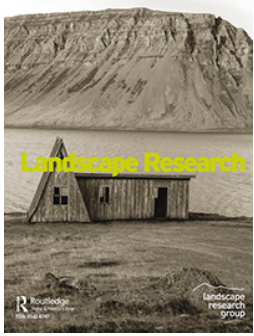


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Assessing equality in neighbourhood availability of quality greenspace in Glasgow, Scotland, United Kingdom

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ABSTRACT

We assess the relationship between neighbourhood-level deprivation and local greenspace quality in Glasgow, Scotland. There is interest globally in inequality within the accessibility of urban greenspace. It is recognised that social and political inequalities can lead to less well-off areas having less or lower-quality greenspace. We evaluate the relationship between neighbourhood-level deprivation and greenspace quality by combining socio-economic data with assessment of neighbourhood greenspace from Google Street View, subjecting our observations to statistical testing. On nearly all measures of greenspace quality, there is a statistically significant correlation between deprivation and greenspace quality, with more disadvantaged areas having lower-quality greenspace. We show it is not only the presence or extent of greenspace, but also the characteristics *within* greenspaces, that vary with deprivation. As existing research suggests, greenspace attributes such as tranquillity, greenness and perceived safety are important to unlock the health, wellbeing and resilience benefits that good quality greenspace can provide.

KEYWORDS

Deprivation; equality; Glasgow; green-space; justice

1. Introduction

The climate emergency and COVID-19 pandemic have energised discussion on inequality in availability of greenspace within cities. It has long been recognised in international scholarship on environmental justice that greenspace may disproportionately accrue to wealthier or more privileged areas within cities (Anguelovski et al., 2019; Pearsall, 2010; Pham, Apparicio, Séguin, Landry, & Gagnon, 2012). However, the COVID-19 pandemic in particular has drawn attention to the need not just for greenery, but for good *quality* greenspace in close proximity to residents if health, wellbeing and social capital is to be maintained under external stresses and pressures (Cole et al., 2020; Honey-Rosés et al., 2020). Given increasing scholarly and policy attention to the importance of community resilience in cities in the face of a changing climate and increased shocks, stresses and extreme events (Bush & Doyon, 2019; Meerow, Pajouhesh, & Miller 2019), disparity in access to quality greenspace and the benefits it can provide to residents is thus especially problematic. Our paper responds to this challenge by assessing the linkages between the characteristics and qualities of specific greenspaces and neighbourhood deprivation, across

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one city where both greenspace and societal wellbeing issues take prominence – Glasgow in Scotland, United Kingdom.

2. Scholarly background

It is well established that greenspace offers significant physical and mental health benefits to urban dwellers (Pearce, Shortt, Rind, & Mitchell, 2016). Nonetheless, there is a burgeoning body of evidence to suggest that abundant, good-quality and accessible greenspace may disproportionately accrue to more affluent neighbourhoods. This has been illustrated in the United Kingdom, where it has been demonstrated that economically deprived neighbourhoods have fewer accessible, high-quality public greenspaces, and that residents in these areas experience poorer health than those who live in green environments (Mell & Whitten, 2021). This trend is also reflected in findings from a breadth of contexts including the USA (Hoffman, Shandas, & Pendleton, 2020; Nyelele & Kroll, 2020); South Africa (Venter, Shackleton, van Staden, Selomane, & Masterson, 2020); and China (Song et al., 2021). A parallel body of research also indicates that greenspace not only supports positive health outcomes in cities, but can facilitate social interaction and build a sense of community; support environmental learning; and maintain pride, identity and social memory. These broader benefits have again been argued both in the UK (Mears, Brindley, Maheswaran, & Jorgensen, 2019); and across international contexts with similar environmental and climatological characteristics to the UK including Sweden (Barthel, Parker, Folke, & Colding, 2014) and Germany (Bendt, Barthel, & Colding, 2013).

These immediate health benefits and the additional societal positives provided by urban greenspaces are argued to support wellbeing – defined as happiness and life satisfaction (Houlden, Weich, Porto de Albuquerque, Jarvis, & Rees, 2018) – and resilience in terms of being able to absorb, respond to and recover from pressures and disturbances (Miller, 2020; Walker, 2020). International scholarship into natural hazards argues that disadvantaged people and neighbourhoods are likely to be at greater risk from environmental or socio-economic shocks and stresses (Cutter, Boruff, & Shirley, 2003; Meerow et al., 2019). In turn, research in both the UK (Fairburn, Maier, & Braubach, 2016) and in analogous contexts such as Norway (Mouratidis, 2020) has argued that for residents of disadvantaged neighbourhoods in particular, greenspace may be a significant contributor to resilience and hence to reducing the impacts of external shocks and stresses.

Under a climate emergency where vulnerable places and people will be disproportionately exposed to extreme events and to a breadth of stresses and pressures, there is hence an increasingly pressing need to understand the linkages between greenspace quality and deprivation. The COVID-19 pandemic has served only to focus debate on the importance of – yet disparity in – access to good quality greenspace to support resilience and wellbeing in cities (Honey-Rosés et al., 2020). Such research is needed not only to identify priority areas where urban greening expansion or improvement may provide the most benefit (Byrne et al., 2016), but also to illuminate historical and structural processes which have led to greening and investment accruing to wealthier and more empowered neighbourhoods. In this regard, assessing and visualising the spatial links between greenspace and deprivation can provide a powerful account of the physical effects of planning and policy decisions in the past, and their continued effects in the present. For instance, research in the USA and subsequent media coverage has sparked discussion on how the effects of ‘redlining’ – a historical practice informing the provision of financial and other services to neighbourhoods, closely associated with racial discrimination – continues to affect greenspace distribution and exposure to heat hazard today (Hoffman et al., 2020; Plumer & Popovic, 2020). Similarly, it has been argued that Apartheid and colonial legacies mean that black South Africans’ needs and experiences of urban nature continue to be side-lined in urban greenspace planning, and have also left South Africa with a legacy of European invasive species

(Shackleton & Gwedla, 2021). Such legacies – whilst perhaps not as pronounced – are also visible in the UK. Mears et al. (2019) in the case of Sheffield hold that greenspace distribution is driven by the location of working-class neighbourhoods in the late 19th Century and public health measures at the time to improve wellbeing, but that greenspaces in these more deprived neighbourhoods have not been maintained in more recent times. Whitten (2019) adds in the context of London that more deprived communities, who may be less empowered to be able to protect greenspace, are affected hardest by long-term cuts to local government greenspace funding.

