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Greenspace access, use, and physical activity: understanding the effects of area deprivation

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Abstract

Objectives—To understand the patterning of greenspace provision and use by area deprivation, and determine how deprivation moderates relationships with physical activity.

Methods—The responses obtained from 6,821 respondents to the 2005 'The Quality of Life in your Neighbourhood Survey' undertaken in Bristol, England, were combined with objective measures of access to greenspaces. Area deprivation was determined using the Index of Multiple Deprivation. Descriptive analyses examined how mean distance, perceived greenspace access and safety, visit frequency, and physical activity varied by deprivation quartile. Logistic regression models examined how relationships were moderated by deprivation.

Results—Respondents in more deprived areas lived closer to greenspaces, but reported poorer perceived accessibility, poorer safety, and less frequent use. Frequency of use declined with distance but only in the most affluent areas. Relationships between physical activity and perceived accessibility, safety, and visit frequency were moderated by deprivation.

Conclusions—The accessibility of greenspaces was better in more deprived areas but those residents had more negative perceptions and were less likely to use the greenspaces. Interventions may be most effective if they target the perceptions and needs of residents of deprived neighbourhoods.

Keywords

Equity; deprivation; greenspace; physical activity

Introduction

Only 40% of men and 28% of women in England currently meet Government recommendations of at least 30 minutes of moderate intensity physical activity five days a

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week (Craig & Mindell, 2008). Personal characteristics are key correlates of physical activity behaviours (Ogilvie et al., 2008) but attributes of the physical environment also seem important (Jones et al., 2007). Hence there is a focus on the potential of interventions based on the provision of supportive environments to increase physical activity prevalence (van Sluijs et al. 2007).

Considerable attention has been focussed on the role of urban parks and greenspaces for physical activity (Bird, 2007). Indeed, the establishment of the public park movement in the 19th Century had origins in the social ideal of providing places of recreation that were equally available for all (Young, 1996). There is evidence that populations with better provision of greenspaces use them more (Neuvonen et al. 2007), are more likely to be physically active overall (Giles-Corti and Donovan, 2002), during leisure time (Huston et al. 2003), and walk (Wen et al. 2007) and cycle more (Wendel-Vos et al. 2004). However, provision of these amenities may not nowadays be equal (Taylor et al. 2007; Panter et al. 2008).

Evidence that greenspace provision may be poorer for more deprived populations comes mostly from the USA and Australia. Talen (1997) reported access to parks in two American towns was best in white, high-income suburban locations. In a small US city Estabrooks et al. (2003) concluded that communities with lower socio-economic status had inferior provision of public parks and walking trails. In Melbourne Australia, Crawford et al. (2008) found that greenspaces in poorer neighbourhoods had fewer amenities to support physical activity amongst children. Elsewhere, Macintyre et al. (2008a) found public parks were better provided in more affluent areas of Glasgow, Scotland. These findings are concerning given that deprived populations exhibit lower physical activity (Kristensen et al., 2006), and residents of deprived neighbourhoods may be less active even after adjustment for personal socioeconomic circumstances (Kavanagh et al. 2005).

Inequities in the provision of greenspaces may contribute to social gradients in physical activity, but evidence is from a limited number of settings. Furthermore, few studies move beyond comparisons of provision by area deprivation, examining how perceptions, accessibility, and usage of greenspaces are moderated by area deprivation, and how these factors may contribute to the observed gradients. This is important in light of the findings of Macintyre et al. (2008b) in Glasgow that perceived distances to public parks poorly equated with those measured objectively. Hence it may hence be that perceptions are more driven by social factors that act to moderate associations with physical activity rather than by actual greenspace provision. Using the setting of the city of Bristol, England, this study provides new evidence on these issues.

