The relationship between the neighborhood built environment and physical activity

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Chapter 3

Green place rather than green space as a health determinant: a 20-year scoping review

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Abstract

Numerous scientific studies, applying different approaches, have provided evidence of the links between the environment and people's health. Green spaces have been the subject of research aimed at exploring their benefits as components of the urban environment. We investigated possible causal relationships between green spaces and health, with the aim of addressing the following question. Does the mere material presence of green spaces contribute to the health of people who live in its vicinity, or are the health-promoting qualities of green spaces attributed to the ability of people to actually see, access, and enjoy them? The latter view highlights the relational dimension of places, and it entails personal relationships with places which are imbued with psychological meaning and significance for those who visit and experience them. We reviewed relevant literature, comprising a total of 189 papers on this topic that have been published over the first two decades of this century. Our findings showed that the material aspects of green spaces, such as their abundance and proximity to residences, received much more attention in studies than their quality and characteristics. However, relational rather than material measures of green spaces demonstrated statistically greater positive impacts of green spaces on health. These findings indicate that both sensory stimuli and activities and feelings attached to green spaces are essential for better health outcomes. Incorporating a relational perspective of green place-thinking into the existing literature on green spaces and health could contribute to optimizing the positive effects of green spaces and thus to the creation of healthy and livable cities.

Keywords: urban green space, place attachment, physical health, mental health, Healthy Cities, review

3.1 Introduction

Urban green space (UGS) is recognized as a key determinant of public health. In recent decades, the relationships between UGS and health-related behaviors and outcomes have been widely explored by health professionals, urban planners, public health analysts, and policy makers, and positive relationships have been identified across studies (Aggio et al.,2015; Akpinar and Cankurt, 2017; Helbich et al., 2018; Ji et al., 2019). Therefore, understanding the mechanism by which green spaces contribute to health and well-being is vital for designing healthy cities and promoting public health, especially in a context of rapid urbanization worldwide (UN, 2019).

Numerous studies and reviews have presented evidence of a positive correlation between UGS and health. This literature shares a common aim of elucidating cause–effect linkages between green elements in a city and the health of people living in their vicinity. However, it reveals an important epistemological divide, with studies adopting either a material or a relational perspective on this topic.

The material perspective entails objective measures of the presence of a certain amount of green space (abundance) at a certain distance (proximity) from a person (Maas et al., 2009; Markevych et al., 2014; Mäki-Opas et al., 2016). Often, Geographic Information System (GIS) maps constructed with data from satellites and remote sensing are used to establish the level of greenness of the area directly surrounding a residential unit. When these data are linked to health data, the correlations can reveal whether residents living in greener environments are healthier, even after controlling for age, education, and other known parameters that affect health.

Although geographic data appears objective and accurate, in some cases, such data may not reflect the actual experiences of urban residents. For example, a quiet street under a canopy of a few big trees and lined by small, well-kept vegetable gardens in front of single-storied houses is experienced by its residents as a distinctly green space with a lush environment. However, it may not be identified as a green space within a GIS map. Conversely, a map may

clearly show a sizable forest in the middle of a neighborhood, whereas in reality it is a steep, inaccessible canyon completely enclosed by the fenced-in backyards of the surrounding houses. None of the residents in the neighborhood may even be aware of the existence of the canyon. The same situation applies to strips of green space lining highways or to abandoned building sites overgrown with shrubs; they are materially present on a map but are invisible, inaccessible, and unappealing to urbanites.

The second perspective is thus a relational one. Here, what matters is whether or not people *perceive* their living environment to be green. UGSs, in the relational view, will have to induce concrete restorative experiences for their users, who perceive their environment to be green, in order to effectively stimulate health via physical activities, promoting social interactions among residents, or the joy of looking out at green scenery (Hartig et al., 2014; Kou, 2015).

The review presented in this paper seeks to compare the two perspectives. It takes stock of what perspective is adopted how often and which one delivered the most convincing empirical results.

3.2 Hypothesis

The relational perspective entails an assumption that physical health benefits are indirectly derived, psychologically and emotionally, through stress reduction or directly through physical activity. The material presence of UGSs is evidently a precondition for the occurrence of relational effects, but according to a relational perspective, health benefits from UGSs require their accessibility, usability, and attractiveness. From a purely material perspective, their impacts, which include cleaner air, noise reduction, and improvements in the urban ecology, are anyhow effective in enhancing people's health irrespective of their psychological and emotional experiences, which are either ignored or acknowledged.

