

The health benefits of urban green spaces: a review of the evidence

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ABSTRACT

Background Urban development projects can be costly and have health impacts. An evidence-based approach to urban planning is therefore essential. However, the evidence for physical and non-physical health benefits of urban green space is unclear.

Methods A literature search of academic and grey literature was conducted for studies and reviews of the health effects of green space. Articles found were appraised for their relevance, critically reviewed and graded accordingly. Their findings were then thematically categorized.

Results There is weak evidence for the links between physical, mental health and well-being, and urban green space. Environmental factors such as the quality and accessibility of green space affects its use for physical activity. User determinants, such as age, gender, ethnicity and the perception of safety, are also important. However, many studies were limited by poor study design, failure to exclude confounding, bias or reverse causality and weak statistical associations.

Conclusion Most studies reported findings that generally supported the view that green space have a beneficial health effect. Establishing a causal relationship is difficult, as the relationship is complex. Simplistic urban interventions may therefore fail to address the underlying determinants of urban health that are not remediable by landscape redesign.

Keywords environment, geography, public health

Introduction

Globally, a dramatic demographic shift towards urbanization is occurring.¹ Between 2000 and 2050, the proportion of people living in urban areas is projected to rise from 46.6 to 69.6%.² Urbanization poses problems through effects such as environmental pollution, accidents, heat island effects and climate change.^{3,4} This has flagged up the need for multi-sectoral action to promote health in urban populations and led to the rise of the 'Healthy Cities' movement.^{5,6}

Physical and psychological benefits have been linked to green spaces through their purported effects on physical activity.⁷ Numerous health benefits of physical activity have been documented, such as the effects on cardio- and cerebro-vascular disease, diabetes, colorectal cancer, osteoporosis, depression and fall-related injuries.^{8–15} It also improves mental functioning, mental health and well-being^{16–22} and may have long-lasting psychological benefits.²³ Benefits on longevity have also been reported.²⁴

Whilst urbanization clearly has health impacts, there is uncertainty as to whether the purported health benefits of green spaces, such as parks and playing fields, are an urban myth or fact. Urban developments are costly projects. It is therefore important that urban design and planning decisions are informed by robust evidence. This review sought to broadly examine the evidence for the population health benefits of green spaces, and to provide a narrative summary for health policy-makers and urban planners.

Methods

Literature searches of electronic journal databases were conducted for studies and reviews of the health effects of green

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spaces. The keywords used were 'green space', 'public open space', 'open space' and 'park'. The inclusion criteria were studies and review articles referring to green or public open spaces with a health perspective, limited to human studies and published in English. Studies and articles were excluded if they did not pertain to health and green or public open spaces, were published before 1990 or were purely a descriptive or opinion piece.

In this review, the terms 'green space' and 'public open space' were used interchangeably and presumed to be synonymous. We also looked at health effect in its broadest sense to cover not just physical health but also mental health and well-being. This was to reflect the various postulated ways in which green spaces are believed to affect health impact such as through attracting people, providing scope for physical activity to occur or having a restorative effect.^{24–26} In addition, we focused on articles pertaining to high-income countries, as different contextual factors are likely to influence associations seen in low- and middle-income countries.

Databases searched included Medline, CINAHL, AMED, BNI, PsycInfo, HMIC, Cochrane library, NHS Economic Evaluation Database and the National Institute for Health and Clinical Excellence (UK). Further back-referencing for relevant articles as well as an internet search for grey literature using identical terminology was also performed. Publication searches were also carried out on agency websites such as the Commission for Architecture and the Built Environment (CABE) and OPENspace, as well as UK government websites such as the Department of Health, and Department for Culture, Media and Sport (DCMS).

This literature review was completed in June 2010. Four hundred and eight-five articles found were initially screened for relevance. Thirty-five relevant articles were identified and appraised for the strength and weaknesses of their methodology and interpretations. These articles were then graded according to the strength of evidence presented (Tables 1–3). Key findings from the various articles were

then thematically summarized and are presented in the following section.

Results

Benefits of green space

Physical health

One postulated mechanism by which green space influences physical health is through its effect on physical activity levels. Modification of the built environment to provide green space offers opportunities for beneficial 'green exercise' such as walking.²⁵ Several reviews support this view and there is some consensus that 'the built environment can facilitate or constrain physical activity'.^{7,26–28} There may also be other physical benefits, although the mechanisms for this are not always clear. For example, the availability of green space has been reported to be independently associated with increased survival in elderly populations.²⁴ Another study also reported a positive association between lower stroke mortality and higher levels of greenness in the environment.²⁷ Whilst there is strong evidence of the health benefits of physical activity, the evidence for the link between physical activity levels and green space availability is weaker.