Methods

Setting

The study used data from the 2005 ‘The Quality of Life in your Neighbourhood Survey’, a postal questionnaire survey of adult Bristol residents undertaken by Bristol City Council. The population was stratified by the 35 Bristol electoral wards (census tracts), representing a mix of urban areas and suburbs and including the most affluent and deprived areas. Some 380 people were randomly selected from the electoral register within each ward. Wards with high levels of deprivation have a lower response rate so a further 570 people were selected from the 12 most deprived areas, to provide a total sample of 20,140 individuals. Each person was sent a questionnaire to return by post, with one follow-up for initial non-responders. Overall 6,821 residents participated; a response rate of 34%.

Data collection

Information on each respondent's age, gender, and self rated health (rated 'good', 'fairly good', or 'not good') was obtained from the questionnaire. Respondents were asked to state frequency of greenspace use and also frequency of participation in sport and moderate physical activity (e.g. brisk walking, gardening, heavy housework or DIY) on a 5-point scale ranging between "5 times a week or more" to "less than once a year". For analysis, the physical activity frequency responses were re-coded to differentiate those respondents reporting participation at least five times a week (current UK guidelines) from those less active.

Two environmental perception measures were recorded by the survey, both on a 5-point scale; the respondent's perception of greenspace access ("very easy" to "very difficult") and of greenspace safety ("very safe" to "very unsafe"). Home locations of respondents to a were mapped based on postcodes using the ArcGIS 9.2 Geographical Information System (GIS) (ESRI, California). The UK Ordnance Survey Code-Point product was used, which provides a 1m precision grid reference of the house nearest the weighted centroid of each postcode zone. Within a city, all addresses will typically fall within 50m of the centroid. The neighbourhood surrounding each centroid was identified as the area within 800 metres (equating to a 10 minute walk) along the road network.

Neighbourhood deprivation was measured using the 2004 English Index of Multiple Deprivation (IMD). The value for the neighbourhood around each home was estimated using area weighted IMD scores based on the Super Output Areas (small census tracts) that fell within each neighbourhood. The IMD scores provide an indicator of material deprivation based on several components including income, employment, health, education, housing, environment, and crime (ODPM, 2004). High scores indicate high levels of deprivation.

The locations of all public greenspaces within Bristol were mapped using a GIS database provided by Bristol City Council. This included details of the size and type of each greenspace. Greenspaces were grouped into five typological categories: Formal (organised layout and structured path network, and generally well maintained), Informal (informal design and less managed feel), Natural (heathland, grassland or woodland), Young People's (for use by children or teenagers), and Sports (e.g. playing fields and tennis courts). Where a greenspace fell into more than one category, the area of each was delineated separately. The GIS database was cross referenced with aerial photography so that no spaces were omitted or erroneously included. Only spaces of at least 2ha in size were considered, as those smaller were deemed unsuitable for use by adults for the purpose of being physically active. Of the 441 separate areas (1770ha) of greenspace in the database, 306 (69%) were excluded based on size, although their area (140ha) was just 7% of the total. They were typically features around roads, such as verges or central reservations. Using the Ordnance Survey Meridian database, the shortest distance via the road network between each postcode centroid and an access point to a qualifying greenspace was identified.

Statistical analysis

Trends across IMD quartiles in the measures were tested by correlating each with the quartiles specified as a continuous variable, whilst differences in greenspace perceptions and visit frequency, and the achievement of physical activity guidelines were examined across quartiles of IMD scores using Chi-squared tests. Logistic regression models were fitted to examine how distance to the nearest greenspace of each type considered was associated with the odds of visiting a greenspace at least once a week and achieving physical activity levels. To examine the moderating effect of deprivation, separate models were fitted for the lowest (most affluent) and highest (most deprived) quartiles of IMD. All models were adjusted for

respondent age, sex, and self-rated health. Analyses were undertaken in SPSS 16.0 (SPSS Inc, Chicago).

Results

Compared to the population of Bristol at the 2001 Census, respondents were more likely to be female (59% sample vs. 51% Bristol), not in employment (55% vs. 60%), retired (27% vs. 15%) and home owner-occupiers (73% vs. 63%). Ethnic minorities were under-represented (4.4% vs. 6.8%) (Bristol City Council, 2005).