The material, objective, map-based world often differs from the relational, perceived, and multidimensional social world. Therefore, the question of which causal chain matters more in the process of developing healthy cities becomes

pertinent. If the relational causal chain matters more than the material size and distance of UGS, then investments should target quality, usability, visibility, and walking routes. If the material causal chain matters even in situations of inaccessibility or unattractiveness, then policies should be aimed at increasing the abundance of UGSs and their proximity to residential areas.

The relational dimension, which encompasses individuals' perceptions, attachments, emotions, and memories of green spaces, has been receiving increasing scholarly attention (Zhang, et al., 2017). Green *space*, refers to the material (urban land covered by vegetation of any kind, WHO, 2017a), whereas green *places* emphasize personal perceptions of and attachments to these spatial sites. The notion of place, conceived as being imbued with meaning (Gulliver et al., 2008; Malpas, 2018), has received considerable attention across geographical studies since the 1970s (Cresswell, 2009&2014). The concept of place entails a greater focus on meanings (e.g., emotions, experiences, and attachment) than on the physical presence of spatial areas. For example, the well-known geographer, Yi-Fu Tuan, defined place as space endowed with meaning attached to it by people in the course of their daily experience (Tuan, 1977). Gulliver et al. (2008) viewed place as encompassing of all of the environmental qualities and values of a locality that are assigned to that space by residents. Thus, the concept of place incorporates the biophysical, social, and spiritual dimensions of a locality. *Place-thinking* emphasizes the subjective meaning of place for individuals (Kyle et al., 2005), fostered through their relationships and interactions with their environment (Lewicka, 2010). Relevant concepts in terms of place attachment, place identity and sense of place have aroused great attention and have been applied in many fields. For example, the application of place identity in urban planning has been argued to have the potential to build a city's uniqueness (Sepe, 2013) and also a sense of common citizenship (Neill, 2003). Moreover, place attachment has been often used in tourism research and found the ability to enhance sustainable tourism, destination resilience, and destination competitiveness (Dwyer et al., 2019). In practice, an emphasis on qualitative or mixed-methods is often required in place-related studies because of the focus on the interaction between people and environments.

Other reviews that have examined the relationship between green spaces and

specific benefits that they provide relating to health and well-being (Van den Berg et al., 2015; Gascon et al., 2016; Lai et al., 2019) have found that more green space is often associated with better health outcomes, such as better mental health and lower mortality. However, the findings are not always consistent. We hypothesized that these variations may result from the adoption of exclusively material or relational perspectives, leading to different conclusions. Assuming that both causal chains cannot be simultaneously true and that the material presence of UGS and their relationally perceived presence often do not tally, such a difference would be expected. This difference would inevitably lead to a difference in the percentage of studies that confirmed the positive relationships between UGS and health outcomes. This scoping review aims to reveal current evidence on material and relational perspectives of UGS and their relation to health.

3.3 Methods

We conducted a scoping review, entailing a search of the literature and summaries of the data using a five-stage methodological framework (Arksey&O'Malley, 2005).

Stage 1: Defining the research question

We defined the research question relating to material and relational studies of UGS. The first was to what degree a relational perspective of place-thinking measured by the proportion of studies adopting this approach within the UGS literature. The second was whether there were differences in the extent to which the hypotheses of material and relational studies were confirmed.

Stage 2: Developing a search strategy

We conducted a search of the literature using the Web of Science electronic database, which is particularly useful when searching for review studies (Obokata et al., 2014). We combined "green space" with the following keywords: "health," "well-being (or wellbeing)," "stress," "obesity," and "mortality." Our literature search builds on a similar review conducted between February and March 2016 by Zhang (2017), which we extended and deepened in December

2020, ensuring the inclusion of all recent articles in the present review. All studies on this topic published during a 20-year period from 2000 to 2019 were included in the search. Apart from searching the Web of Science database, we searched for relevant studies on the basis of our own professional knowledge of the literature in this field.

Considering the aim of this scoping review, we established the following inclusion criteria. First, green space within urban settings had to be associated with at least one type of health-related outcome, such as physical activity or mental health. Second, the study had to be written in English and published in a peer-reviewed journal. Third, the goal of the study had to be to explore the relationship between green space and health-related outcomes and not to test a method or develop a theoretical framework. Fourth, the primary focus had to be on green spaces rather than on multiple dimensions of the built environment, such as blue or gray spaces. We excluded review studies and studies that were not focused on biodiversity or on visits to green spaces.