Mental health and wellbeing

Physical and social features of the environment may also affect behaviour.²⁵ Studies in various groups such as students, inner city girls and workers reported associations between green space with a variety of psychological, emotional and mental health benefits.^{28,29} The provision and access to green space also positively affects reported stress and quality of life.^{30–33} A large epidemiological study in the Netherlands found a positive correlation between the quantity of urban green space and the perception of general health.³⁴ Green spaces may also influence social capital by providing a meeting place for users to develop and maintain neighbourhood social ties.^{35–37} The social interaction enhances the personal and social communication skills of users.^{26,36} The presence of green vegetation and the formation of neighbourhood social ties in urban areas in turn significantly contributes to residents' sense of safety and adjustment.³⁶ However, much of the literature on the psychological benefits of green space tended to be qualitative or from grey literature sources, the quality of which varied. There is generally a lack of robust evidence for the link between mental health, well-being and green space but this may be due to the inherent difficulties in quantifying non-physical health benefits.

Table 1 Evidence grading

Evidence grade	Interpretation of evidence
I High	The described effect is plausible, precisely quantified and not vulnerable to bias
II Intermediate	The described effect is plausible but is not quantified precisely or may be vulnerable to bias
III Low	Concerns about plausibility or vulnerability to bias severely limiting the value of the effect being described and quantified.

Table 2 Studies on the relationship between green space and health

<i>Study</i>	<i>Setting</i>	<i>Study design</i>	<i>Findings</i>	<i>Evidence grade</i>
Ball <i>et al.</i> ⁴²	45 urban neighbourhoods, Australia	Cross-sectional questionnaire survey of 1282 women. Stratified random sampling	Different personal, social and environmental factors associated with walking for leisure.	II
Cerin <i>et al.</i> ⁴⁸	32 urban communities, Australia	Cross-sectional survey of 2650 adults. Stratified cluster sampling design	Accessibility associated with increased physical activity. Young adults (18–35 years) reported more physical activity in the presence of public open space.	II
Cohen <i>et al.</i> ⁵⁰	7 cities, USA	Cross-sectional study of 1556 adolescent girls looking at physical activity levels and park use.	Adolescent girls living near parks (within 0.5 miles) are more likely to engage in more non-school moderate-vigorous physical activity.	II
Cohen <i>et al.</i> ⁵²	Urban setting, USA	Observational study of the usage of eight parks. Direct observation of 2000 park users as well as interviews with 1318 persons.	More males than females use parks, and males were twice as likely to be vigorously active. Residential proximity strongly associated with park use and physical activity. People living within a mile of a park were four times more likely to use it once a week or more, and had 38% more exercise sessions per week than those living further away.	II
Coombes <i>et al.</i> ⁵⁵	Urban setting, UK	Survey data from 6821 adults were combined with GIS and green space data, and analyzed.	Frequency of green space use declined with increasing distance from the green space. Respondents living closer to the green space reported higher physical activity levels and were less likely to be obese.	III
Foster <i>et al.</i> ⁶¹	Urban setting, UK	Observational study analyzing survey results for 13 927 participants and GIS data.	No correlation was found between access to green spaces and physical activity levels.	III
Hillsdon <i>et al.</i> ⁵⁹	Urban setting, UK	Cross-sectional study of 4950 respondents examining access to open space and physical activity.	No correlation was found between access to green spaces and physical activity levels.	III
Hu <i>et al.</i> ²⁷	Setting not stated, USA	Ecological study of stroke mortality and dasymetric mapping of air pollution and greenness.	High levels of stroke mortality were observed in areas with lower levels of exposure to green space.	III
Kweon <i>et al.</i> ³⁵	Inner-city neighbourhood, USA	Qualitative interviews of 91 residential home residents	Exposure to green common spaces associated with better social integration of elderly persons.	II
Lee <i>et al.</i> ⁴⁹	82 urban neighbourhoods, USA	Observational ecological study comparing neighbourhood socioeconomic status of 2672 women and individual physical activity.	Women with low income or living in deprived neighbourhoods have less access to physical activity resources (including parks). Greater availability of physical activity resources nearby appears to benefit women living in more deprived neighbourhoods and low-income women more.	II
Maas <i>et al.</i> ³⁴	Various settings (urban, mixed urban–rural and rural) in the Netherlands	Self-administered survey of 250 782 persons of their perceived general health and the characteristics of their living environment.	Reported that the amount of green space present in the respondents' living environments was positively associated with their perceived general health. This association was stronger for lower socioeconomic groups, youth and the elderly.	II

