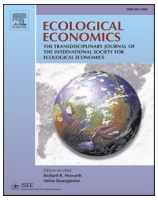
Ecological Economics 211 (2023) 107872

Contents lists available at ScienceDirect

Ecological Economics

journal homepage: www.elsevier.com/locate/ecolecon



Factors influencing the realisation of the social impact of urban nature in inner-city environments: A systematic review of complex evidence

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ARTICLE INFO

Keywords:
Urban nature
Social impact
Co-production
Inclusion
Systematic review

ABSTRACT

The beneficial health, wellbeing and liveability impacts of urban nature are broadly evidenced and increasingly engaged with in planning and policy. But anomalies in empirical evidence suggest that benefits do not flow equally to all. This review paper analyses the contribution of existing research on how the material and social context and subjective factors shape the social impact of urban nature. We review 46 international papers published between 2019 and 2021 that present findings from inner-city metropolitan contexts. The findings evidence variations in benefits and some dis-benefits derived from urban nature associated with features of the material context (e.g., urban and greenspace form, infrastructure and facilities), the social context (e.g., demographic diversity and socio-economic standing) and subjective factors such as gender and cultural identity. We recommend an inclusive research and planning approach that is attuned to the role of the human experience in the realisation of the social impact of urban nature to ensure that the prevalent urban greening agenda actually benefits all city dwellers and does not unintentionally contribute to further inequality. We recommend a shift of focus from 'physical access to nature' to 'actually realised access to its benefits' for more inclusive policy and planning.

1. Introduction

The potential of urban nature such as greenspaces and waterscapes to deliver a host of benefits in the form of more active lifestyles, rest and relaxation, noise reduction, cohesive communities and cleaner air, is well-established in the current literature (e.g., La Rosa et al., 2016; WHO, 2016; Hunter et al., 2019). Various local authorities and housing developers are beginning to embrace this potential to provide benefits to liveability and the quality of life. But it appears that benefits do not simply flow from nature to residents in a linear and equitable manner. For example, in their systematic review of environmental, health, wellbeing, social and equity effects of urban green space interventions, Hunter et al. (2019) report that the evidence of the type of impact across different urban contexts and types of greenspaces is contradictory: improvements to and increased availability of greenspaces sometimes have no or even adverse impact on behaviours that are associated with improved wellbeing. While better 'marketing' of new greenspace amenities can be used to improve the realisation of benefits (Hunter et al., 2019), Jennings et al. (2016) provide evidence that greenspaces situated in poorer contexts are perceived as less beneficial than similar sites in wealthier neighbourhoods. Juntti and Lundy (2017) demonstrate how new greenspaces can have a fragmenting impact on disadvantaged communities in the context of urban regeneration. There is also evidence of so called 'green gentrification' which refers to the positive impact of increased greenspace on urban property value and the subsequent gradual pricing out of less well-off residents form newly greening neighbourhoods (Anguelovski et al., 2022). Beyond the socio-economic context, Fischer and Eastwood (2016) found that subjective factors – identity and capabilities – condition people's ability to benefit from greenspaces. This complexity casts doubt on the ability of the greener cities to actually deliver beneficial outcomes for all in the often varied and unequal urban context. This is a worry because for example, the WHO, the UN Sustainable Development Goal 11 and the UK's National Institute for Health and Care Excellence recommend increased access to greenspace to yield tangible health and wellbeing benefits for urban communities (UNGA, 2015; WHO, 2016; NICE, 2018). Without a critical understanding of whether and how those benefits are actually realised, policy and planning solutions may contribute to further inequality rather than benefits for all.

This review paper argues that there is an urgent need to move

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https://doi.org/10.1016/j.ecolecon.2023.107872
Received 5 August 2022; Received in revised form 25 April 2023; Accepted 28 April 2023
Available online 12 May 2023

beyond a simplistic conceptualisation of 'access to nature' as physical distance to and extent of nature within a given urban area in efforts to derive health, wellbeing and community benefits from urban nature. The starting point of our review is the understanding that the impact of urban nature (all types of greenspaces and waterscapes) its benefits and dis-benefits, are co-produced by humans and nature (Fish et al., 2016; O'Brien, 2014; Fischer and Eastwood, 2016; Juntti and Lundy, 2017). Humans make sense of their environments as a part of everyday life activities (O'Brien, 2014) and therefore, urban nature delivers both benefits and dis-benefits depending on contextual and subjective factors influencing these activities (Andersson et al., 2015; Fischer and Eastwood, 2016; Juntti and Lundy, 2017). These benefits and dis-benefits are here termed the 'social impact' of urban nature. In this paper, we collate findings on the role of context (both social and material) as well as subjective factors in the realisation of social impact from urban nature from research published in the 2.5 years up to April 2021. By applying the ontology of co-production, we highlight the relevance of existing literature in developing a more in-depth understanding of how the social impact of urban nature is actually realised. We argue that understanding how contextual and subjective factors condition the co-production of nature's social impact in the urban context is crucial in supporting policy and planning approaches that actually deliver the much-lauded potential health, wellbeing and liveability benefits to all within cities (see also Johnston and Russell, 2011; Fischer and Eastwood, 2016).

2. On the ontology of co-production and the social impact of urban nature

The ontology of co-production builds on the relational understanding of power developed by French sociologists such as Latour (2004) and Pierre Callon (1984). It suggests that agency, the ability of an actor (human or non-human) to make a difference, is always vested in interaction, never a quality assigned to an individual 'á priori'. A human, any living entity, or an inanimate object can and will only be lent agency when in interaction with another. Callon (1984) used the example of scallops, fishermen and marine conservationists and their struggles to 'negotiate' a sustainable co-existence in St. Brieuc Bay in France. A successful strategy, one that worked, was only realised if all three (and more) actors executed it 'in collaboration' – co-produced it. Similarly, the ontology of co-production views the realisation of urban nature's benefits to people as produced through active and passive engagements between people and nature as a part of the everyday experience in cities (O'Brien, 2014; Fischer and Eastwood, 2016). This can be for example the act of venturing out for a walk in a park, or the more passive act of interpretation – the assignation of meaning – for example, to a park as a feature that yields positive place value (O'Brien, 2014; Juntti et al., 2021). Nevertheless, both are essential actions in the realisation of nature's impacts on humans, as benefits, or dis-benefits. Although the ontology of co-production is not often explicitly recognised in literature nor in the practice of greenspace planning and design (Fischer and Eastwood, 2016; Johnson and Russell 2011), we suggest that literature nevertheless provides indirect evidence of it in reporting on the contradictions and contextual factors that characterise and mediate people's engagements with urban nature. For example, where a feature of nature is divisive, liked by some, but disliked or otherwise experienced in a negative manner by others, and thus yields an ecosystem dis-service, or a dis-benefit to that group or individual (Andersson et al., 2015; Juntti and Lundy, 2017).