Table 1 shows the mean distance respondents live from their nearest greenspace by quartiles of neighbourhood deprivation. It illustrates that access to greenspace was generally better for those living in more deprived neighbourhoods, with shortest mean distances generally in the most deprived quartile. Exceptions were formal greenspaces and those used for sports, where the reverse was observed.

Table 2 shows that trends in perceptions of greenspace access were not in the same direction as the objective measures. Those in the most affluent neighbourhoods were more likely to report that access was “very easy” compared to those in the most deprived areas. Similarly, compared to the most affluent, over three times the percentage of respondents in the most deprived neighbourhoods felt that access was “fairly difficult” or “very difficult”. Similar associations were observed with perceived safety, with those in more deprived neighbourhoods being less than half as likely to report greenspaces being “very safe” and more than twice as likely to report them “fairly unsafe” or “very unsafe”.

Table 2 also shows strong disparities in reported greenspace use associated with area deprivation. Despite mean distances being generally shorter, those in the most deprived neighbourhoods were less frequent visitors than the most affluent, being nearly half as likely to report visiting a greenspace at least weekly, and over twice as likely to report less than once a year. There were also gradients in the achievement of physical activity guidelines, with those in the most deprived being the least active.

By comparing the effects of distance for the most and least affluent quartiles, Table 3 shows the moderating effect of neighbourhood deprivation on the relationship between frequency of use and distance to greenspace. For those in the most affluent quartile, there is evidence of a strong distance decay effect for all greenspace types except those for young people. Compared to the most proximal, those living furthest from each type of greenspace were between 56% and 30% less likely to report visiting at least once a week. Surprisingly there was no evidence of a distance decay effect in the more deprived neighbourhoods, despite these respondents reporting more difficult access and lower visit frequency.

Table 4 shows how neighbourhood deprivation moderates the relationship between physical activity and perceived accessibility, safety, visit frequency, and distance to greenspaces. For all respondents, gradients were apparent with higher reported difficulty of access, higher reported unsafeness, and lower reported visit frequency being associated with lower odds of achieving physical activity guidelines. However, for both safety perceptions and visit frequency, the gradient was strongest for those in the most deprived neighbourhoods. Although there was evidence of reduced achievement of the guidelines amongst those living further from greenspaces, the trends were not statistically significant for either deprivation group.

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Discussion

With the exception of formal spaces, we did not find evidence that the residents of more deprived neighbourhoods had poorer access to greenspaces, with mean measured distances generally being lowest for the most deprived. This suggests that, in Bristol at least, the original aims of the urban public parks movement are being met in terms of provision. However, the observed gradient in perceived access was the opposite of that objectively measured; residents from more deprived areas were much more likely to report access as difficult. They were also more likely to report poorer safety and they visited greenspaces less frequently. Taken together these results show how social factors appear to modify the relationship between what is provided and what is perceived as being available. As distances were generally short, lower availability of private transport amongst the more deprived is unlikely to be a cause. Hence it may be that residents of more deprived areas simply do not see the greenspaces as being provided for them. Alternatively, greenspace quality in deprived neighbourhoods may be lower and hence discourage use. Certainly higher reporting of problems with safety, a factor consistently shown to be associated with physical activity (e.g. Carver et al. 2008; Piro et al. 2006) suggests this may be so, although the possibility remains that the residents of deprived areas simply have more negative perceptions of their general neighbourhood environment and therefore use it less.

We expected any moderating effect of deprivation on the relationship between distance and greenspace use to operate most strongly on those in more deprived areas. However, we found the opposite was the case; the effect of distance was much stronger for the most affluent. Given that this group are likely to be the most mobile, had the most favourable perceptions, and also used the spaces more, the reasons for this are unclear. Respondents were asked to report their use of any type of greenspace rather than their nearest, but it is not clear why this disparity would explain our observation. One possible explanation is that, whilst residents of deprived communities make fewer trips to greenspaces, when they do visit they travel further to one that is selected for characteristics (e.g. safety or standards of maintenance) other than proximity to the home. Further work is required to confirm the observation.