Maas <i>et al.</i> ⁶⁰	Various settings (urban, mixed urban–rural and rural) in the Netherlands	Interviews with 4.899 persons about their physical activity, self-perceived health, demographic and socioeconomic backgrounds, correlated with the quantity of green space available to each individual.	The amount of green space in the living environment is scarcely related to the level of physical activity undertaken by individuals.	III
Maas <i>et al.</i> ²⁹	Various settings (urban, mixed urban–rural and rural) in the Netherlands	Observational study of urban areas in Holland, comparing proximity to green space with prevalence rates of disease using medical record data from 96 general practices serving 345 143 persons.	The annual prevalence rates of 15 of 24 disease clusters were lower in areas with more green space within a 1 km radius. Relationship was particularly strong for children and the lower socioeconomic classes. However, the effect size was small (OR: 0.95– 0.98).	II
Maas <i>et al.</i> ³⁴	Various settings (urban, mixed urban–rural and rural) in the Netherlands	Health interview survey of 12,669 persons that examined self-reported health, social contacts, and characteristics of the respondents' living environments.	Proximity to green space was associated with lower rates of self-reported ill health, lack of social support and loneliness.	III
Mitchell and Popham ³⁸	Various settings (urban, mixed urban–rural and rural) in England	Observational ecological study comparing income deprivation, mortality and proportion of green space by geographical areas.	All-cause mortality and circulatory disease mortality was associated with levels of exposure to green space.	II
Potestio <i>et al.</i> ⁶²	Urban setting, Canada	Survey of 6772 children body-mass indices and their access to green spaces.	No association was found between childhood obesity levels and green space availability.	III
Richardson <i>et al.</i> ⁶³	Small urban areas, New Zealand	Observational ecological study of 1 546 405 urban residents in 1009 areas.	After controlling for confounders such as age, sex, socioeconomic deprivation, smoking, air pollution and population density, there was no observed associations between green space and mortality.	II
Roemmich <i>et al.</i> ⁵¹	Setting not stated, USA	Cross-sectional analysis of a longitudinal study of the participation in physical activity of 59 children.	Greater access to parks was associated with increased levels of physical activity participation by children.	III
Stigsdotter <i>et al.</i> ³¹	Setting not stated, Denmark	Health interview survey of 11 238 respondents.	Greater use of green space associated with less reported stress. Closer proximity to green space was also associated with better self-reported health.	III
Sugiyama <i>et al.</i> ¹⁸	32 urban neighbourhoods, Australia	Cross-sectional mail questionnaire survey of 1895 adults. Used spatially-based sampling.	Perception of neighbourhood greenness associated with better physical and mental health (OR: 1.37 & 1.60 respectively) as well as recreational walking.	II
Takano <i>et al.</i> ²⁴	Urban residents, Japan	Analysed 5 year survival of 3144 persons born in 5 different years in 2 cities.	Urban areas with walkable green space associated with increased survival of senior citizens (OR: 1.13–1.17).	II
Taylor <i>et al.</i> ¹⁹	Setting not stated, USA.	Questionnaire survey of 96 parents of children with attention deficit disorder. Convenience sampling used.	Children with attention deficit disorder function better after activities in green setting.	III
van den Berg <i>et al.</i> ³²	Various settings (urban, mixed urban–rural and rural) in the Netherlands	Survey of 4529 respondents.	Respondents with higher levels of green space reported being less affected by stressful life events, and better perceived mental health.	III
Witten <i>et al.</i> ⁸²	Urban setting, New Zealand	Survey of 12 529 adults correlated with GIS data on proximity to parks and beaches.	Reported no correlation between access to open spaces and physical activity.	II