Fig. 1. demonstrates our conceptualisation of the role of contextual and subjective factors in the co-production of the social impact of urban nature in everyday engagements between humans and nature. We suggest that the material and social context as well as individual subjective factors of the human participants shape those engagements and therefore merit attention (Juntti and Lundy, 2017; Fischer and Eastwood, 2016). For example, Juntti and Lundy (2017: 17) conclude that "aspects contributing to the perceived liveability of a neighbourhood also condition the experienced [ecosystem services] and [ecosystem dis-services]", and stipulate 'place-sensitive ecosystem service delivery' which considers the 'material and social context', and the role of subjective needs, concerns, cultural preferences, and interest (see also Fischer and Eastwood, 2016; Andersson et al., 2015). Further, whereas urban water features are largely experienced as positive by residents, Juntti et al. (2021) found that, in the context of disadvantaged, informal neighbourhoods in Brazil, urban streams are experienced as yielding mainly dis-services in the form of attracting litter and frequently causing floods. The material context – inadequate solid waste collection and open streams – was seen as the main reason for the littering problem, but residents also disliked the open, un-culverted streams because they were symbolic of the lack of investment and value assigned to the informal neighbourhood by municipal authorities. Therefore, urban nature took

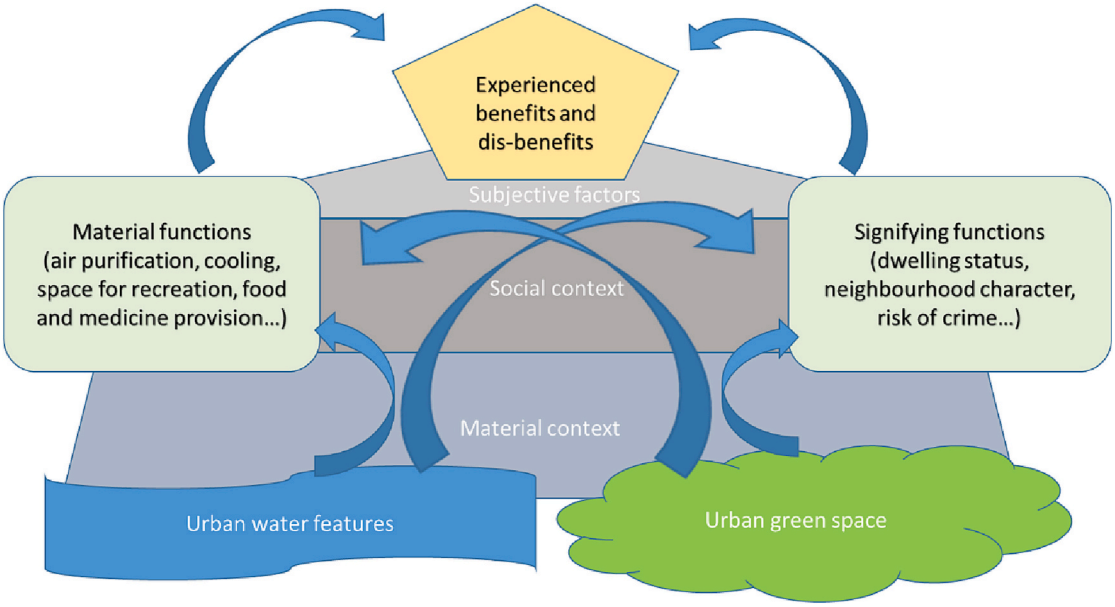

Fig. 1. The role of context in the co-production of social impact (experienced benefits and dis-benefits) of urban nature, where the arrows refer to active and passive engagements (or interactions) between humans and nature (sources: Juntti and Lundy, 2017; Juntti et al., 2021).

on both material and signifying functions in the everyday lives of urban residents, yielding opportunities for waste disposal on one hand, and representing a neglected, neighbourhood on the other (Juntti et al., 2021; Fig. 1.).

In this paper, we use the term 'social impact' to capture both the benefits and dis-benefits experienced by individuals and/or communities through urban nature-related interactions, whether material or immaterial (O'Brien, 2014). In literature, social impact encompasses the so-called cultural ecosystem-services, which are increasingly seen to include contributions to wellbeing and physical and mental health, and community impacts such as sense of place and increased cohesion (e.g. MEA, 2003; Russell et al., 2013; Ravetz, 2015; La Rosa et al., 2016; Hunter et al., 2019; Juntti et al., 2021). Considering the huge number of publications focussing on cultural ecosystem services, we limited our systematic review to papers that specifically mention the term 'social impact'. Based on the analysis of the reviewed literature, we categorise the social impact of urban nature under the five headings of amenity/recreation, environmental, community health and wellbeing, individual health and wellbeing, and land and property value. We follow the reviewed literature in separating recreation and health impact, which despite being closely related, were treated predominantly as distinct in literature. Similarly, we are informed by the reviewed literature in defining urban nature for the purposes of this review as all manner of greenspaces such as parks (formal and informal, and of all sizes) public gardens, small patches of 'pocket greenspaces', urban woodland, street trees, hedges and other similar greenery and waterscapes such as ponds, rivers, canals, streams and reservoirs.

3. Methodology

This systematic review was generated following Bryman (2016) suggestions on the systematic review process and PRISMA guidelines (Page et al., 2021).

3.1. Defining the purpose, rationale, and scope of the review

The specific purpose of this review is to integrate relevant new research findings produced in the 2.5 years up to and including the first half of 2021, since the publication of a range of comprehensive review papers on the social impact of urban nature (e.g., La Rosa et al., 2016; WHO, 2016; Hunter et al., 2019). Specifically, we looked for evidence of whether and how the type of nature, the broader material and social environment and the people themselves influence the impact of greenspaces and water in an inner-city context. To do this, three review questions were established (Page et al., 2021):

1. How is the social impact of urban nature conceptualised?
2. What is the role of the social and material context in the social impact of urban nature?
3. What are the subjective factors associated with the social impact of urban nature?

For the purposes of this review, material context encompasses, but is not limited to, availability and condition of infrastructure (such as access infrastructure and its quality, fences/gates, footpaths, signage, benches), and the type of nature (such as its form, diversity and the presence of trees or water). The social context encompasses, but is not limited to, socio-economic, demographic and ethnic diversity, crime rate, presence of anti-social behaviours and the extent and type of social interactions. Finally, subjective factors refer to personal variables such as gender, age, race and subjective cultural values, needs and preferences of people. These can be seen broadly to influence both identity and capability, determined by Fischer and Eastwood (2016) as influential to whether and how people benefitted from peri-urban woodlands.

3.2. Search process

A literature search (Bryman, 2016) was conducted on the 18th of April 2021 on the Scopus database using the keywords 'urban green spaces *or* urban nature *or* urban surface water *and* social impact'. The search was limited to the journal articles written in English in the years 2019 and onward. The search strategy is presented in Fig. 2.

3.3. Selection and appraisal of the research papers

The identified papers were subjected to an iterative review process based on a reading of the paper abstracts after removing duplicated paper(s). The Scopus results only included peer-reviewed journal articles and the main criteria then focussed on relevance to the project. 'Relevance' was ensured by following these criteria:

As to exclusion criteria, papers that focus solely on science based environmental impact (such as measuring noise or pollution) and/or pertaining to a context which could not be considered comparable to a developed inner-city metropolitan context were excluded. This is because the review was originally carried out for the *BlueGreen Impact project*, which aimed to construct guidance for practitioners on maximising the experienced benefits and minimising dis-benefits of urban nature in London UK. The reliability and validity of the inclusion and exclusion process were ensured using Rayyan (Ouzzani et al., 2016), a web tool for systematic reviews that allowed the two researchers to work collaboratively during paper classification.

528 records were identified as a result of the search strategy (Fig. 2). One duplicating paper was removed without abstract screening. The title and abstracts of the remaining 527 papers were screened by both authors collaboratively. The full-text screening included an appraisal of papers based on quality (significance and clarity of data, analysis and/or findings), accessibility, study design(s), the transferability of the findings to a develop dinner-city metropolitan context as well as whether the findings were relevant to the social impact of urban nature (Fig. 3). In the inclusion and exclusion process, Rayyan allowed reviewers to see the papers on which there was disagreement. Percentage agreement on screening was 99.246% and Cohen's Kappa was calculated as 97.55% ('almost perfect agreement'). As a result, 99 papers were deemed to be relevant to the review questions and were included in the full-text screening. During the appraisal of full-text, 53 papers were excluded with a full agreement of authors. As detailed in Fig. 4, the most frequent reason of these exclusions was the irrelevance of the papers to the social impact of urban nature or not being transferable to the relevant context. Second most frequent reason of the exclusion was quality. Although the initial search was limited to peer reviewed articles and the sample was of generally high quality, 18 articles were excluded on the basis of the salience and reliability of findings, considering the data that had been collected. Five studies were excluded because the primary or secondary empirical data used was not relevant to the review questions or the papers were purely conceptual (study design in Fig. 4.). As a result of full-text review, 46 papers were included in the systematic literature review reported in this paper.