Nonetheless, while there are ample illustrations of the linkages between greenspace distribution and socio-economic factors that use census data and remote sensing-based techniques to understand greenspace distribution (Hoffmann, Barros, & Ribeiro, 2017; Majekodunmi, Emmanuel, & Jafry, 2020; Pham et al., 2012), much less prevalent in the literature are attempts to assess the quality and characteristics of greenspace from ground level in a systematic city-wide way. Factors such as perceived safety, accessibility and quality are all argued to influence the benefit residents may derive from greenspaces (Hoffmann et al., 2017; Mouratidis, 2020). Although some of these factors are of course most effectively assessed at a site level through direct input from residents, looking for visual cues such as lighting, shade and access points in a systematic way across a whole city may help to give a fuller understanding of greenspace quality and how it relates to deprivation in a neighbourhood than can be gleaned from a top-down view.

The purpose of this paper is therefore to exemplify a more nuanced way of understanding the linkages between greenspace quality and neighbourhood deprivation across a whole city, through the use of Google Street View to assess greenspace characteristics for Glasgow (Scotland, United Kingdom) and subsequent comparison with neighbourhood deprivation indices. Whilst Street View has been used in a greenspace context to provide a richer understanding of greenspace abundance (Larkin & Hystad, 2019; Li et al., 2015) and assess links between greenspace and physical activity (Lu, 2019), attempts to link greenspace quality with a broader set of socio-economic factors are more limited. In this paper, we hence demonstrate a methodology for systematically and empirically understanding whether greenspace with positive characteristics may disproportionately accrue to more affluent areas, and what the implications of this may be for health, wellbeing and resilience at the neighbourhood level.

3. Context

Glasgow is the largest city in Scotland, UK, with a population of approximately 600 000 in Glasgow City and 1.8 million in the larger Glasgow City Region. The city and wider region has significant policy urgency around redressing lower life expectancies, higher instances of chronic illness and health inequalities compared to the rest of Scotland and western Europe. These are referred to as the 'Glasgow Effect', and are linked to historical factors including urban change, lower social capital, and a negative physical environment (Cowley, Kiely, & Collins, 2016; Walsh, McCartney, Collins, Taulbut, & Batty, 2017). This urgency around wellbeing comes against a backdrop of increasing risk from changes in the climate. A large proportion of neighbourhoods along the River Clyde in Glasgow City have been identified as being at acute or extreme flood disadvantage (Kazmierczak, Cavan, Connelly, & Lindley, 2015). Neighbourhoods in Glasgow are also at particular risk from extreme heat due to a combination of climatological and socio-economic factors (Majekodunmi et al., 2020; O'Neill & Tett, 2019). In the Glasgow context, there is hence a strong imperative to make links between climate adaptation and resilience, and public health and wellbeing benefits. This feeds into a context where social inequality, and its potential implications for vulnerability and resilience, have comparatively high prominence.

In response to these multiple challenges, local governments and public sector institutions in Glasgow have engaged enthusiastically with resilience thinking and redressing inequality. Recent

research into public health issues in Glasgow has recommended improving greenspace access and quality within deprived areas in the city (Walsh et al., 2017). Indeed, greenspace, as part of broader nature-based approaches, play an important role in realising responses to environmental and societal challenges in the city. Glasgow City Region in 2021 launched the Glasgow City Region Adaptation Strategy, an overarching document to guide climate adaptation in the Glasgow City Region. One of the interventions proposed within the strategy is to 'deliver nature-based solutions for resilient blue-green ecosystems, landscapes and neighbourhoods', within which there is a strong steer towards targeting urban greening interventions at the most environmentally and socially vulnerable people and places (Climate Ready Clyde, 2021).

For nature-based approaches to resilience and adaptation, Glasgow City Council has engaged with Europe-wide initiatives such as the European Union Horizon 2020-funded Connecting Nature project (Connecting Nature, 2020), where it acted as a front-runner city and drew on collaboration and international expertise to develop a city-wide Open Space Strategy (Glasgow City Council, 2020). As part of the process of developing and implementing its Open Space Strategy, Glasgow City Council conducted an audit of its open spaces and accessibility and quality standards; and has produced a publicly-available online GIS 'dashboard' of greenspaces in the city that integrates demographic and socio-economic with environmental data (Glasgow City Council-Connecting Nature, n.d.). The city is currently in the process of developing a delivery plan for the Open Space Strategy, which will be developed in consultation with communities and local organisations and will set out how the multiple benefits people may derive from greenspaces can be realised simultaneously. Lastly, in line with previous research noting the prevalence of vacant and derelict land within Glasgow and its potentially negative effects for neighbouring communities (Maantay, 2013; Maantay & Maroko, 2015; White & Bunn, 2017), Glasgow City Council has worked to map vacant and derelict land and to aims to provide funding bring such land into productive use (Glasgow City Council, n.d.).

The assessment of deprivation at neighbourhood level is well covered in Scotland through the Scottish Index of Multiple Deprivation (SIMD). SIMD a statistical tool used by local authorities, the Scottish Government, the National Health Service in Scotland and other government bodies to support policy and decision making – specifically to target government action in areas which need it the most. SIMD incorporates several different aspects of deprivation (indicators contributing to income, employment, health, education, housing, geographic access and crime) and combines these into a single index providing a measure of deprivation for each Data Zone (roughly neighbourhood/community sized). The SIMD identifies deprived areas and not deprived people (Public Health Scotland, 2020). Notably, in their review of the 'Glasgow Effect', Walsh et al. (2017) noted that there was previously a lack of good socio-economic data available to understand deprivation, a gap which the SIMD helps to fill.

4. Method

The research focussed on greenspaces and neighbourhoods within the boundaries of Glasgow City Council. The tool used to assess the quality of greenspaces was Google Street View, which has been used elsewhere in greenspace research (Li et al., 2015; Lu, 2019) and environmental vulnerability research more broadly (Curtis, Curtis, Mapes, Szell, & Cinderich, 2013; Mabon, 2016) as a way of remotely and systematically assessing local environments from 'ground level'. The aim in doing so, as above, was to build on extant research and ongoing policy and practice initiatives in Glasgow to understand and redress inequalities in greenspace provision, by providing a systematic city-wide assessment of greenspace quality from the ground level to complement extant top-down and site-specific work. In other words, we sought to understand whether deprivation was linked not only to greenspace abundance, but also greenspace *quality*.