Stage 3: Selecting studies

We identified 3,795 studies published between January 2000 and December 2019 using the keywords that we applied in our search of the literature. After screening titles and abstracts of articles, we identified 256 studies. Our evaluations of the full-text of the articles resulted in the selection of a total of 176 studies. To this figure, we added 13 studies that were selected on the basis of expert knowledge, leading to a total of 189 empirical studies that were included in the review.

Stages 4 and 5: Summarizing and reporting the data

We extracted information on authors, journals, and study locations from each of the articles included in the review. We also summarized the methods used to measure green space and findings on the relationship between green spaces and health outcomes. The results section below presents the fifth stage of the methodology, namely reporting the data.

3.4 Results

3.4.1 Overview

This scoping review included 189 empirical studies in which the relationship between green spaces and health outcomes was referred 245 times (in some studies, more than one measurement were applied for UGS). As shown in Table 3-2, "reference" was used to indicate UGS measurements that has been applied in included studies to link with health outcomes. "Positive relations" indicates health benefits of UGS identified in the references. Most of the studies were conducted in Europe (49%) and North America (20%). Since 2016, an increasing number of studies have focused on Asia, especially China. More than three quarters of the included studies were cross-sectional studies (see appendix 1: Table 3-1).

As indicated in Table 3-1, we identified three main categories of measures of UGS. The first was proximity to green spaces measured either from a material or a relational perspective. The second was the abundance of green spaces (always measured from a material perspective), and the third was the quality or the characteristics of green spaces (always relational). We identified 11 subcategories, which are described in more detail in the following section. Figure 3-1 reveals a growing number of references to UGS measurements, particularly since 2012. More than half of the included studies were published during the last four years (2016–2019) of the 20-year period.

Of the above-identified measures, abundance was the most frequently used (63.3%), with proximity and the quality and characteristics of UGS receiving less attention (19.2% and 17.6%, respectively). In total, 184 out of 245 references (75.1%) indicating positive relations between green spaces and better health outcomes over the 20-year study period (Table 3-2).

Table 3-2 Measures of green space in the reviewed studies

Category	Measurement of green space	References (instance)	Positive relations (instance)	Positive relations (%)
Proximity (P)	P1 (relational): self-reported distance/walking time/access to UGS	11	11	100.0%
	P2 (relational): self-reported appearance of UGS within certain distance	1	1	100.0%
	P3 (material): GIS-measured distance to UGS	26	15	57.7%
	P4 (material): GIS-measured appearance of UGS within certain distance	9	6	66.7%
	P in total	**47**	**33**	**70.2%**
Abundance (A)	A1 (material): GIS/Satellite image-measured the amount/percentage/ NDVI of UGS within pre-defined area around household/household postal code	82	64	78.3%
	A2 (material): GIS/Satellite image-measured the amount/ percentage/NDVI of UGS within pre-defined area around each neighborhood center/population weighted centroid	12	11	91.7%
	A3 (material): GIS/Satellite image-measured the amount/percentage/ NDVI of UGS/UGS service area within a geographic unit such as neighborhood/community/county/city	48	35	73.5%
	A4 (material): numbers of UGS for certain population	3	1	33.3%
	A5 (material): numbers of UGS within certain area	7	4	57.1%
	A6 (material): the size of nearest UGS	3	2	66.7%
	A in total	**155**	**117**	**75.5%**
Quality (Q)	**Q (relational)**: the quality and characteristics of UGS	**43**	**34**	**79.1%**
Total		**245**	**184**	**75.1%**

Notes: "Reference" denotes application to a type of UGS measurement that is linked to one or more health outcomes in the included studies. "Positive relations" indicates health benefits of UGS identified in the references.