3.4. Data extraction and synthesis

The 46 included papers were subjected to a thematic analysis with the help of NVivo software. This involved open coding, aiming to identify types of social impact of urban nature and material, social and subjective factors that were featured in the selected papers. The broad aim of the analysis was to answer the review questions and thereby build an up-to-date understanding of literature that has emerged since the completion of the most recent reviews in 2016 and 2019 (WHO, 2016; Hunter et al., 2019) concerning the social impact of urban nature. The open coding yielded five categories of social impact (amenity/recreation, environmental, community health and wellbeing, individual health and wellbeing, and land and property value), which are discussed in

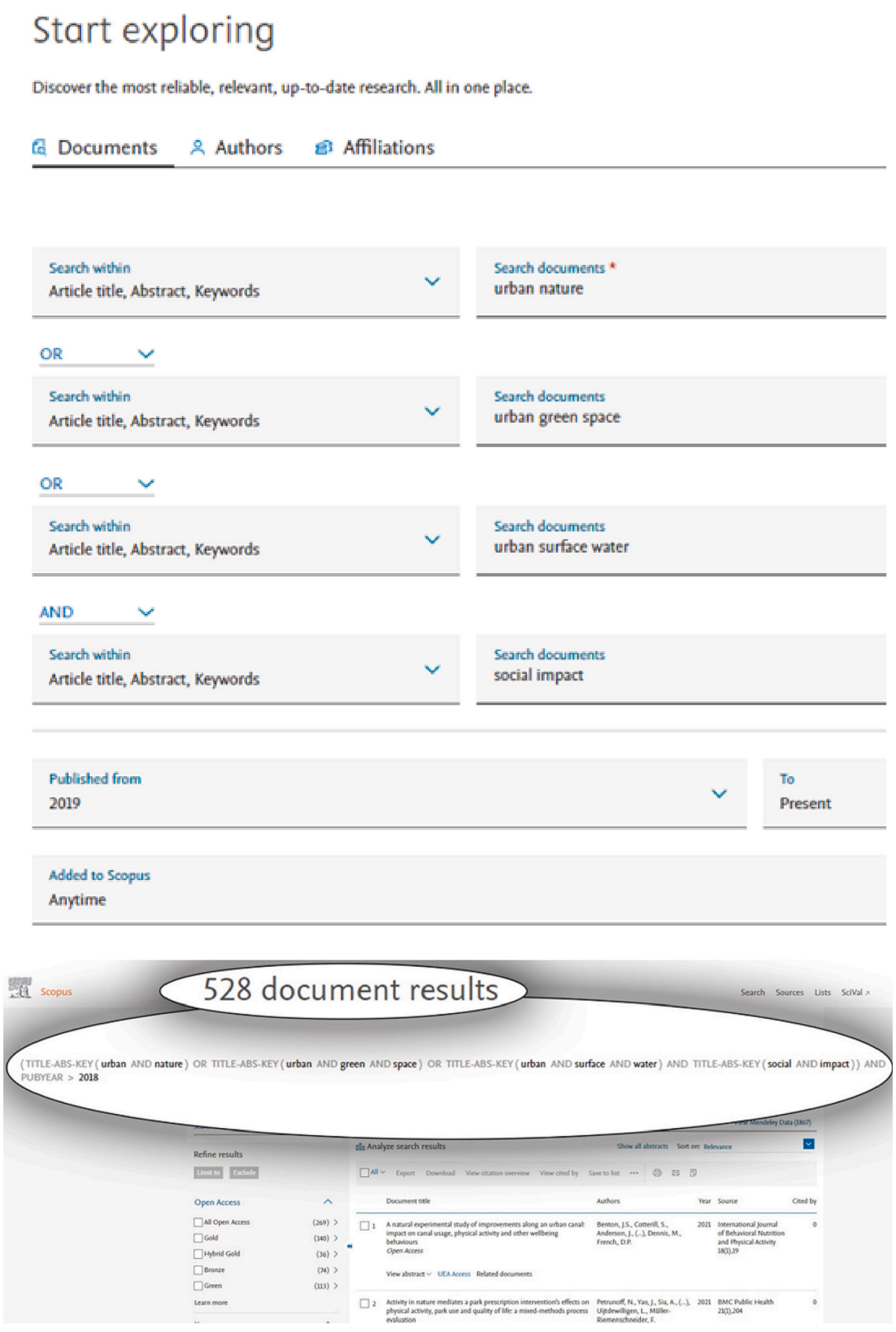

Fig. 2. Search strategy of the systematic review.

Papers presenting findings on the impacts of urban nature, which consider,

- Social impact in a broad sense and the role of
- The social context or
- The physical context or
- Subjective factors

Fig. 3. 'Relevance' in the systematic literature review process.

section 4.2. The material, social and subjective factors evidenced in the literature as influencing the realisation of these impacts were coded under 2–5 categories each. The material context featured: spatial form and attractiveness, presence of infrastructure and services, distance from and extent of greenery, broader environmental quality (e.g. air quality and temperature), and ability to grow and engage with provisioning ecosystem services. Social context on the other hand encompassed: demographic and socioeconomic status and diversity and cultural and ethnic diversity. Finally, the subjective factors encompassed: income status, demographic group, lifestyle factors, and identity and cultural heritage. We do not suggest that these categories constitute exhaustive definitions of the material social and subjective factors that mediate the co-production of nature's benefits in the urban context, but merely that these were the categories featured in the 46 papers included in the analysis. Following open coding, we chose a narrative form of analysis (Bryman, 2016) describing the manner in which these factors mediated the experienced benefits and dis-benefits that humans gained from urban nature in the featured studies. This narrative is presented in section 4.3 and summarised in Table 3. Section 4.4 outlines the anomalies and contradictory findings and discusses the implications of the ontology of co-production. The conclusions provide some recommendation for planning practice based on the ontology of co-production evidenced in this review.

4. Review results

4.1. A meta-analysis of the selected papers

A meta-analysis of the focus, geographical scope, disciplinary field and methodological approach of each of the 46 reviewed papers was undertaken. Table 1. demonstrates that studies focused on the material context dominate the field ($N = 31$) with least attention to the role of the social context ($N = 18$) in how the social impact of urban nature is mediated. Subjective factors were featured in 23 papers.