Glasgow was divided into the Data Zones used in SIMD 2016 (see simd.scot and <https://www2.gov.scot/Topics/Statistics/SIMD>). All of the 264 Data Zones within the boundary of Glasgow City Council were assessed. Within each Data Zone, greenspace quality was assessed using two approaches. First was to identify formal greenspaces in the Data Zone using Glasgow City Council's Parks, Play Areas, Cemeteries and Outdoor Recreation GIS portal (<https://glasgow-gis.maps.arcgis.com/apps/webappviewer/index.html?id=d94b9f705a8441768cb90f04f7932e57>), which includes the location of and information on all greenspaces managed by Glasgow City Council within the Glasgow City area. Evaluation was carried out by looking at the greenspace through Street View, as well as information on facilities provided on the GCC GIS portal and travel distance calculations provided by Google Maps (see Table 1). All of the 'formal' greenspaces managed by Glasgow City Council across the whole city were therefore assessed. Second was to take ten random locations within each Data Zone which appeared to represent greenspace from the satellite view on Google Maps but were not listed on the GCC GIS portal, as a means of understanding the extent and quality of 'informal' greenspaces in each neighbourhood. As these greenspaces were selected at random based on what appeared green from satellite view, they therefore included vacant and derelict land. We felt it was important to include vacant and derelict land in the survey, as vacant and derelict land represents a type of open space which is a critical issue in Glasgow and one which is argued to disproportionately expose more deprived communities to blight and environmental burdens (Maantay, 2013; Maantay & Maroko, 2015).

These Street View observations were used to assign a Likert-type score to the characteristics (5 = excellent; 4 = good; 3 = average; 2 = poor; 1 = very poor). Table 1 shows the coding guide that was used to determine the 'score' given to each data zone.

For each greenspace, the SIMD decile of the data zone was noted alongside the scores for greenspace quality rating as per Table 1 and the process outlined above. An 'overall score' for the overall quality of each greenspace – the sum of the scores assigned under each characteristic – was also calculated. The numerical data were inputted into SPSS as a basis for statistical analysis. It is worth acknowledging that whilst the coding guide and Likert-type scale was developed jointly by both authors involved in research, the scores applied in the paper are based on those assigned by one researcher. Handing a subset of the data to an additional researcher to code would have been one way of assessing intercoder reliability.

5. Results

5.1. Descriptive statistics

Tables 2 and 3 provide descriptive summaries of the data. What is notable is that on the whole, greenspaces in Glasgow score highly for physical accessibility, security and proximity to bus routes; but score less well for greenness, aesthetics, and tranquillity.

Prior to statistical testing, the data were tested for normality by calculating skewness scores and Shapiro-Wilk tests of normality. On this basis, the variables 'Overall Score' and 'Well-Kept' were determined to be subjected to parametric testing (One-Way ANOVA); whereas all other variables were determined to be subjected to non-parametric testing¹ (Kruskal–Wallis Test). Note also that data was deemed to be ordinal because the values represent categories with some intrinsic ranking. Nevertheless, in order to run the Kruskal–Wallis Test, the data needed to be treated as scales. The p-value against which the data was compared was 0.05.

Table 1. Coding guide for greenspace characteristics.

Characteristic	5 (Excellent)	4 (Good)	3 (Average)	2 (Poor)	1 (Very poor)
Accessibility	Open at all times and wheelchair access	Gates or lack of wheelchair access	Gates and lack of wheelchair access; or other obstructions	Gates and lack of wheelchair access; and other obstructions	No access
Security	Lively and safe surrounding area, i.e. well-lit with good visibility and close to visibly inhabited buildings. Excellent state	Dark/badly-lit area or close to empty shops/buildings	Both dark/badly-lit and close to empty shops/buildings	Visibly abandoned and derelict buildings	Combination of darkness/poor lighting and visible dereliction
Cleanliness		Noticeable litter on the ground	Large amounts of litter	Dumping/fly-tipping	Combination of litter and dumping
Greenness	Forest/large park with lots of vegetation	Park with vegetation	Park with scarce vegetation	Greenspace with grass and scarce trees	Greenspace with little grass and few trees
Well-kept	Grass cut and clean with no brown patches, flower pots filled, trees trimmed, equipment in good shape, surroundings neat and tidy	Good condition but not excellent, e.g. empty flower beds	Not well looked-after but functional	Limited evidence of maintenance	Derelict or abandoned
Aesthetics	Exceptional beauty, for instance lakes, flowerbeds etc.	Some visually pleasing features in landscape	Average	Functional green landscape	Visibly degraded environment
Biodiversity	Greenspace labelled as nature reserve, wildlife reserve etc.	Visibly high biodiversity	Fewer than 10 visually identifiable species	Fewer than 5 visually identifiable species	1–2 species of trees/bushes
Tranquillity	Secluded area away from major roads or large buildings, or greenspace large enough that centre is secluded	Secluded area close to train tracks, or with other occasional noise	Close to busy road, but big enough to have a calm centre; next to small neighbourhood road	Next to busy road	Next to construction or motorway
Facilities	At least 3 activities and space for events	3 activities	2 activities (usually playing field and playground)	1 activity (usually playground)	None
Nearest metro	<1 min walk	<5 min walk	<15 min walk	<30 min walk	30 min + walk
Nearest bus	<1 min walk	<5 min walk	<15 min walk	<30 min walk	30 min + walk
Nearest train	<1 min walk	<5 min walk	<15 min walk	<30 min walk	30 min + walk

Table 2. Descriptive statistics for each of the greenspace categories.

Characteristic	Mean	Median	Mode	Standard deviation
Accessibility	4.14	4	5	1.007
Security	4.50	5	5	0.939
Cleanness	4.18	5	5	1.129
Greenness	2.94	3	2	1.334
Well-kept	3.03	3	3	1.248
Aesthetics	2.38	2	1	1.267
Biodiversity	2.18	2	1	1.360
Tranquillity	2.75	2	2	1.384
Facilities	1.70	1	1	1.008
Nearest metro	1.45	1	1	1.088
Nearest bus	4.73	5	5	0.578
Nearest train	2.58	2	1	1.470

Table 3. Frequency of scores for each greenspace characteristic.