There were distance decay effects for physical activity and perceived greenspace accessibility, perceived safety, and visit frequency. Area deprivation also moderated them. Poorer perceptions of safety, and lower visit frequency, were especially associated with lower physical activity in respondents from the most deprived neighbourhoods, although it should be noted that our measure of physical activity was not specific to that undertaken in greenspaces. This, coupled with the fact that environmental perceptions are known to be socially patterned (e.g. Macintyre et al. 2008b), may explain why we did not find strong evidence of an association between objectively measured distance and physical activity.

Study limitations and strengths

Strengths included the large sample size of almost 7,000 respondents which purposively included a mix of respondents of different socioeconomic status in a city with high socio-demographic diversity. We had information on reported greenspace use and perceptions as well as a detailed database on the provision of greenspace in the city. A limitation was that the measures of visit frequency, physical activity, and bodyweight were all self reported. Notably, physical activity levels were somewhat higher than anticipated, with 39% of respondents reporting being active at least 5 times a week. The cross sectional nature of the study means it is difficult to ascribe causality to relationships we have observed. In addition, although we had information on the types of greenspaces present, we did not have detail on the specific features provided by each, or on standards of maintenance or presence of social

nuisances such as crime or vandalism. Furthermore, we did not socio-economic details of individuals.

Conclusions

We found the accessibility of greenspaces was generally better in more deprived areas but that those living in them had more negative perceptions and were less likely to use them. We also found some evidence that area deprivation moderated the effect of perceptions on physical activity. Hence it appears that simply examining greenspace provision or accessibility by area deprivation hides a more complex picture which may be particularly influenced by negative environmental perceptions in less affluent groups.

Although UK planning policies such as Planning Policy Statement 3 (Department for Communities and Local Government, 2006) stipulate that greenspaces should be incorporated into urban planning, it is concerning that no minimum requirements exist to ensure guidelines are sufficiently met. Our findings suggest that interventions to encourage higher physical activity via greenspaces may be better addressing the expressed needs of local communities and issues of greenspace type, quality and safety rather than simply providing more greenspaces *per se*. Hence the next step should be to undertake qualitative work to better understand the mechanisms underlying the relationships we have observed, and clearly guide the design and targeting of future interventions.

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Table 1

Greenspace accessibility by deprivation: distance (metres) to nearest greenspace.

	Overall mean distance (m)	Distance to nearest greenspace (m) for IMD Quartiles								p-value[1]
		1 (most affluent)		2		3		4 (most deprived)		
		MEAN	95% CI	MEAN	95% CI	MEAN	95% CI	MEAN	95% CI	
All greenspaces	334	428	(415-442)	301	(286-315)	319	(306-333)	289	(277-300)	<0.001
Formal greenspaces	1758	1532	(1474-1590)	1816	(1758-1875)	1662	(1602-1722)	2020	(1955-2085)	<0.001
Informal greenspaces	481	626	(608-644)	471	(453-490)	438	(421-455)	390	(374-406)	<0.001
Natural greenspaces	570	680	(660-699)	510	(488-531)	571	(550-591)	521	(505-538)	<0.001
Young people's greenspaces	2207	1967	(1920-2014)	2846	(2784-2908)	2361	(2296-2426)	1654	(1618-1691)	<0.001
Sports greenspaces	1082	1111	(1083-1138)	1010	(984-1036)	972	(946-997)	1235	(1207-1262)	<0.001

Bristol, England, 2005

CI = Confidence Intervals, IMD = Index of Multiple Deprivation.

[1] From test for trend

Table 2

Greenspace perceptions, usage, and physical activity by deprivation.

