the association depends on the degree of urbanity and level of income deprivation in an area. One possible interpretation of this analysis is that quality

as well as quantity of greenspace is significant in determining health benefits.

Authors' affiliations

Richard Mitchell, Frank Popham, Research Unit In Health, Behaviour and Change, University of Edinburgh Medical School, Teviot Place, Edinburgh, UK

Funding: RM and FP are funded by the Chief Scientists Office of the Scottish Executive Health Department. The opinions expressed are of the authors and not the funders.

Contribution: RM designed the study and wrote the first draft, RM and FP carried out the analyses and revised subsequent drafts. RM is the guarantor for the study. Both authors gave final approval of the version to be published.

No ethical approval was required for these secondary analyses of aggregate and anonymised data.

Correspondence to: Dr R Mitchell, Research Unit In Health, Behaviour and Change, University of Edinburgh Medical School, Teviot Place, Edinburgh EH8 9AG, UK; Richard.Mitchell@ed.ac.uk

Accepted 30 October 2006

REFERENCES

- 1 **de Vries S**, Verheij RA, Groenewegen P, *et al*. Natural environments-healthy environments? An exploratory analysis of the relationship between greenspace and health. *Environ Plann A* 2003;**35**:1717–31.
- 2 **Groenewegen PP**, den Berg AE, de Vries S, *et al*. Vitamin G: effects of green space on health, well-being, and social safety. *BMC Public Health* 2006;**6**:149.
- 3 **Liu GC**, Downs SM, Cunningham C. A spatial analysis of pediatric asthma and greenspace. *Pediatr Res* 2002;**51**:178.
- 4 **Maas J**, Verheij RA, Groenewegen PP, de Vries S, *et al*. Green space, urbanity, and health: how strong is the relation? *J Epidemiol Community Health* 2006;**60**:587–92.
- 5 **Takano T**, Nakamura K, Watanabe M. Urban residential environments and senior citizens' longevity in megacity areas: the importance of walkable green spaces. *J Epidemiol Community Health* 2002;**56**:913–18.
- 6 **Pretty J**, Peacock J, Sellens M, *et al*. The mental and physical health outcomes of green exercise. *Int J Environ Health Res* 2005;**15**:319–37.
- 7 **Hartig T**, Mang M. Restorative effects of natural environment experiences. *Environ Behav* 1991;**23**:3–26.
- 8 **Ulrich RS**. Aesthetic and affective response to natural environment. In: Altman I, Wohlwill JF, eds. *Human behaviour and environment: advances in theory and research*. Vol 6: Behaviour and the natural environment. New York: Plenum Press, 1983:85–125.
- 9 **ODPM**. Generalised land use database statistics for England. London: ODPM Publications, 2005.
- 10 **O'Reilly D**, Rosato M, Patterson C. Self reported health and mortality: ecological analysis based on electoral wards across the United Kingdom. *BMJ* 2005;**331**:938–9.
- 11 **Noble M**, Wright G, Dibben C, *et al*. *The English indices of deprivation 2004 revised*. London: ODPM Publications, 2004.
- 12 **Bibby P**, Shepherd J. *Developing a new classification of urban and rural areas for policy purposes – the methodology*. London: DEFRA, 2004.
- 13 **Land Use Consultants**. *Glasgow Green Network Dataset. Case study: links with open space strategy development. Glasgow: land use consultants*, 2006.
- 14 **Fairburn J**, Walker G, Mitchell G. *Investigating environmental justice in Scotland: links between measures of environmental quality and social deprivation*. Edinburgh: Scotland and Northern Ireland Forum for Environmental Research, 2005.
- 15 **Robinson W**. Ecological correlations and the behavior of individuals. *Am Sociol Rev* 1950;**15**:351–7.