Characteristic	5 (Excellent)	4 (Good)	3 (Average)	2 (Poor)	1 (Very poor)
Accessibility	117 (44.3%)	97 (36.7%)	30 (11.4%)	11 (4.2%)	9 (3.4%)
Security	188 (71.2%)	40 (15.2%)	20 (7.6%)	11 (4.2%)	5 (1.9%)
Cleanness	139 (52.7%)	75 (28.4%)	25 (9.5%)	9 (3.4%)	16 (6.1%)
Greenness	52 (19.7%)	32 (12.1%)	65 (24.6%)	77 (29.2%)	38 (14.4%)
Well-kept	39 (14.8%)	57 (21.6%)	76 (28.8%)	57 (21.6%)	35 (13.3%)
Aesthetics	24 (9.1%)	25 (9.5%)	62 (23.5%)	70 (26.5%)	83 (31.4%)
Biodiversity	29 (11%)	19 (7.2%)	40 (15.2%)	58 (22%)	118 (44.7%)
Tranquillity	44 (16.7%)	38 (14.4%)	47 (17.8%)	78 (29.5%)	57 (21.6%)
Facilities	5 (1.9%)	12 (4.5%)	40 (15.2%)	49 (18.6%)	158 (59.8%)
Nearest metro	14 (5.3%)	10 (3.8%)	9 (3.4%)	14 (5.3%)	217 (82.2%)
Nearest bus	208 (78.8%)	44 (16.7%)	9 (3.4%)	3 (1.1%)	0 (0%)
Nearest train	40 (15.2%)	41 (15.5%)	43 (16.3%)	49 (18.6%)	91 (34.5%)

5.2. One-Way ANOVA

5.2.1. Overall score

For the overall score, there was a statistically significant difference between data zones in different SIMD deciles as determined by one-way ANOVA ($F(9,254) = 6.07$; $p = 0.00$).

A Tukey Honestly Significant Difference post-hoc test revealed a statistically significant difference between SIMD 1 ($M = 33.80$, $SD = 7.356$) and 3 ($M = 39.57$, $SD = 7.763$) ($p = 0.015$); SIMD 1 ($M = 33.80$, $SD = 7.356$) and 8 ($M = 43.07$, $SD = 7.066$) ($p = 0.000$); SIMD 1 ($M = 33.80$, $SD = 7.356$) and 9 ($M = 43.50$, $SD = 6.613$) ($p = 0.000$); SIMD2 ($M = 34.96$, $SD = 6.388$) and 8 ($M = 43.07$, $SD = 7.066$) ($p = 0.004$); SIMD2 ($M = 34.96$, $SD = 6.388$) and 9 ($M = 43.50$, $SD = 6.613$) ($p = 0.006$); SIMD4 ($M = 33.53$, $SD = 5.194$) and 8 ($M = 43.07$, $SD = 7.066$) ($p = 0.007$); and SIMD4 ($M = 33.53$, $SD = 5.194$) and 9 ($M = 43.50$, $SD = 6.613$) ($p = 0.009$).

At a very high level, these results indicate that within Glasgow City, there is a significant difference in overall greenspace quality between areas experiencing high deprivation (especially the most deprived deciles of SIMD1 and 2); and areas experiencing the lowest levels of deprivation.

5.2.2. Well-kept

For the well-keptness of the spaces, there was a statistically significant difference between groups as determined by one-way ANOVA ($F(9,254) = 4.78$; $p = 0.00$).

A Tukey Honestly Significant Difference post-hoc test revealed a statistically significant difference between SIMD 1 ($M = 2.60$, $SD = 1.250$) and 8 ($M = 3.93$, $SD = 0.961$) ($p = 0.002$); SIMD 1 ($M = 2.60$, $SD = 1.250$) and 9 ($M = 3.75$, $SD = 0.754$) ($p = 0.049$); SIMD 1 ($M = 2.60$, $SD = 1.250$) and 10 ($M = 4.13$, $SD = 0.990$) ($p = 0.000$); SIMD2 ($M = 2.96$, $SD = 1.271$) and 10 ($M = 4.13$, $SD = 0.990$) ($p = 0.028$); and SIMD4 ($M = 2.60$, $SD = 0.986$) and 10 ($M = 4.13$, $SD = 0.990$) ($p = 0.015$).

Again, this indicates a significant difference in the well-keptness of greenspaces between the most- and least-deprived areas, especially the most deprived areas in SIMD1.

5.3. Kruskal-Wallis

A Kruskal-Wallis Test revealed statistically significant differences between SIMD deciles for security (χ^2 (9, $n = 264$) = 38.178, $p = 0.000$); cleanness (χ^2 (9, $n = 264$) = 20.986, $p = 0.013$); greenness (χ^2 (9, $n = 264$) = 29.313, $p = 0.01$); aesthetics (χ^2 (9, $n = 264$) = 35.464, $p = 0.000$); biodiversity (χ^2 (9, $n = 264$) = 27.937, $p = 0.001$); tranquillity (χ^2 (9, $n = 264$) = 27.297, $p = 0.001$); facilities (χ^2 (9, $n = 264$) = 18.973, $p = 0.025$); nearest metro station (χ^2 (9, $n = 264$) = 20.978, $p = 0.013$); and nearest bus (χ^2 (9, $n = 264$) = 41.438, $p = 0.000$).

A Kruskal-Wallis Test revealed statistically significant non-significant differences for accessibility (χ^2 (9, $n = 264$) = 4.375, $p = 0.885$); and nearest train (χ^2 (9, $n = 264$) = 15.040, $p = 0.090$).

These results suggest that across nearly all characteristics of greenspace, there is a statistically significant difference in assessed quality between the least deprived data zones and the most deprived, with greenspaces in more deprived areas scoring lower on the indicators of green-space quality.

6. Discussion

Our findings indicate that across nearly all domains, there is a significant difference in the quality of greenspace between the least- and most deprived data zones within Glasgow City. This supports recent quantitative research in Glasgow, which suggests that greenspace is not equitably distributed across the city and is lacking in the most deprived areas (Majekodunmi et al., 2020); and also reflects the qualitative concerns of García-Lamarca & Gray (2021) that the notable enthusiasm for improving and enhancing open- and greenspaces in Glasgow may not necessarily benefit the most vulnerable and deprived places. This is also consistent with the extensive body of qualitative and spatial literature from a breadth of global contexts (Byrne et al., 2016; Song et al., 2021; Venter et al., 2020) indicating that urban greening and its benefits may disproportionately accrue to wealthier or less deprived neighbourhoods within cities. However, our study illustrates that these disparities affect not just the presence or abundance of greenspace in a neighbourhood, but also the qualities associated with green and open spaces and thus the potential for citizens to engage with and derive benefit from them.

This finding is significant because existing research indicates that local availability of greenspace is important for physical activity, social connectivity and positive physical health outcomes (Richardson, Pearce, Mitchell, & Kingham, 2013); and also for mental health benefits (Chang et al., 2020). However, this existing research also holds that greenspace characteristics such as tranquillity (Waters, Warren, Ratcliffe, & Godefroy, 2021), sense of safety (Hong et al., 2018) and perceived green-ness (Loder, Schwerdtfeger, & Van Poppel, 2020) are critical components of realising these benefits. As such, even though greenspaces are promoted as a health, wellbeing and resilience-building strategy for more deprived areas (Twohig-Bennett & Jones, 2018), the Glasgow City findings reflect what has been observed in Glasgow (Maantay, 2013) and elsewhere in the UK (Mears et al., 2019), namely that residents in more deprived areas may not have access to *quality* green and open spaces.