Table 2. presenting further analysis of the reviewed papers shows that European countries and China dominate the field of research on the social impact of urban nature in terms of numbers of publications. Almost half (48%) of the reviewed papers employ a quantitative methodology, and a quarter adopt a mixed method. 46% of the reviewed papers rely solely on primary data whereas 43% are based on secondary data. 69% of the selected papers included all types of greenspaces in the

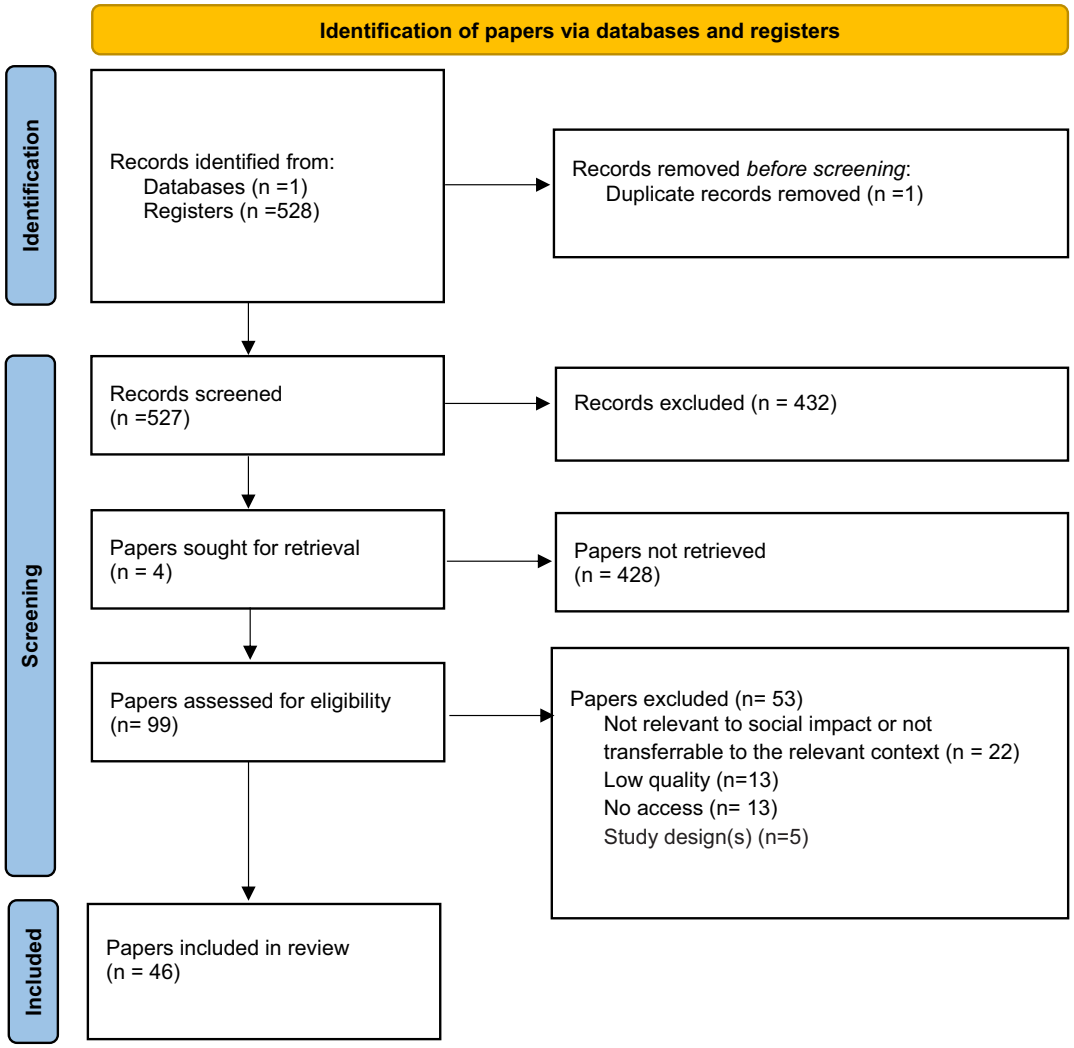

Fig. 4. The number of academic papers identified, selected, and included (adapted from Page et al., 2021).

Table 1
Papers that featured the material and social context and subjective factors.

Material context	Social context	Subjective factors
Abdelhamid and Elfakharany, 2020	Alejandre and Lynch, 2020	Alejandre and Lynch, 2020
Abramovic et al., 2019	Cole et al., 2019	Andreucci et al., 2019
Alejandre and Lynch, 2020	García De Jalón et al., 2020	Chen et al., 2019
Bockarjova et al., 2020	Georgiou et al., 2021	Cole et al., 2019
Chang et al., 2020	Hatala et al., 2020	Du et al., 2021
Chen et al., 2019	Hunter et al., 2019	Felappi et al., 2020
Czembrowski et al., 2019	Jarvis et al., 2020	Fuertes et al., 2020
Ding et al., 2020	Jennings et al., 2016	Georgiou et al., 2021
Du et al., 2021	Juntti et al., 2021	Hatala et al., 2020
Felappi et al., 2020	Mmako et al., 2020	Hunter et al., 2019
Fuertes et al., 2020	Mottaghi et al., 2020	Kabisch et al., 2021
García De Jalón et al., 2020	Mouratidis, 2019	Lin and Wu, 2021
Georgiou et al., 2021	Pineda-Pinto et al., 2021	Mottaghi et al., 2020
Hunter et al., 2019	Kotsila et al., 2020	Mouratidis, 2019
Jarvis et al., 2020	Vert et al., 2019	Nitavska (2020)
Jing et al., 2021	Watson et al., 2020	Noordzij et al., 2020
Kabisch et al., 2021	Wolch et al., 2014	Poulain et al., 2020
Liu et al., 2020	Zhang et al., 2020	Syrbe et al., 2021
Mmako et al., 2020		Ullah et al., 2020
Mouratidis, 2019		Vert et al., 2019
Peng et al., 2021		Vujcic et al., 2019
Poulain et al., 2020		Watson et al., 2020
Russo and Cirella, 2020		Zhang et al., 2020
Skalna and Haupt, 2019		
Soga et al., 2021).		
Syrbe et al., 2021		
Vujcic et al., 2019		
Watson et al., 2020		
Wolf et al., 2020		
Zhang et al., 2020		
Zhu et al., 2019		

Table 2
Location, research design and focus of the reviewed papers.

	N	%
Geographical location of 46 selected papers		
Europe (including the UK, Norway, Sweden, Latvia, Serbia, Ireland, Germany, Spain, Poland, Netherlands, Italy, Czech Republic, Lithuania)	18	**39%**
China	11	**24%**
Canada	2	**4%**
Australia	2	**4%**
USA	1	**2%**
Türkiye	1	**2%**
Brazil	1	**2%**
Japan	1	**2%**
Egypt	1	**2%**
Qatar	1	**2%**
N/A	7	**15%**
Research design of 46 selected papers		
Quantitative	22	**48%**
Qualitative	13	**28%**
Mixed	11	**24%**
Type of data		
Primary	21	**46%**
Secondary data	20	**43%**
Both	5	**11%**
Focus of the investigation in terms of greenspace (45 papers in total)		
All types of greenspaces	31	**69%**
Parks	6	**13%**
Community gardens and edible green infrastructure	4	**9%**
Street view greenspaces	2	**4%**
Private greenspaces	1	**2%**
Urban forest	1	**2%**
Focus of the investigation in general		
Only water	1	**2%**
Only greenspaces	33	**72%**
Both water and greenspaces	12	**26%**

investigation, and very few studies focussed exclusively on the social impact of urban forest, street view greenspaces, community garden and edible green infrastructure, and private greenspaces. Only 2% of the selected papers focussed exclusively on water, and 26% included both greenspaces and water as a focus of investigation.

Most papers were published in journals falling within the field of sustainability/environment. But health and engineering journals were also featured.

4.2. Range and types of social impact from urban greenspace

The reviewed papers featured five categories of social impact of urban nature: amenity/recreation, environmental, community health and wellbeing, individual health and wellbeing, and property value. In this first section we briefly review the impact featured under each category.