Table 3 Summary of reviews on green space/public open space and health

<i>Study</i>	<i>Setting</i>	<i>Study design</i>	<i>Findings</i>
Bauman and Bull ⁸³	Predominantly North American and Australian studies.	Review of 11 reviews of environmental correlates of physical activity and walking.	Consistent associations between access, perceived safety and aesthetic features of parks and physical activity. Limitations identified included lack of standardization of measurement, wide variety of methods used and reliance on cross-sectional study design.
Bedimo-Rung, <i>et al.</i> ²⁶	Not stated.	Literature review of the relationship between parks, physical activity and public health to support a conceptual model proposed.	Described health, social and economic benefits of parks. Proposed a conceptual model of the environmental attributes of a park that affects park use.
Kaczynski and Henderson ⁴⁷	Predominantly North American and Australian studies, although there were a few European studies cited.	Reviewed 50 quantitative studies that looked at the relationship between parks and physical activity.	For different types of parks and recreation settings, there were different associations seen. Generally, proximity to parks was associated with increased physical activity.
NICE ⁷²	Various	UK guidance based on five reviews examining whether environmental change affected physical activity levels.	Modification and promotion of parks may increase walking. However, difficulties in ascribing causality to associations. Lack of evidence, e.g. on the long-term effect of interventions to change behaviour or of the differential impact on different social groups, highlighting the need for further research.
Morris ⁵⁶	Not stated	Literature review (including grey literature) of black and minority ethnic groups and public open space.	Identified barriers to public open space use by black and minority ethnic groups.
Morris ⁷	Not stated	Literature review (including grey literature) of the relationship between health and open space.	Identified health, well-being, economic and social benefits of open space.
Owen <i>et al.</i> ⁴⁵	Various	Review of 18 quantitative studies on environmental influences on walking. 16 studies used cross-sectional design and 2 were prospective studies.	Aesthetic attributes and accessibility affected physical activity. Studies reported only a small variance in physical activity. There was also a consistency in the patterns of associations seen.
Pretty <i>et al.</i> ²⁵	Not stated	UK policy paper reviewing the determinants of health and well-being, and connections to nature/green exercise.	Reports benefits of natural settings on individual well-being. Also describes potential public health benefits of increasing green exercise.
Transportation Research Board ⁴³	Urban, USA	Summary paper on the role of the built environment on physical activity. Details of methodology not stated.	Growing body of evidence (mainly cross sectional) of association between built environment and physical activity levels.
Travlou ⁶⁸	Various	Literature review (including grey literature) of teenagers and public space.	Described the experience and perceptions of young people with regard to public space use.
Tzoulas and James ⁸⁴	European policy documents. Origin of research articles not stated.	Literature review of both policy documents and research articles of the role of urban green space and health.	Various studies reporting associations between urban green space and health and well-being. Proposed that good quality open space is related to better quality of life of urban residents.

Tzoulas <i>et al.</i> ⁷⁷	Not stated	Literature review of the associations between urban green space and health.	Studies suggest that green infrastructure may have a considerable potential for improving the health of urban residents. Proposed a conceptual model linking green infrastructure, ecosystem health and human health and well-being. Highlighted a need to evaluate the potential economic implications of green infrastructure.
Verheij ⁷⁸	Limited to studies from OECD countries.	Literature review of articles published between 1985 and 1994 on the relationship between health and people's environment.	Proposed that the extent to which the urban environment affected a person's health was dependent on the person's individual characteristics. Stated a need for large-scale studies.

Socioeconomic benefits of green space

Exposure to green spaces may have an impact on urban socioeconomic health inequalities.³⁸ Studies found that inner city and poor populations are less likely to report participation in outdoor recreation activities.^{26,39} Teenagers living in disadvantaged neighbourhoods for example lacked access to parks they considered safe and were therefore less likely to participate in physical activities than teens in more affluent neighbourhoods.⁴⁰ Another study noted that people in low-income households were more likely to adopt low levels of activity and were least well served by affordable facilities.⁴¹ Affluent residents, on the other hand, were more likely to live in close proximity to facilities of any type.

Socioeconomic differentials in physical inactivity are consistent with socioeconomic gradients in many health outcomes and may represent a key pathway through which socioeconomic status affects health.⁴² The unequal distribution of green space could account for some of the cross-cultural and socioeconomic variations in their use. Whilst access to green space appears to be implicitly linked with levels of deprivation, what cannot be discounted are confounding factors such as individual lifestyles that could have socioeconomic links.