A second discussion point concerns a move from thinking about greenspaces in terms of their health and wellbeing benefits at a site level, towards conceptualising green and open space as part of a broader suite of nature-based solutions providing societal and environmental benefits such as resilience and climate risk reduction. Indeed, both Glasgow City Council's Open Space Strategy and the Glasgow City Region Climate Adaptation Strategy make this

move towards embedding greenspace within broader approaches to nature-based solutions at a city-wide level (Climate Ready Clyde, 2021; Glasgow City Council, 2020). Our research has focussed largely on the physical characteristics of greenspaces and their potential benefits to communities' wellbeing. However, it is notable in our results that perceived biodiversity and perceived greenness are significantly lower in more deprived areas within Glasgow. Interest is growing rapidly in potential socio-economic inequalities in the ecosystem services provided by urban greenspaces within a nature-based solutions framing (Langemeyer & Connolly, 2020). Previous research in Glasgow has indeed suggested that more deprived areas benefit less from the heat mitigation and flood risk reduction potential of greenspaces (Majekodunmi et al., 2020). Healthy and biodiverse greenspaces may be reflective of the potential of a local ecosystem to deliver such ecosystem services (Aronson et al., 2017). As such, the lower perceived greenness and biodiversity, which was statistically significant for more deprived areas in our study, may give further indication that greenspaces in more deprived areas of Glasgow are less able to provide neighbourhoods with a breadth of social *and* ecological resilience benefits.

This claim of course requires further empirical verification by drawing in urban ecological knowledge and thinking in terms of a city-wide green network (Hislop, Scott, & Corbett, 2019). Further research may hence wish to build on emerging interest in using new media to assess local ecosystem services (Guerrero, Møller, Olafsson, & Snizek, 2016); and develop applications of Street View-based research for systematic remote evaluation of greenspaces in a way that goes beyond landscape or recreational factors (Li et al., 2015; Lu, 2019). Moreover, consideration also ought to be given within planning and decision-making as to some of the tensions and trade-offs that may exist between greenspace types. As Burgess (2002) has noted, for instance, woodland greenspaces may be perceived to be more dangerous and unwelcoming, and may be less likely to be accepted by communities.

Finally, it is vital to reflect on the implications of how findings from research like ours are interpreted. We acknowledge the concerns of Power, Neville, Devereux, Haynes, and Barnes (2013) that uncritical map-based representations of 'deprived' or 'vulnerable' areas may do more harm than good by reinforcing existing stigma. For this reason, although all data sources on which this paper is based are publicly available, we have refrained from naming specific locations or constructing maps of 'disadvantage' in this paper. Following the Slater (2013) critique of 'neighbourhood effects' research, it is also imperative that one does not read results such as ours as suggesting that the health, wellbeing and indeed resilience outcomes of deprived neighbourhoods can be enhanced simply by 'improving' the quality of greenspaces or the surrounding built environment. Rather, following exemplary recent work such as Hoffman et al. (2020) on red-lining practices in the USA and Shackleton and Gwedla (2021) on how Apartheid legacies continued to affect greenspace distribution in South African cities, quantitative and spatial assessments of greenspace inequality ought to be considered a starting point for stimulating discussion on *why* such disparities occur, and what broader actions in areas such as social policy and urban planning may need to be taken to redress underpinning inequalities. It is especially important to situate current disparities in greenspace quality, both in Glasgow and the wider UK plus analogous contexts, in light of historical processes that have traditionally precluded the development of greening initiatives through cycles of disinvestment and stigmatisation (García-Lamarca & Gray, 2021; Mears et al., 2019; Whitten, 2019).

Moreover, work such as that by Butler, Schafran, and Carpenter (2018) illustrates that residents' own lived and embodied experiences of and relationships to place 'on the ground' may be very different to the perceptions of external viewers and assessors. Caution thus ought to be exercised not to assign too much weight to external assessments of factors such as 'safety' and 'aesthetic quality', especially if it leads to policy or planning interventions being forced on a locality in a way that may be viewed as patronising or unwanted. Possible strategies to more sympathetically make use of city-wide assessments of greenspace quality may hence include

involving communities themselves in data collection and analysis (Fifield, 2020); explicitly including environmental and climate justice into deprivation indices (Fairburn et al., 2016; Kazmierczak et al., 2015); or applying equity lenses to urban and greenspace planning (Cave, Kim, Viliani, & Harris, 2020; Horst, McClintock, & Hoey, 2017) as a way of more carefully understanding how interventions may affect people differently according to demographic or socio-economic characteristics.

6.1. Limitations

It is important to acknowledge we focussed mainly on 'formal' greenspaces as defined by Glasgow City Council in this study, although we did attempt to capture broader greenspace quality in each neighbourhood through assessing randomly-selected points in the local environment. Research elsewhere has demonstrated the value of informal (Rupprecht & Byrne, 2014) and/or temporary (Hou, 2020) greenspaces in promoting social interaction and wellbeing; and, conversely, the negative effects that vacant and derelict open spaces may have on neighbouring communities (Maantay & Maroko, 2015). Further research may thus wish to more fully assess the qualities and characteristics of informal greenspaces, and especially the differences in the quantities, qualities and characteristics of formal *versus* informal greenspaces within a neighbourhood. Nonetheless, as a proxy for the level of historical attention and investment in the planned environment from city-scale actors in a neighbourhood, the characteristics of formal greenspaces form a good basis for understanding differences across cities such as Glasgow.

There is also a degree of subjectivity in the use of Street View to assess environmental 'quality'. As per previous research (Mabon, 2016), factors such as weather, time elapsed since images were taken (meaning that Street View shows the past and not the 'real world' as it is now), and differing time and dates of images between locations can lead to inconsistencies in how the virtual environment is viewed and assessed. The scores applied in our paper are also based on those assigned by one researcher, and could be cross-checked for intercoder reliability by getting a second researcher to code a sub-set of the data.