4.2.1. Amenity/recreation and environmental impact

The majority of the reviewed papers evidenced the ability of urban nature to provide benefits in terms of active recreation. Research on all types of urban greenspaces in both European and Chinese contexts found that visitors value them for recreational opportunities affording increased physical activity and aesthetic qualities, climate regulatory functions and high biodiversity (e.g. Syrbe et al., 2021; Georgiou et al., 2021; Felappi et al., 2020; García De Jalón et al., 2020 and Vujcic et al., 2019 for Europe; and Du et al., 2021 and Chang et al., 2020 for China). Flood protection services of urban greenery were also recognised as an important benefit of greenspace, along with their function in air purification and as a carbon sink (e.g. Syrbe et al., 2021).

4.2.2. Individual and community, health and wellbeing benefits

The health and wellbeing benefits of urban nature are now well recognised, and they are well evidenced in the reviewed papers also. Kabisch et al. (2021: 2) emphasise the benefits of urban greenspace for 'social health', taken to include feelings of integration, a sense of community and perceived and experienced safety, and individual resilience towards environmental stressors in the German context (see also Chang et al., 2020 for China). Green views from windows were found to quell the fear of crime in Guangzhou, China (Jing et al., 2021), and in Japan, Soga et al. (2021) found that a green view was more important for reported mental health benefits than access to greenspace itself.

Du et al. (2021) found clear 'wellbeing benefits' in terms of reported feelings of relaxation, calm, fitness, vigour, ease of communication and positive mindset in China (see also review by Hunter et al., 2019; Vujcic et al., 2019 in Serbia; Chang et al., 2020 in China; Ribeiro et al., 2021 in Europe and Tannous et al., 2021 in Qatar). Hatala et al. (2020) view the social impact of urban greenspace from the perspective of Canadian indigenous people, arguing that this is an underrepresented perspective in considerations of health benefits afforded by urban nature, not least because the indigenous understanding of health differs from the mainstream Western science-informed one. Hatala et al. (2020) discovered that for indigenous youth in Ontario, Canada, urban nature afforded a calming impact, provided them with metaphors for resilience and helped to nurture hope. This in turn "helped them to cope with stress, anger, fear, and other general difficult situations they may encounter and navigate on a day-to-day basis" (Ibidem: 538).

The therapeutic potential of urban greenspace in the prevention and treatment of certain disabilities is also recognised (Skalna and Haupt, 2019; Kotsila et al., 2020). Russo and Cirella (2020: 357) found that "in conjunction with other [green infrastructure] urban agricultural types, [allotments and communal gardens] offer excluded groups or individuals the ability to participate and become involved in the

community at large. In this way, allotments can contribute to a sense of self-worth, as well as community—helping to shape a person's livelihood and encourage overall social integration."

4.2.3. Property and neighbourhood value or prestige

Three of the reviewed papers suggested that investment in urban nature raises property value (Bockarjova et al., 2020; Czembrowski et al., 2019; Yazar et al., 2020). Additionally, García De Jalón et al. (2020) found that investment in increased access to greenspaces yielded economic benefits that compensated for the costs within a 10-year period. Yazar et al. (2020) present evidence of problematic 'green gentrification' in Istanbul, Türkiye. The concept of 'sustainable neighbourhoods' which includes new greenspaces such as green roofs, parks and trees, contributed 'prestige value' to residential projects and stipulated an interpretation of "green" as something "elite and exclusive which has to be purchased and privatised. The prestige value of LEED and BREEAM certification is thus being used as a way to privatise green spaces instead of opening up new public green spaces or upgrading the existing green areas in the district." (Yazar et al., 2020: 649).

4.3. Role of context

The role of material and social context and subjective factors in mediating the above impacts is explored in narrative form here and summarised in Table 3.

4.3.1. Material context: factors and mechanisms that mediate the co-production of social impact from urban nature

In line with previous literature (e.g., Andersson et al., 2015; Spangenberg et al., 2014), our review findings show that the material context took on both signifying and material (enabling or restricting) functions in mediating the social impact of urban nature (Juntti et al., 2021). Spatial form, diversity of natural features, infrastructure and maintenance, distance to and extent of greenery and the presence of features that enable engaging with nature make a difference to the type and extent of recreation activities, the extent to which nature yields health and community benefits, and to its impact on property value.

Spatial form and attractiveness

Two of the reviewed studies found that the presence of urban trees had a positive influence on peoples' perceptions of safety, and moreover, also correlated with lower levels of crime in the European context (Mouratidis, 2019; Wolf et al., 2020).

Motivation to visit and length of stay in greenspaces correlated positively with near-natural (i.e., less intensively maintained) green space, safe, clean, and accessible pathways, species richness, serenity, and features that carried cultural connotations (some connection to local history/the arts/architecture and design) in studies from Germany, Czechia and China (Syrbe et al., 2021; Chen et al., 2019; Du et al., 2021). Urban forests, public parks and water bodies were the most popular greenspace types (ibidem). But Kabisch et al. (2021) found that parks with open space and less vegetation and tree canopy coverage were favoured for socialising, BBQs and picnics, whereas ones with more vegetation and cover were preferred for exercise. There was evidence that the presence of water may increase fitness levels, perhaps by affording physical activity particularly well, and that water features within parks contributed to increased ability to afford 'mental restoration' (Felappi et al., 2020; Georgiou et al., 2021; Syrbe et al., 2021). Mental wellbeing benefits were also reported to correlate with accessible isolated 'special spaces' and what was described as 'quiet' environments, as well as with vegetation diversity (Du et al., 2021).

Presence of infrastructure and services

The recreation and wellbeing benefits of greenspaces increased with good access and sports infrastructure (Du et al., 2021). Alejandre and Lynch (2020) found that playgrounds and the availability of courts and zoned areas increased children's physical activity in urban green spaces, although children with high BMI benefitted less (Poulain et al., 2020).

Table 3
Summary matrix of the factors mediating the social impact of urban greenspace drawn from the systematic literature review.

Social impact of urban nature	*Role of context*		
	Material	Social	Subjective characteristics
Amenity/ recreation	**Maintenance** Less intensively maintained greenspace with safe, clean, and accessible pathways as well as water bodies is preferred over highly maintained greenspace. Diversity of form and species is found attractive. (Syrbe et al., 2021). **Design and form** Trees increase perceptions of safety and insulate from heat leading to longer stays and more active recreational pursuits in parks. (Mouratidis, 2019; Wolf et al., 2020; Kabisch et al., 2021). Availability of trees and other shading vegetation is essential for experiencing cooling effects (Peng et al., 2021; Kabisch et al., 2021) Waterbodies encourage active forms of recreation. (Georgiou et al., 2021) Greenspaces that display cultural and design features and species typical to the locality are preferred by visitors. (Chen et al., 2019) **Facilities and infrastructure** Facilities and services increase amenity value and encourage social activities (Chang et al., 2020; Liu et al., 2020; Syrbe et al., 2021) Separate areas for active engagements and serene nature increase the attractiveness of parks (Alejandre and Lynch, 2020; Du et al., 2021). **Distance and extent** Vicinity and high	**Socio-economic context** There are barriers to amenity access to blue and green spaces in poor neighbourhoods, but the literature is inconclusive on what these are (Cole et al., 2019; Juntti et al., 2021). **Cultural and ethnic diversity** Neighbourhood ethnic diversity is associated with a higher variety of greenspace uses, which may be incompatible. Some groups may feel excluded and even threatened by others (Mottaghi et al., 2020; Hatala et al., 2020). In certain contexts, ethnic minority groups may be discouraged from accessing greenspaces due to racism from other park users and authorities (Hatala et al., 2020) Neighbourhood ethnic diversity increased the range of experienced risks, associated with water features (Mottaghi et al., 2020). **Community cohesion** Perceived social cohesion may encourage access (Watson et al., 2020).	**Gender and demographic group** Women visit greenspaces more than men do (Ullah et al., 2020; Syrbe et al., 2021). Availability of lighting is key to women's perceptions of safety and willingness to visit the parks after dark (Kabisch et al., 2021). Public parks are particularly important to the elderly as well as families with young children (Kabisch et al., 2021). Age-appropriate infrastructure is important, especially for children and older peoples' ability to access benefits (Alejandre and Lynch, 2020). People with young children are more likely to perceive water features as dangerous (Mottaghi et al., 2020). People with young children are more likely to observe species diversity (Mouratidis, 2019) **Lifestyle and health factors** Those with active lifestyles are more likely to report positive recreational benefits from greenspace (Vujcic et al., 2019). Those with existing good mental health are better able to benefit from water features and vicinity to greenspace for active recreation (Watson et al., 2020).