	IMD Quartile 23				
	1 (most affluent)	2	3	4 (most deprived)	p-value[1]
Perception of greenspace access (%)					
Very easy	66.2	54.9	56.5	44.6	
Fairly easy	26.0	31.9	29.9	36.0	
Neither/nor	4.4	6.0	6.1	8.6	
Fairly difficult	2.3	4.6	5.1	7.3	
Very difficult	1.1	2.5	2.5	3.5	<0.001
Perception of greenspace safety (%)					
Very safe	27.8	15.8	12.7	11.5	
Fairly safe	56.7	58.7	59.7	55.1	
No opinion	7.3	10.7	10.5	14.3	
Fairly unsafe	6.9	12.0	13.3	14.6	
Very unsafe	1.3	2.8	3.8	4.5	<0.001
Greenspace visit frequency (%)					
≥ weekly	41.3	30.9	33.0	26.9	
2-3 per month	25.9	26.0	25.2	24.7	
1-6 per year	21.6	26.1	23.7	24.0	
<1 per year	11.2	17.0	18.0	24.4	<0.001
Achieve physical activity guidelines (%)	41.6	37.3	39.9	36.3	0.007

Bristol, England, 2005

IMD = Index of Multiple Deprivation.

[1] From χ^2 test

Table 3

Odds ratios for visiting a greenspace at least once a week, adjusted for age, sex, and self-rated health, by distance to green space type.

Distance measure	Visiting green space at least once a week			
	Most affluent IMD quartile		Most deprived IMD quartile	
	OR	95% CI	OR	95% CI
All greenspaces				
quartile 1 (nearest <100m)	1.00	-	1.00	-
quartile 2	0.73	(0.52-1.02)	0.82	(0.60-1.12)
quartile 3	0.60	(0.44-0.83)	0.80	(0.59-1.09)
quartile 4 (furthest >500m)	0.44**	(0.33-0.60)	0.81ns	(0.59-1.12)
Formal greenspaces				
quartile 1 (nearest <830m)	1.00	-	1.00	-
quartile 2	0.71	(0.55-0.91)	1.04	(0.72-1.51)
quartile 3	0.91	(0.67-1.24)	1.07	(0.73-1.55)
quartile 4 (furthest >2250m)	0.53**	(0.39-0.71)	0.86 ns	(0.59-1.26)
Informal greenspaces				
quartile 1 (nearest <200m)	1.00	-	1.00	-
quartile 2	0.63	(0.44-0.89)	0.74	(0.55-1.01)
quartile 3	0.41	(0.29-0.58)	0.72	(0.53-0.98)
quartile 4 (furthest >680m)	0.51**	(0.38-0.69)	0.99 ns	(0.70-1.39)
Natural greenspaces				
quartile 1 (nearest <250m)	1.00	-	1.00	-
quartile 2	0.94	(0.68-1.30)	0.94	(0.68-1.30)
quartile 3	0.58	(0.43-0.80)	0.81	(0.59-1.10)
quartile 4 (furthest >800m)	0.56**	(0.42-0.75)	0.99 ns	(0.71-1.38)
Young people's greenspaces				
quartile 1 (nearest <1300m)	1.00	-	1.00	-
quartile 2	1.49	(1.12-1.98)	1.23	(0.93-1.62)
quartile 3	0.97	(0.75-1.27)	1.26	(0.92-1.72)
quartile 4 (furthest >2800m)	1.21ns	(0.90-1.62)	1.31ns	(0.81-2.12)
Sports greenspaces				
quartile 1 (nearest <640m)	1.00	-	1.00	-
quartile 2	0.72	(0.54-0.96)	0.91	(0.62-1.33)
quartile 3	0.71	(0.53-0.95)	1.17	(0.83-1.65)
quartile 4 (furthest >1470m)	0.70*	(0.52-0.93)	1.07 ns	(0.76-1.49)

Bristol, England, 2005.

From test for trend:

ns = not statistically significant CI = Confidence Intervals, IMD = Index of Multiple Deprivation.

* p< 0.05

** p< 0.01

Table 4

Odds ratios for achieving physical activity guidelines, adjusted for age, sex, and self-rated health, by perceived greenspace access, safety, frequency of visits, and distance to greenspace type.