Finally, it is important not to be overly critical of greenspace efforts in Glasgow itself. As laid out in Section 2, Glasgow City Council has pro-active and capable greenspace and planning teams, committed to both social justice and technically-appropriate urban greening capable of responding to future climate and environmental challenges (Connecting Nature, 2020). This is supported by efforts across the Glasgow City Region to develop a multifunctional green network capable of delivering a number of social and environmental benefits (Hislop et al., 2019); and to develop just responses to climate change challenges (Climate Ready Clyde, 2018). The need for greenspaces to benefit disadvantaged areas, and to take concrete action for this to happen under a backdrop of environmental and social pressures, is thus well understood in the city. Studies such as ours can support this effort by supplementing existing top-down map-based assessments of greenspace across Glasgow City and site-specific consultations with residents with a systematic and city-wide 'on the ground' view of greenspace quality and its links to deprivation. As per our points above, our assessment may provide a starting point for discussions with communities and with local stakeholders on their own experiences of greenspace quality, and of how the different greenspace functions that Glasgow City Council wishes to encompass within its Open Space Strategy (Glasgow City Council, 2020) may be balanced with one another.

7. Conclusion

In this paper, we assessed greenspace quality across different neighbourhoods in Glasgow according to levels of socio-economic deprivation. This is a relevant topic given increasing

international interest in the social, cultural and political factors leading to unequal distribution of greenspace within cities; and the increased awareness of health and wellbeing benefits of neighbourhood greenspace raised by the COVID-19 pandemic. Through quantitative analysis drawing on socio-economic data and assessment of greenspace quality through Google Street View, we found that neighbourhood deprivation closely correlates to the quality of local greenspace in a statistically significant way, such that more deprived areas tend to have lower-quality greenspace. Our findings make a contribution to the international literature by showing not only that greenspace and green abundance varies by deprivation, but also that a wide range of qualities found within greenspaces vary according to neighbourhood deprivation. Given that greenspaces are promoted for disadvantaged areas in particular as a means of supporting physical and mental health and social connectivity, the lower quality of greenspace in these areas may prevent residents realising these benefits to their full potential. Nevertheless, it is vital not to stop at merely observing such disparities, or to come to the conclusion that improving greenspace quality alone will enhance resilience in disadvantaged areas. Rather, spatial and statistical findings such as ours should be used as a starting point to reflect on the social and political processes that lead to such uneven geographies in the first instance, and on the structural actions that may be required to remedy these inequalities.

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Note

1. However, accessibility, greenness, aesthetics, biodiversity, tranquillity and nearest bus were parametric for some SIMD.

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References

- Anguelovski, I., Connolly, J. J. T., Pearsall, H., Shokry, G., Checker, M., Maantay, J., ... Roberts, J. T. (2019). Why green "climate gentrification" threatens poor and vulnerable populations. *Proceedings of the National Academy of Sciences of the United States of America*, 116(52), 26139–26143. doi:10.1073/pnas.1920490117
- Aronson, M. F. J., Lepczyk, C. A., Evans, K. L., Goddard, M. A., Lerman, S. B., MacIvor, J. S., ... Vargo, T. (2017). Biodiversity in the city: Key challenges for urban green space management. *Frontiers in Ecology and the Environment*, 15(4), 189–196. doi:10.1002/fee.1480
- Barthel, S., Parker, J., Folke, C., & Colding, J. (2014). Urban gardens: Pockets of social-ecological memory. In *Greening in the red zone* (pp. 145–158). Dordrecht: Springer Netherlands. doi:10.1007/978-90-481-9947-1_11
- Bendt, P., Barthel, S., & Colding, J. (2013). Civic greening and environmental learning in public-access community gardens in Berlin. *Landscape and Urban Planning*, 109(1), 18–30. doi:10.1016/j.landurbplan.2012.10.003
- Burgess, J. (2002). 'But is it worth taking the risk?': How women negotiate access to urban woodland: a case study. In R. Ainley (Ed.), *New frontiers of space, bodies and gender* (pp. 133–146). Boca Raton, FL: Routledge. doi:10.4324/9780203019382-14
- Bush, J., & Doyon, A. (2019). Building urban resilience with nature-based solutions: How can urban planning contribute? *Cities*, 95, 102483. doi:10.1016/j.cities.2019.102483
- Butler, A., Schafraan, A., & Carpenter, G. (2018). What does it mean when people call a place a shithole? Understanding a discourse of denigration in the United Kingdom and the Republic of Ireland. *Transactions of the Institute of British Geographers*, 43(3), 496–510. doi:10.1111/tran.12247
- Byrne, J., Ambrey, C., Portanger, C., Lo, A., Matthews, T., Baker, D., & Davison, A. (2016). Could urban greening mitigate suburban thermal inequity?: The role of residents' dispositions and household practices. *Environmental Research Letters*, 11(9), 095014. doi:10.1088/1748-9326/11/9/095014
- Cave, B., Kim, J., Viliani, F., & Harris, P. (2020). Applying an equity lens to urban policy measures for COVID-19 in four cities. *Cities & Health*, 1–5. doi:10.1080/23748834.2020.1792070
- Chang, H.-T., Wu, C.-D., Wang, J.-D., Chen, P.-S., Wang, Y.-J., & Su, H.-J. (2020). Green space structures and schizophrenia incidence in Taiwan: Is there an association? *Environmental Research Letters*, 15(9), 094058. doi:10.1088/1748-9326/ab91e8
- Climate Ready Clyde. (2018). *Towards a Climate Ready Clyde: Climate risks and opportunities for Glasgow city region key findings and next steps*. Retrieved from <http://climatereadyclyde.org.uk/wp-content/uploads/2018/11/Climate-Ready-Clyde-Climate-Risk-and-Opportunity-Assessment-Key-findings-and-next-steps.pdf>
- Climate Ready Clyde (2021). *Glasgow city region climate adaptation strategy and action plan*. <http://climatereadyclyde.org.uk/adaptation-strategy-and-action-plan/>
- Cole, H. V. S., Anguelovski, I., Baró, F., García-Lamarca, M., Kotsila, P., Pérez del Pulgar, C., ... Triguero-Mas, M. (2020). The COVID-19 pandemic: Power and privilege, gentrification, and urban environmental justice in the global north. *Cities & Health*, 1–5. doi:10.1080/23748834.2020.1785176
- Connecting Nature. (2020). *Glasgow | Connecting Nature*. <https://connectingnature.eu/glasgow>
- Cowley, J., Kiely, J., & Collins, D. (2016). Unravelling the Glasgow effect: The relationship between accumulative biopsychosocial stress, stress reactivity and Scotland's health problems. *Preventive Medicine Reports*, 4, 370–375. doi:10.1016/j.pmedr.2016.08.004
- Curtis, J. W., Curtis, A., Mapes, J., Szell, A. B., & Cinderich, A. (2013). Using Google Street View for systematic observation of the built environment: Analysis of spatio-temporal instability of imagery dates. *International Journal of Health Geographics*, 12(1), 53. doi:10.1186/1476-072X-12-53
- Cutter, S. L., Boruff, B. J., & Shirley, W. L. (2003). Social vulnerability to environmental hazards. *Social Science Quarterly*, 84(2), 242–261. doi:10.1111/1540-6237.8402002
- Fairburn, J., Maier, W., & Braubach, M. (2016). Incorporating environmental justice into second generation indices of multiple deprivation: Lessons from the UK and progress internationally. *International Journal of Environmental Research and Public Health*, 13(8), 750. doi:10.3390/ijerph13080750
- Fifield, S. (2020). *The Urban Politics of Greenspace: Exploring Community Empowerment for Greenspace Aspirations, Justice and Resilience. A Participatory Action Research Project in Glasgow*. Glasgow: University of Glasgow.
- García-Lamarca, M., & Gray, N. (2021). Land remediation in Glasgow's East End. In I. Anguelovski & J. Connolly (Eds.), *The Green City and Social Injustice* (pp. 100–110). Boca Raton, FL: Routledge. doi:10.4324/9781003183273-10
- Glasgow City Council. (2020). *Glasgow's open space strategy*. <https://www.glasgow.gov.uk/openspacestrategy>