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Table 3 (*continued*)

Social impact of urban nature	*Role of context*		
	Material	Social	Subjective characteristics
	exposure to greenspace encourage recreational benefits, even small greenspaces increase these in dense urban contexts (Jarvis et al., 2020; Vujcic et al., 2019). **Broader environmental quality** Perceived low environmental quality (e.g., air pollution) may hinder access (Kabisch et al., 2021). High temperatures (above 29 degrees Celsius) discourage access (Kabisch et al., 2021)		
Community health and wellbeing	**Design and form** Presence of trees correlates with lower levels and fear of crime (Mouratidis, 2019; Wolf et al., 2020). Greenspaces with sparser vegetation but more facilities and services are favoured for social purposes (Kabisch et al., 2021). Community gardens can significantly increase the integration of marginalised people into communities (Ding et al., 2020; Russo and Cirella, 2020; Skalna and Haupt, 2019). Community gardens may create exclusive communities within communities, but this can be mitigated by open design features and the provision of social activities (Ding et al., 2020).	**Socio-economic context** There are significant potential benefits from new greenspaces in poor and social housing neighbourhoods (Vert et al., 2019). **Ethnic and cultural diversity** Ethnic and cultural diversity may increase the likelihood of conflicts associated with accessing greenspaces (Mottaghi et al., 2020).	N/A
Individual wellbeing and health	**Design and form** The presence of trees and the ability to see greenery from windows can broaden access to mental health benefits of greenspace (Jing	**Socio-economic context** Only residents of gentrifying neighbourhoods report health benefits from improved greenspaces (Cole	**Socio-economic group and education** Low-income groups displayed a positive correlation between the green exposure of residential areas

Table 3 (*continued*)

Social impact of urban nature	*Role of context*		
	Material	Social	Subjective characteristics
	et al., 2021; Soga et al., 2021). The impact of urban greenspace on somatic symptoms and clinically measurable health remains ambiguous. Perceived quality of the greenspace influenced experienced benefits but this does not correlate with objective markers of greenspace quality or context (Watson et al., 2020; Felappi et al., 2020; Zhang et al., 2020).	et al., 2019) Middle- and high-income groups and those living in predominantly wealthy neighbourhoods are best poised to derive individual health benefits from greenspaces (Vert et al., 2019; Georgiou et al., 2021). Disadvantaged neighbourhoods pose barriers to health and well-being benefits from greenspace, ranging from fear of crime to higher prevalence of existing ill-health (Cole et al., 2019; Juntti et al., 2021).	and mental health in a study on exposure to urban greenspace in Guangzhou, China (Zhang et al., 2020). Only high education and/or high-income residents of gentrifying neighbourhoods displayed a positive correlation between exposure to active green space and self-reported health (Cole et al., 2019). **Demographic group** Men seem to be better able to find serenity and less likely to fear crime in urban greenspaces (Chen et al., 2019). **Health and lifestyle factors** Higher BMI children benefit more from access to nature rather than sports facilities (Alejandre and Lynch, 2020; Poulain et al., 2020). Those already in good health benefit more in terms of experienced mental and physical health benefits (Vujcic et al., 2019; Watson et al., 2020). **Identity and cultural heritage** Cultural understandings of nature mediate the mental health and well-being benefits from urban nature, such as the ability of indigenous youth to derive resilience and life lessons from urban nature (Hatala et al., 2020). For children, social influencers can make a difference in their willingness to engage with urban greenspace (Alejandre and Lynch, 2020)
Land/ property value	**Design and form** Correlation with property prices is strongest with the	**Socio-economic context** Investment in opening up	N/A

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Table 3 (*continued*)

Social impact of urban nature	*Role of context*		
	Material	Social	Subjective characteristics
	presence of aesthetic values from greenspace (Bockarjova et al., 2020; Czembrowski et al., 2019; García De Jalón et al., 2020). The presence of water and multifunctional greenspaces also added to property value (Bockarjova et al., 2020; Czembrowski et al., 2019). Property buyers view greenspaces that afford recreational opportunities as adding value but play areas as decreasing it (Bockarjova et al., 2020)	greenspace for increased recreational and amenity value in poor areas can provide monetary returns within a 10-year timeframe (García De Jalón et al., 2020).	
	Maintenance 'Naturalness' (and species diversity) had a very weak impact on property value (Bockarjova et al., 2020). Access to recreational activities was insignificant in terms of a property price premium (Bockarjova et al., 2020).		

Kabisch et al. (2021) found that the levels of lighting impacted particularly women's perceptions of safety and willingness to visit the parks after dark. Lack of road connections, poor access to water or a lack of suitable facilities discouraged the use of greenspaces (Syrbe et al., 2021), whereas litter bins, benches, road signs, kiosks, bars, and cafes were found to greatly boost their appreciation (Chang et al., 2020; Liu et al., 2020; Syrbe et al., 2021).

Versatility, the ability of formal parks to meet "the diverse interests of different users ranging from recreational areas (both active and passive) and educational spaces to cultural events for tourist attraction and to increase [a] sense of place for urban dwellers" was deemed crucial for frequency of visits in Alexandria, Egypt (Abdelhamid and Elfakharany, 2020: 321). Similarly, the availability of versatile organised activities increased active engagement and the meaningfulness of greenspaces for people suffering from dementia (Mmako et al., 2020).

Design features were found to be key to inclusivity of community gardens (Ding et al., 2020). Ding et al. (2020) found that while community gardens can be exclusive, their integration into existing greenspaces, visual openness and good functional infrastructure (access to water, shade, benches, coffee area) promoted inclusiveness and therefore extend the benefits to social capital within the broader community.

The impact of urban nature on property value was shown to depend on the context, type and vicinity of greenspace (Bockarjova et al., 2020). Czembrowski et al. (2019) conducted research in Stockholm, Sweden to find that the higher number of potential functions of urban greenspace and the nearer it was, the stronger its impact on property prices. However, that impact could be either positive or negative. Spaces with high perceived aesthetic value yielded the biggest premium, with some positive impact from water and multifunctional greenspaces. But 'naturalness' and species diversity had a very weak impact. While spaces affording physical activity (recreation) were viewed as having positive price impact and those affording 'play' as negative, the affordance of recreational activities was insignificant in terms of a price premium (Czembrowski et al., 2019; see also Bockarjova et al., 2020).

Extent and vicinity of greenery

Jarvis et al. (2020) review points out that studies often focus on extent of greenspace within a set zone and the vicinity to it from the dwelling or neighbourhood as decisive for the extent and type of benefits garnered from urban nature (e.g. Zhu et al., 2019). In these studies, high extent of greenspace within a set zone correlated positively with restorative impact on mental wellbeing, regardless of the size of the considered zone. Similarly, findings from Serbia by Vujcic et al. (2019) suggest that extent and vicinity of greenspace correlate positively with self-reported mental and health benefits, but the extent of these also depends on the extent of physical activity such as walking, or jogging performed in the greenspaces. However, findings on somatic and mental health impacts were contradictory. Lin and Wu (2021) reported only a marginal impact from the vicinity and extent of urban greenspaces on the self-reported health of old people and discovered a slight negative impact from living close to a large river or the coast in China. This said, Liu et al. (2020) suggest that the presence of small but accessible and varied green spaces, preferably with some water features in the urban park system was crucial for meeting the recreational needs of local residents.