	Achieve physical activity levels			
	Most affluent IMD quartile		Most deprived IMD quartile	
	OR	95% CI	OR	95% CI
Perception of greenspace access				
Very easy	1.00	-	1.00	-
Fairly easy	0.91	(0.72-1.16)	0.83	(0.65-1.05)
Neither/nor	0.80	(0.48-1.32)	0.57	(0.37-0.87)
Fairly difficult	0.60	(0.29-1.24)	0.70	(0.45-1.11)
Very difficult	0.34 *	(0.10-1.21)	0.45 **	(0.23-0.90)
Perception of greenspace safety				
Very safe	1.00	-	1.00	-
Fairly safe	0.76	(0.60-0.96)	0.56	(0.40-0.78)
No opinion	0.42	(0.26-0.67)	0.39	(0.25-0.60)
Fairly unsafe	0.65	(0.41-1.02)	0.40	(0.26-0.61)
Very unsafe	0.85 **	(0.34-2.15)	0.54 **	(0.29-1.00)
Greenspace visit frequency				
≥ weekly	1.00	-	1.00	-
2-3 per month	0.57	(0.44-0.74)	0.34	(0.25-0.46)
1-6 per year	0.57	(0.44-0.75)	0.26	(0.19-0.36)
<1 per year	0.43 **	(0.30-0.64)	0.30 **	(0.22-0.42)
Distance to greenspace				
quartile 1 (nearest <100m)	1.00	-	1.00	-
quartile 2	0.89	(0.63-1.25)	1.06	(0.79-1.41)
quartile 3	0.90	(0.65-1.24)	1.04	(0.78-1.38)
quartile 4 (furthest >500m)	0.86 ns	(0.64-1.16)	0.97 ns	(0.72-1.32)
Distance to Formal greenspace				
quartile 1 (nearest <830m)	1.00	-	1.00	-
quartile 2	1.03	(0.81-1.32)	0.90	(0.64-1.27)
quartile 3	0.70	(0.51-0.96)	0.73	(0.52-1.03)
quartile 4 (furthest >2250m)	0.85 ns	(0.64-1.13)	0.85 ns	(0.61-1.20)
Distance to Informal greenspace				
quartile 1 (nearest <200m)	1.00	-	1.00	-
quartile 2	0.82	(0.58-1.16)	1.07	(0.81-1.41)
quartile 3	0.93	(0.67-1.29)	0.95	(0.72-1.25)
quartile 4 (furthest >680m)	0.81 ns	(0.60-1.09)	1.09 ns	(0.79-1.50)
Distance to Natural greenspace				
quartile 1 (nearest <250m)	1.00	-	1.00	-
quartile 2	0.98	(0.71-1.37)	0.97	(0.72-1.31)
quartile 3	0.97	(0.71-1.32)	1.00	(0.76-1.33)

	Achieve physical activity levels			
	Most affluent IMD quartile		Most deprived IMD quartile	
	OR	95% CI	OR	95% CI
quartile 4 (furthest >800m)	0.92 ns	(0.69-1.23)	1.15 ns	(0.84-1.57)
Distance to Young people's greenspace				
quartile 1 (nearest <1300m)	1.00	-	1.00	-
quartile 2	1.02	(0.77-1.36)	1.03	(0.80-1.32)
quartile 3	0.76	(0.58-0.99)	0.88	(0.66-1.16)
quartile 4 (furthest >2800m)	1.03 ns	(0.77-1.38)	0.74 ns	(0.46-1.17)
Distance to Sports greenspace				
quartile 1 (nearest <640m)	1.00	-	1.00	-
quartile 2	0.82	(0.62-1.10)	1.26	(0.89-1.77)
quartile 3	0.87	(0.65-1.15)	0.98	(0.71-1.35)
quartile 4 (furthest >1470m)	0.99 ns	(0.74-1.32)	1.01ns	(0.75-1.37)

Bristol, England, 2005.

From test for trend:

ns = not statistically significant CI = Confidence Intervals, IMD = Index of Multiple Deprivation.

* p< 0.05

** p< 0.01