Environmental determinants of physical activity and green space use

The presence itself of green space is unlikely to explain the public health benefits suggested and the relationship is likely to be complex and influenced by multiple factors including attributes of the environment and the individual.^{3,26,43,44} Environmental influences have been identified that appear to affect the use of green space and therefore leisure-time physical activity in these areas.⁴⁴ These include characteristics of the green space such as its features, condition, accessibility and safety.⁴⁵

Accessibility

Most studies to date have consistently reported the association between ease and convenience of access with either utilitarian forms of physical activity or leisure-time physical activity.^{9,24,45–49} This observation applied both to adults and children.^{50,51} People with very good access to large attractive green space were more likely to use it. Moreover, users were also more likely to achieve recommended levels of activity compared with non-users. Residential proximity to green spaces was also associated with increased levels of physical activity^{8,52–55} and the presence of barriers such as major roads was an influencing factor.⁴⁹ Whilst many studies have consistently noted the importance of access

and green space use, there have been exceptions. One British study using cross-sectional methodology failed to demonstrate such a relationship.³⁹ Of particular note, the authors in that study noted that positive associations reported in other articles 'appear to be restricted to specific types of green spaces and walking or cycling behaviour'.

Quality and availability of space

The quality and availability of green space may also have a bearing on its use.⁵⁴ This aspect includes issues of maintenance and availability of facilities and activities that affect the appeal of the green space.⁵⁶ People choose to use or not use green spaces not only for its features but also the condition of those facilities and features. Places in disrepair are less likely to be visited and contribute to a perceived sense of lack of safety.²⁶

User determinants of physical activity and green space use

The personal attributes of users can affect their physical activity levels and use of green space.⁴⁹ They include the following:

Age

Several studies observed variations in green space use by different age groups but the findings are inconsistent. Older persons and teenagers were commonly cited as more infrequent users^{42,57,58} but some studies report that young adults partake in more leisure-time physical activity in the presence of green space.⁴⁸ A decline in physical activity in adolescence was also reported with total participation time in physical activities falling by up to 37% between the ages of 15 and 18 years.^{59–61} This trend was particularly marked for teenage girls.

The causes for this are not clear, although possible explanations include social exclusion, stigma, boredom, fear of crime or harassment, racial and ethnic tensions, heavy traffic and litter.⁶² The appropriateness of the green space could be an issue for older children who were provided with only 'token spaces inappropriate to their needs'. In addition, in some areas, teenagers may experience hostile attitudes due to an inferred association with vandalism and crime in public space.⁶³ The inconsistencies in green space use by the different age groups therefore suggest a more complex relationship.

Gender, ethnicity and disability

Gender differences in green space use were also reported. Males used parks more than females, and were twice as

likely to be vigorously active.⁵² Women were more likely to walk purposefully rather than for exercise.⁸ Studies of park use also note that ethnic minorities and people with disabilities were less likely to use green spaces.^{38,42,56–58,64} One explanation given for these differences was the perception of 'safety'. However, the interaction between socioeconomic variables, gender, ethnicity and disability is complex and confounds associations reported. For example, women with low income or from lower socioeconomic status neighbourhoods were reported to differentially benefit from greater physical activity resource availability.⁶⁵ Furthermore, there were few empirical studies of racial and ethnic variation in park use, and much of the existing evidence was variable and anecdotal.⁵⁶ It is therefore difficult to tease out the relative contributions of the different factors implicated.

Psychological factors (e.g. self-efficacy, perceived barriers)

Several enabling factors positively associated with increased levels of walking and physical activity were identified. These include high individual motivation, positive attitude towards the process of being physically active and partaking in physical activity with a significant other.^{66,67} Conversely, personal barriers also exist such as being overweight, not enjoying exercise, being too old, a lack of time due to other commitments, ill health, injury or disability or concerns about the environment or unpredictable weather conditions.^{68,86,87} There was evidence from 14 corroborative studies that interventions were ineffective unless fundamental issues were addressed such as individual confidence to change behaviour, cost and availability and pre-existing concerns of the risks associated with walking and cycling.⁴⁶

Safety

Several studies and surveys reported an association between perceived safety and physical activity levels.^{8,40,53,68} For example, the state of disrepair of green space negatively affects its use by making it feel less safe.⁶⁹ One review noted that safety concerns were important for children, young people and their parents.⁴⁶ The perceived safety by women in particular was also associated with levels of walking, although there was no statistical association noted for men.

Limitations of the data

A major limitation for many studies has been the predominance of before-and-after and cross-sectional study design.^{45,48,49,70,71} Less than 20% of studies used a comparison group, a substantial number only measured physical activity levels after an intervention and a minority used an

appropriate measure of physical activity. The follow-up period was often short (at around 8 weeks) and most studies did not account for the fact that the intervention may have only had an impact on groups that were already active and not affected by the population as a whole. Many of the studies could not exclude selection bias or confounding.⁷⁰ In several studies the possibility of *reverse causality* could not be adequately excluded. For example, in studies examining physical activity levels and proximity to green space, it is unclear if this was a true association or whether the converse applied whereby individuals who were more physically active chose to move into particular neighbourhoods with proximity to green space.⁵⁸ There were also a number of studies where the relationships reported were null or not statistically significant.^{59–63} There was insufficient robust evidence of a causal association between green space and physical activity levels and it was difficult to ascertain to what extent the interventions or environmental attributes under examination were responsible for the changes seen.⁷² Some of the research was based on aesthetic and value judgements by both experts and non-experts⁷³ and articles not published in peer-reviewed journals, such as government and non-governmental documents, tended to quote anecdotal evidence to support their conclusions.