Broader environmental quality

High temperature (29.5 °C or above) was associated with a significant reduction in the number of park users in all age groups, but the greener the parks the more they were used for physical exercise even in high temperatures (Kabisch et al., 2021; see Peng et al., 2021 for similar findings from China). In the summer heat, different park characteristics served different recreational demands of different user groups at different times of the day. Kabisch et al. (2021) emphasise the need to carefully plan a park design that is tailored to specific local environmental conditions.

Ability to grow and engage with productive ecosystem services

Community gardens and specifically the opportunity to interact with nature's elements, grow and nurture, were seen to have a therapeutic impact and nurture social and ecological connections with place in a study of refugees struggling to come to terms with dislocation (Abramovic et al., 2019). Community gardens were seen to support recovery, as well as the realisation of wellbeing in the broader population, but, due to exclusive management and design features, they may become exclusive, creating a majority that is 'left out', albeit mostly willingly (Ding et al., 2020).

4.3.2. Social context: factors and mechanisms that mediate the co-production of social impact from urban nature

A review of research up to 2019 found that evidence of the benefits of urban nature to human health and wellbeing in disadvantaged neighbourhoods was, at best, mixed (Hunter et al., 2019). Ethnic and socio-economic diversity, housing status and perceptions of the status of the neighbourhood appear to play a role in how urban greenspace and water features are interpreted and experienced among residents (Jennings et al., 2016; Juntti and Lundy, 2017). The influence of the social context on the social impact of urban nature is therefore predominantly through the signifying function of urban nature (Juntti et al., 2021). Our review found a range of studies that deepen and broaden this understanding.

Demographic and socioeconomic status and diversity

There is clearly some complexity to how different socio-economic groups appear able to derive health and wellbeing benefits from urban

nature (Pineda-Pinto et al., 2021) and both household income and the socio-economic status of the locality seem to matter. In line with numerous others, Jarvis et al. (2020) report from a study in Canada that both access and exposure to water and greenspace decline in areas characterised by socio-economic deprivation (marginalisation, residential instability, deprivation, and dependency). But the ability of low-income residents to benefit from greenspace seems to vary. In China, low-income groups displayed a positive correlation between the green exposure of residential areas and mental health (Zhang et al., 2020). But the same study found a negative correlation between the same variables for middle-income and high-income groups. Conversely, findings from the US suggest that only highly educated and/or high-income residents of gentrifying neighbourhoods displayed a positive correlation between exposure to active green space and self-reported health (Cole et al., 2019). In Cole et al.'s study, any potential health benefits from exposure to greenspace were overridden by the tendency of those living in poor non-gentrifying neighbourhoods to report worse health outcomes than wealthier neighbourhoods' residents. García De Jalón et al. (2020) found that while the positive impact that increased urban nature was perceived to have on property value in poor neighbourhoods was predominantly viewed as beneficial in Spain, a small minority experienced this undesirable impact – a dis-benefit. Therefore, it appears that the role that the socio-economic context plays in how urban nature is experienced, is significant but complex.

Cultural and ethnic diversity

There is also complexity to how urban nature yields benefits in culturally or ethnically diverse neighbourhoods. Mottaghi et al. (2020) found that views regarding the desirability of urban water features such as ponds and canals in a diverse Stockholm neighbourhood were mixed, with the risks that these features pose for children in specific highlighted (see also Mouratidis, 2019). For example, water was seen to yield dis-benefits in attracting undesirable social activities such as the consumption of alcohol in public places specifically by residents with children and/or those from ethnic groups where alcohol consumption is not culturally encouraged. This is an example of how urban nature may reveal and exacerbate differences between social groups due to the different functions and uses that the groups were putting them to (Mottaghi et al., 2020). In urban contexts, where socio-economic and ethnic diversity is associated with deprivation, these considerations may help explain what 'blocks' the ability of blue and greenspace to yield benefits to the same extent as in more homogenous 'gentrified' neighbourhoods.

Hatala et al. (2020) highlight another dimension of the social context that conditions how urban nature is engaged with by indigenous youth in Canada: because of prevalent racial and/or ethnic discrimination, indigenous youth do not feel safe accessing all parts of urban nature and there are areas, parks etc., that they do not feel 'belong to them' (see also Wolch et al., 2014). In this manner, the application of nature-based solutions in the city can replicate and impose colonial divisions and interpretations (Hatala et al., 2020). Yet, where they were able to interact with nature, indigenous youth described a broad range of mental health related benefits.

4.3.3. *Subjective factors that mediate the co-production of social impact from urban nature*

Income status

In our sample, subjective income status is featured in four studies. From these, it seems that higher socio-economic class and level of education increase frequency of physical access and ability to derive mental and physical health benefits from urban nature (e.g., Du et al., 2021; Georgiou et al., 2021; Cole et al., 2019). While socio-economically disadvantaged residents also report benefits from increased access to urban nature and water features (Vert et al., 2019; García De Jalón et al., 2020), the evidence is less salient and, in many cases, contradictory for both health impacts and increased activity levels (Hunter et al., 2019; Watson et al., 2020; Cole et al., 2019).

Demographic group

Georgiou et al. (2021) emphasise the indirect impact of age, gender, socio-economic status, and education on the ability to benefit from accessible greenspace. They also found other confounding factors, including average time spent at home a day, presence of chronic disease, BMI, ownership of a dog and energy expenditure at work, which impacted the extent of access to greenspaces. Syrbe et al. (2021) studied the impact of demographic factors on the value assigned to urban nature. They found that public parks are particularly important to the elderly whereas middle-aged individuals value urban forests the most. Water bodies are highly rated by almost all age groups, with a slight drop in appreciation by the elderly. In Cole's study (Cole et al., 2019), there was a positive correlation between frequency of access to greenspace and positive health impacts only for white residents in the US. Andreucci et al. (2019) found that older people, who may be unable to travel to more distant parks or forests, enjoy street trees, street greenery and fountains. Young parents appreciate the availability of playgrounds and sports facilities (Syrbe et al., 2021).

In terms of gender, women visit greenspaces more than men (Ullah et al., 2020; Syrbe et al., 2021) but Chen et al. (2019) found that men perceived space to be 'serene' more often than women.

Level of education and employment status also had a significant positive correlation with perceptions of space and sensitivity to its social and sensory dimensions (Mouratidis, 2019). Moreover, families with children perceived space to be rich in species more often than singletons (Ibidem).

Health and lifestyle factors

Those in good mental health and with active lifestyles appeared better poised to benefit from urban nature both for recreation and community benefits (Vujcic et al., 2019; Watson et al., 2020). For example, while young adults' and children's activity levels correlated positively with the availability of sports and paly equipment, those classified as obese benefitted more from access to nature rather than to sports facilities (Alejandre and Lynch, 2020; Poulain et al., 2020; Fuertes et al., 2020). Therefore, urban nature is central to maintaining children's and young adults' active leisure behaviour as well as to managing weight and emotional wellbeing, but versatility is needed to meet differing subjective needs.

Watson et al. (2020) found from a study in several European countries (Spain, the Netherlands, Lithuania, and the UK) that mental health, perceptions of social cohesion and concern about air quality mediated the experienced positive impact of urban greenspace on the presence of somatic symptoms. However, there was no correlation between objective greenspace indicators and the prevalence of symptoms.