- Glasgow City Council. (n.d.). *Glasgow vacant and derelict land supply map*. Retrieved January 10, 2022, from <https://www.arcgis.com/apps/webappviewer/index.html?id=d4642ae80e3e41fe92b350c5385db4c6>
- Glasgow City Council-Connecting Nature. (n.d.). *Connecting Nature NBS_v2*. Retrieved January 5, 2022, from <https://glasgowgis.maps.arcgis.com/apps/dashboards/d11c42a0a9d2416ba231392e6798e0ba>
- Guerrero, P., Möller, M. S., Olafsson, A. S., & Snizek, B. (2016). Revealing cultural ecosystem services through Instagram images: The potential of social media volunteered geographic information for urban green infrastructure planning and governance. *Urban Planning*, 1(2), 1–17. doi:10.17645/up.v1i2.609
- Hislop, M., Scott, A. J., & Corbett, A. (2019). What does good green infrastructure planning policy look like? Developing and testing a policy assessment tool within Central Scotland UK. *Planning Theory & Practice*, 20(5), 633–655. doi:10.1080/14649357.2019.1678667
- Hoffmann, E., Barros, H., & Ribeiro, A. (2017). Socioeconomic inequalities in green space quality and accessibility—Evidence from a Southern European City. *International Journal of Environmental Research and Public Health*, 14(8), 916. doi:10.3390/ijerph14080916
- Hoffman, J. S., Shandas, V., & Pendleton, N. (2020). The effects of historical housing policies on resident exposure to intra-urban heat: A study of 108 US urban areas. *Climate*, 8(1), 12. doi:10.3390/cli8010012
- Honey-Rosés, J., Anguelovski, I., Chireh, V. K., Daher, C., Konijnendijk van den Bosch, C., Litt, J. S., ... Nieuwenhuijsen, M. J. (2020). The impact of COVID-19 on public space: an early review of the emerging questions – Design, perceptions and inequities. *Cities & Health*, 00(00), 1–17. doi:10.1080/23748834.2020.1780074
- Hong, A., Sallis, J. F., King, A. C., Conway, T. L., Saelens, B., Cain, K. L., ... Frank, L. D. (2018). Linking green space to neighborhood social capital in older adults: The role of perceived safety. *Social Science & Medicine*, 207, 38–45. doi:10.1016/j.socscimed.2018.04.051
- Horst, M., McClintock, N., & Hoey, L. (2017). The intersection of planning, urban agriculture, and food justice: A review of the literature. *Journal of the American Planning Association*, 83(3), 277–295. doi:10.1080/01944363.2017.1322914
- Hou, J. (2020). Governing urban gardens for resilient cities: Examining the ‘Garden City Initiative’ in Taipei. *Urban Studies*, 57(7), 1398–1416. doi:10.1177/0042098018778671
- Houlden, V., Weich, S., Porto de Albuquerque, J., Jarvis, S., & Rees, K. (2018). The relationship between greenspace and the mental wellbeing of adults: A systematic review. *PLoS One*, 13(9), e0203000. doi:10.1371/journal.pone.0203000
- Kazmierczak, A., Cavan, G., Connelly, A., & Lindley, S. (2015). *Mapping flood disadvantage in Scotland 2015: Main report*. Retrieved from <https://www.gov.scot/publications/mapping-flood-disadvantage-scotland-2015-main-report/>
- Langemeyer, J., & Connolly, J. J. T. (2020). Weaving notions of justice into urban ecosystem services research and practice. *Environmental Science & Policy*, 109, 1–14. doi:10.1016/j.envsci.2020.03.021
- Larkin, A., & Hystad, P. (2019). Evaluating street view exposure measures of visible green space for health research. *Journal of Exposure Science and Environmental Epidemiology*, 29(4), 447–456. doi:10.1038/s41370-018-0017-1
- Li, X., Zhang, C., Li, W., Ricard, R., Meng, Q., & Zhang, W. (2015). Assessing street-level urban greenery using Google Street View and a modified green view index. *Urban Forestry & Urban Greening*, 14(3), 675–685. doi:10.1016/j.ufug.2015.06.006
- Loder, A. K. F., Schwerdtfeger, A. R., & Van Poppel, M. N. M. (2020). Perceived greenness at home and at university are independently associated with mental health. *BMC Public Health*, 20(1), 802. doi:10.1186/s12889-020-8412-7.
- Lu, Y. (2019). Using Google Street View to investigate the association between street greenery and physical activity. *Landscape and Urban Planning*, 191, 103435. doi:10.1016/j.landurbplan.2018.08.029
- Maantay, J. (2013). The collapse of place: Derelict land, deprivation, and health inequality in Glasgow, Scotland. *Cities and the Environment (CATE)*, 6, 1–52.
- Maantay, J., & Maroko, A. (2015). At-risk’ places: Inequities in the distribution of environmental stressors and prescription rates of mental health medications in Glasgow, Scotland. *Environmental Research Letters*, 10(11), 115003. doi:10.1088/1748-9326/10/11/115003
- Mabon, L. (2016). Charting disaster recovery via Google Street View: A social science perspective on challenges raised by the Fukushima Nuclear Disaster. *International Journal of Disaster Risk Science*, 7(2), 175–185. doi:10.1007/s13753-016-0087-4
- Majekodunmi, M., Emmanuel, R., & Jafry, T. (2020). A spatial exploration of deprivation and green infrastructure ecosystem services within Glasgow city. *Urban Forestry & Urban Greening*, 52, 126698. doi:10.1016/j.ufug.2020.126698
- Mears, M., Brindley, P., Maheswaran, R., & Jorgensen, A. (2019). Understanding the socioeconomic equity of publicly accessible greenspace distribution: The example of Sheffield, UK. *Geoforum*, 103, 126–137. doi:10.1016/j.geoforum.2019.04.016
- Meerow, S., Pajouhesh, P., & Miller, T. R. (2019). Social equity in urban resilience planning. *Local Environment*, 24(9), 793–808. doi:10.1080/13549839.2019.1645103