Despite these limitations, there was some consistency in the patterns of associations reported such as the effect of access and perception of safety on leisure-time physical activity levels. Although many studies reported only a small variance in physical activity levels, cumulatively on a population-wide basis these could be substantial. Furthermore, despite the limited number of gender-based studies, strong gender differences were reported. Much of the work has been based in American, Australian, Dutch and British settings. In view of the differences in ethnic composition and socioeconomic differences between these populations, it is unclear if findings from one urban area can be directly translated elsewhere.

Discussion

What is already known on this topic

Various reviews on this topic have been carried out but tended to be narrowly focused on a particular aspect of health, e.g. physical or mental. Our review sought to pull together the evidence holistically to include all aspects of health and well-being. Regular physical activity is important for health and well-being and current evidence suggests that individuals could derive health benefits by engaging in as little as 30 min of moderate exercise daily.^{70,71,85}

Unfortunately, physical activity levels in many developed countries have declined over recent decades with a shift towards more sedentary lifestyles.⁴³ Reversing this decline could confer considerable population health benefits.²⁵ To this end, the UK government set targets to increase levels of participation in physical activity and sport including measures for providing more cleaner, safer and greener public spaces.^{74,75} The importance of creating more good quality open space where it is lacking has also been echoed in the Marmot Review as a means of tackling health inequalities.⁷⁶ However, our review has found that the evidence for such policies is not strong.

Main finding of this study

Establishing a causal relationship between green spaces and health was difficult and reviews done so far have been based on weak studies. Even after socioeconomic factors are controlled for, the possibility of confounding cannot be excluded.⁷⁷ Conducting population surveys on distinct physical health problems are difficult as incidence or prevalence figures are often too low to do so and the time spans for benefits to materialize may be long.⁷⁸ Further research is needed to quantify the strength of association between green spaces and urban health, but also to investigate the psycho-social and economic dimensions that are more difficult to measure.^{77,79}

What this study adds

That said the reported findings in studies were generally consistent and supported the current view that urban design can facilitate physical activity and reduce impediments to exercise. Determinants such as the perception of safety, perception of attractiveness and pollution (air and noise) can also be favourably changed.⁷² There are also wider non-physical benefits such as impacts on wellbeing and mental health, as well as social inclusion.^{19,23,25,31,33,35,46}

Limitations of this study

The study of the determinants of urban health is complex. Cities are constantly changing resulting in differences in living conditions both within and between cities.¹ City-level analysis presumes a degree of homogeneity in individual behaviours but city-wide characteristics are not necessarily shared by all of its inhabitants equally. The availability of green space varies considerably between different urban areas and no universal standards exist that detail the optimal amount or characteristics of green space.

Assessments of the equity of access to green spaces may be useful and tools such as geographical mapping could be

used for this purpose. However, spatial studies that quantify measures such as proximity to parks poorly capture social dimensions such as the fear of crime. There are also difficulties capturing factors such as environmental barriers that hinder access such as the presence of heavily trafficked roads, lack of pedestrian crossings and quality of pavements. Individual factors, such as motivation to engage in physical activity, need addressing too.⁸⁰ As such, improving access alone may not increase physical activity levels.^{59,81,82}

Whilst there is some evidence and expert consensus to suggest that green spaces can facilitate physical activity, the evidence of a direct effect at present remains weak.⁶⁰ However, the available evidence does on balance suggest a positive association between green spaces and better health. Robust research is required to firmly establish and quantify the contribution of the different types of green spaces to urban health, and to distinguish walking and cycling benefits from other postulated benefits.^{39,83} Prospective urban developments involving green spaces could act as 'natural experiments' and provide research opportunities to examine their health impacts.

The relationship between green space and urban health is complex and other factors influence the observed associations. Health and urban planners need to be cognizant of this complexity as simplistic interventions may fail to address confounding factors, such as socioeconomic differentials whose roots are multi-faceted, that are less easily remediable by urban landscape redesign.

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