Identity and cultural heritage

Hatala et al. (2020) describe how the cultural heritage of indigenous youth in Ontario, Canada, informed the manner in which they were engaging with urban nature. Their ability to engage with natural entities and elements (weather, river, water…) through metaphor and at an emotional level enabled them to benefit richly and to derive spiritual guidance from nature.

Alejandre and Lynch (2020) looked at children's access to urban greenspaces in the USA, Netherlands, Canada, New Zealand, Türkiye, and Germany and found that 'social influencers' play a significant role in encouraging children's access to greenspaces provided that safe, clean, and conducive green spaces were available.

4.4. *Contradictions and complexity in the social impact of urban nature*

As is evident from above, the social impact of urban nature is by no means uniform, independent of its material features or the social context. The physical function of the material form of nature and infrastructure in affording different types of activities is easy to grasp. For example, it is reasonable to deduce that parks with less vegetation but good facilities and infrastructure such as picnic areas are favoured for social interaction and those with more vegetation are better disposed

for physical activities due to the shade and type of surfaces they afford (Kabisch et al., 2021). But it appears that it is the signifying function of nature and what we term here the social context that introduce complexity to the realisation of nature's benefits and in some cases dis-benefits in the urban context. In this review, this complexity was particularly evident from studies using objective markers to measure the impact of urban nature on health. Both research looking at objective markers of mental health and self-reported somatic symptoms of illness reported no or negative correlation with increased greenspace (Zhang et al., 2020 in China; and Noordzij et al., 2020 in the Netherlands). Further, objective markers of greenspace also failed to yield a correlation with the prevalence of somatic symptoms in a study reporting on several European countries (Watson et al., 2020) and marginal or negative impact in Lin and Wu (2021) research in China. In fact, Watson et al. (2020) suggest that it is essentially subjective satisfaction with urban greenspace and perceived social cohesion that mediate the beneficial impacts on self-reported health (the absence of somatic symptoms). This would explain the difficulty of deriving benefits from greenspaces in disadvantaged contexts, where perceptions of the quality of greenspace are low (Jennings et al., 2016) and of crime rates often high (Mouratidis, 2019).

But also the material functions of nature can be divisive. For example, water is mostly highly valued and, in some cases, reported to yield enhanced fitness and restorative benefits (Felappi et al., 2020; Georgiou et al., 2021; Syrbe et al., 2021). But some dislike it because it is perceived a dangerous or for the social activities (consumption of alcohol outdoors) that they associate with it (Georgiou et al., 2021; Felappi et al., 2020; Syrbe et al., 2021; Mottaghi et al., 2020). Mottaghi et al. (2020: 140) suggest that in culturally diverse contexts, urban nature aimed at addressing environmental concerns in turn "stirred up a series of socio-material concerns" such as conflicts of perceived purpose and associated risk, and of actual use, that would need to be settled. This demonstrates that also the material functions of urban nature take on meanings and can have trade-offs and underpin conflicts and marginalisation depending on the social context.

Therefore, urban nature both yields different kinds of material affordances and is assigned significance and meanings that shape the way it is engaged with and whether and how its benefits or dis-benefits are realised. These depend to a certain extent on the material and social context, but Nitavska (2020) also suggests that spatial form influences perception and image of a place through often subjective subconscious connections to memories, associations, and individuals. This type of assignation of meaning may underlie for example the function of trees in reducing both perceptions and actual rates of crime in some of the reviewed studies (Mouratidis, 2019). Perhaps the starkest evidence of the role of cultural heritage in modifying the experienced benefits from urban nature came from a study of indigenous youth in Canada, who were able to derive multiple mental health benefits from urban nature due to ability to engage with it through cultural metaphors, despite often limiting access due to experiences of racism (Hatala et al., 2020). Sadly, Hatala et al. (2020) found that despite this high ability to benefit, indigenous youth have limited access to urban nature due to the social context – the prevalence of racism which means that these young people feel that certain spaces are out of bounds for them.

This complexity in how the material and social context as well as subjective characteristics shape the social impact of urban nature speaks to the ontology of co-production where the 'human factor' plays a role in whether and how the social impact of urban nature is realised (O'Brien, 2014; Fischer and Eastwood, 2016; Juntti and Lundy, 2017). The assignation of meaning, a key part of the co-production of the impact of urban nature (O'Brien, 2014), can be seen to be shaped by the material and social context within which nature is engaged with and plays a key role in whether and for whom the potential benefits of nature are realised.

5. Conclusions

Inspired by the emerging aspiration for 'urban greening' in planning and literature, this systematic review provides an evidence-based understanding of whether and how the much-lauded benefits, and potential dis-benefits, of urban nature are actually realised in the urban context. We reviewed findings from international literature reporting on the social impact of urban nature from locations in or comparable to a developed-country inner-city context. We viewed the social impact of urban nature (its experienced benefits and dis-benefits) as co-produced in the interactions between humans and nature in the context of everyday urban life. Our aim was to collate evidence on the role of the material, social and subjective factors in mediating the manner in which nature is perceived and engaged with, and therefore experienced by urban residents. The findings from the 46 reviewed papers emphasise the need for a shift of focus from a simplistic notion of physical access to nature to actually realised access to its potential benefits for more inclusive policy and planning.

This review reveals that there is already a wealth of knowledge on how the material and social context within which urban nature is situated influences the co-production of benefits and dis-benefits, or in short, nature's social impact. The detailed findings from the narrative analysis of literature are summarised in Table 3. They demonstrate that material features and the form of urban nature influence frequency of visits and activities undertaken within greenspaces and waterscapes, and those, in turn, influence whether and how benefits are realised (e.g. Kabisch et al., 2021). But the social context and the meanings associated with urban nature within this context and by different ethnic and demographic groups are decisive for whether the potential benefits of urban nature are realised for everybody in an equitable manner. For example, socio-economic status of the area, perceptions of crime, cultural diversity and experienced racism or other forms of discrimination matter to how urban nature is perceived and this in turn influences its experienced impact on health (e.g. Watson et al., 2020) and whether it is accessed at all in the first place (e.g. Hatala et al., 2020). In ethnically diverse neighbourhoods, experiences of the impact of urban nature, such as water, can be conflicting, where water features are experienced to yield both benefits and dis-benefits by different groups (e.g. Mottaghi et al., 2020). This suggests the need to manage possible trade-offs between diverse uses and subsequent unequally distributed benefits and dis-benefits. Subjective demographic attributes like gender and age and lifestyle attributes like fitness and BMI matter also as they in turn inform preferences and capability (e.g. Poulain et al., 2020). Findings regarding the role of socio-economic deprivation are particularly complex. In areas classified as deprived, research mostly report less wellbeing benefits and some dis-benefits from nature (e.g. Jarvis et al., 2020; Juntti et al., 2021), but greenspaces are nevertheless found to be highly valued and are seen to yield a lot of added value in terms of increased opportunities for affordable active recreation (García De Jalón et al., 2020). It is therefore important that greenspace provision in poorer neighbourhoods is not overlooked. More research is required on how exactly nature's benefits are realised in deprived urban contexts and how everyone's access to these benefits can be ensured. This understanding needs to inform both policy on greenspace targets and its actual delivery through planning and design practices to ensure that the much-lauded benefits of urban nature are actually realised for all in an equitable manner and that 'urban greening' does not lead to further inequality.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

Acknowledgements

This research forms a part of the BlueGreen Impact project undertaken in collaboration with Middlesex University and the London Development Trust and received support from the Higher Education Innovation Fund from Middlesex University.

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