- Mell, I., & Whitten, M. (2021). Access to nature in a post covid-19 world: Opportunities for green infrastructure financing, distribution and equitability in urban planning. *International Journal of Environmental Research and Public Health*, 18(4), 1516–1527. doi:10.3390/ijerph18041527
- Miller, S. (2020). Greenspace after a disaster: The need to close the gap with recovery for greater resilience. *Journal of the American Planning Association*, 86(3), 339–348. doi:10.1080/01944363.2020.1730223
- Mouratidis, K. (2020). Neighborhood characteristics, neighborhood satisfaction, and well-being: The links with neighborhood deprivation. *Land Use Policy*, 99, 104886. doi:10.1016/j.landusepol.2020.104886
- Nyelele, C., & Kroll, C. N. (2020). The equity of urban forest ecosystem services and benefits in the Bronx, NY. *Urban Forestry & Urban Greening*, 53, 126723. doi:10.1016/j.ufug.2020.126723
- O'Neill, S., & Tett, S. (2019). *Mapping future Scottish heatwave extremes: Report for Climate Ready Clyde*. Retrieved from http://climatereadyclde.org.uk/wp-content/uploads/2019/10/GlasgowCityRegion_Heatwave-Report-CRC_web.pdf
- Pearce, J., Shortt, N., Rind, E., & Mitchell, R. (2016). Life course, green space and health: Incorporating place into life course epidemiology. *International Journal of Environmental Research and Public Health*, 13(3), 331. doi:10.3390/ijerph13030331
- Pearsall, H. (2010). From brown to green? Assessing social vulnerability to environmental gentrification in New York City. *Environment and Planning C: Government and Policy*, 28(5), 872–886. doi:10.1068/c08126
- Pham, T. T. H., Apparicio, P., Séguin, A. M., Landry, S., & Gagnon, M. (2012). Spatial distribution of vegetation in Montreal: An uneven distribution or environmental inequity? *Landscape and Urban Planning*, 107(3), 214–224. doi:10.1016/j.landurbplan.2012.06.002
- Plumer, B., & Popovic, N. (2020, August 24). How decades of racist housing policy left neighborhoods sweltering - The New York Times. *New York Times*. <https://www.nytimes.com/interactive/2020/08/24/climate/racism-redlining-cities-global-warming.html>
- Power, M. J., Neville, P., Devereux, E., Haynes, A., & Barnes, C. (2013). 'Why bother seeing the world for real?': Google Street View and the representation of a stigmatised neighbourhood. *New Media & Society*, 15(7), 1022–1040. doi:10.1177/1461444812465138
- Public Health Scotland (2020). *The Scottish Index of Multiple Deprivation*. Retrieved from <https://www.isdscotland.org/Products-and-Services/GPD-Support/Deprivation/SIMD/>
- Richardson, E. A., Pearce, J., Mitchell, R., & Kingham, S. (2013). Role of physical activity in the relationship between urban green space and health. *Public Health*, 127(4), 318–324. doi:10.1016/j.puhe.2013.01.004
- Rupprecht, C. D. D., & Byrne, J. A. (2014). Informal urban green-space: Comparison of quantity and characteristics in Brisbane, Australia and Sapporo, Japan. *PLoS One*, 9(6), e99784 doi:10.1371/journal.pone.0099784
- Shackleton, C. M., & Gwedla, N. (2021). The legacy effects of colonial and apartheid imprints on urban greening in South Africa: Spaces, species, and suitability. *Frontiers in Ecology and Evolution*, 8, 467. (Vol. doi:10.3389/fevo.2020.579813
- Slater, T. (2013). Your life chances affect where you live: A critique of the 'cottage industry' of neighbourhood effects research. *International Journal of Urban and Regional Research*, 37(2), 367–387. doi:10.1111/j.1468-2427.2013.01215.x
- Song, Y., Chen, B., Ho, H. C., Kwan, M. P., Liu, D., Wang, F., ... Song, Y. (2021). Observed inequality in urban green-space exposure in China. *Environment International*, 156, 106778. doi:10.1016/j.envint.2021.106778
- Twohig-Bennett, C., & Jones, A. (2018). The health benefits of the great outdoors: A systematic review and meta-analysis of greenspace exposure and health outcomes. *Environmental Research*, 166, 628–637. doi:10.1016/j.envres.2018.06.030
- Venter, Z. S., Shackleton, C. M., van Staden, F., Selomane, O., & Masterson, V. A. (2020). Green Apartheid: Urban green infrastructure remains unequally distributed across income and race geographies in South Africa. *Landscape and Urban Planning*, 203, 103889. doi:10.1016/j.landurbplan.2020.103889
- Walker, B. H. (2020). Resilience: What it is and is not. *Ecology and Society*, 25(2), 1–3. doi:10.5751/ES-11647-250211
- Walsh, D., McCartney, G., Collins, C., Taulbut, M., & Batty, G. D. (2017). History, politics and vulnerability: Explaining excess mortality in Scotland and Glasgow. *Public Health*, 151, 1–12. doi:10.1016/j.puhe.2017.05.016
- Waters, G., Warren, B., Ratcliffe, E., & Godefroy, J. (2021). Tranquil City: Identifying opportunities for urban tranquility to promote healthy lifestyles. *Cities & Health*, 5(1–2), 137–138. doi:10.1080/23748834.2019.1617918
- White, J. T., & Bunn, C. (2017). Growing in Glasgow: Innovative practices and emerging policy pathways for urban agriculture. *Land Use Policy*, 68, 334–344. doi:10.1016/j.landusepol.2017.07.056
- Whitten, M. (2019). Blame it on austerity? Examining the impetus behind London's changing green space governance. *People, Place and Policy Online*, 12(3), 204–224. doi:10.3351/ppp.2019.8633493848