(by authors)

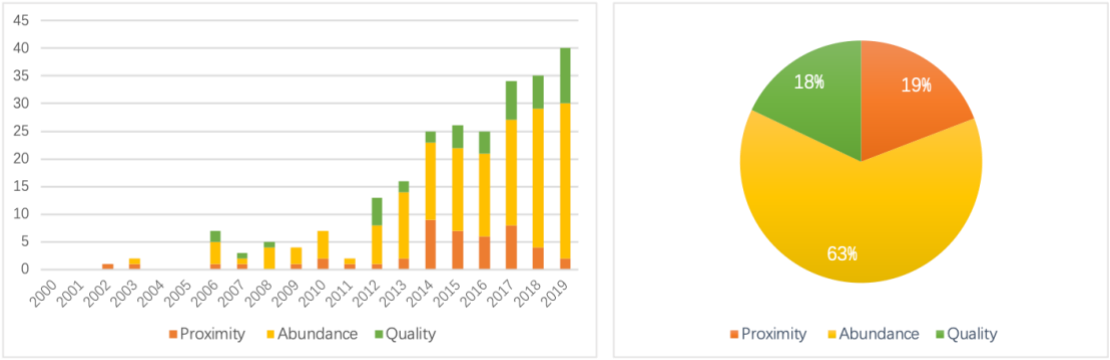

Figure 3-1 Numbers and percentages of three categories of UGS measures in the literature: 2000–2019 (by author)

3.4.2 Measures of green spaces

3.4.2.1 Category P: Proximity to green spaces

As shown in Table 3-2, we identified 47 references to proximity of green spaces used as a measure. Of these references, 70.2% indicated that green spaces were positively related to better health outcomes.

Two subcategories of UGS measurements (P1 and P2) used self-reported (subjective) data to measure the distance from residential units to green spaces (Nielsen and Hansen, 2007; Dadvand et al., 2016; Petersen et al., 2018). Self-reported measures of distance/walking time/access to green spaces (P1) were presented in 11 references, all of which showed positive relations between green spaces and health. A measure for self-reported observations of green spaces/parks located within a certain distance of residential units (P2) was found one time and indicated a positive relation to health outcomes.

Proximity was also measured objectively using a GIS system to measure distances of green spaces from residential areas (P3, e.g. Grazuleviciene et al., 2014; Halonen et al., 2014). These measures occurred most frequently (26 times). However, instances of positive relations for this measure were the lowest (57.7%). In addition, only moderately positive correlations (66.7%) were found for green spaces/parks observed within a certain distance and measured using a GIS system (P4, e.g. Dadvand et al., 2016; Hobbs et al., 2017). In three

out of nine cases, no relations or negative relations were reported for P4 and health outcomes.

3.4.2.2 Category A: Abundance of green space

There were 155 references to the abundance of green spaces in relation to public health in the reviewed studies, out of which 117 (75.5%) indicated that an abundance of green spaces has a positive impact on health outcomes.

The A1 and A2 measures both use the amount/percentage/Normalized Difference Vegetation Index (NDVI) of green space measured with GIS/satellite images (Nutsford et al., 2013; Ji et al., 2019; McMorris et al., 2015). This simple, graphical indicator can be used to analyze remote sensing measurements to assess whether or not the target being observed contains live green vegetation. However, there were differences in how the measured areas were defined in the studies. A1 was considered a measure of green space located within a predefined area with reference to a residence or its postal code. It featured in 82 studies and was the most commonly used measure of green spaces for all 11 subcategories of measurements. Positive relations were identified in 78.3% of cases. A2 was a measure of green space within a predefined area around each neighborhood center or population-weighted centroid. Correlations found using this measure were highly positive (91.7%, 11 out of 12 studies in which A2 was used). A3, which was a measure of green space within a geographic unit, such as neighborhood, city, or predefined area, was also widely applied, with positive relations reported for 35 out of 48 cases in which it was applied.

Three other subcategories of measures of the abundance of UGSs were relatively less explored (Potestio et al., 2009; Sarkar et al., 2018). A total of 13 studies discussed these measures. Positive correlations were found in 33.3% of these studies that used A4 (numbers of green spaces for specific populations), 57.1% of studies that used A5 (numbers of green spaces within a specified area), and 66.7% of studies that used A6 (the size of the nearest green space).

3.4.2.3 Category Q: Quality and characteristics of green space

Despite being the most promising category associated with better health outcomes, the quality and characteristics of green spaces was the least

discussed category. There were 43 references to this measure, of which 34 (79.1%) revealed positive impacts of green space on health.

This category had no subcategories because the measurements varied considerably across studies. For example, some studies applied quantitative research methods, entailing participants' self-reported perceptions of the quality of green spaces (Adjei and Agyei, 2015; Ali et al., 2017; Kothencz et al. 2017; Cleary et al., 2019). Others framed certain quality-related criteria which were applied to the environment (e.g., Van Herzele and De Vries, 2012; Van Dillen et al., 2012). Qualitative research method were employed in studies whereby participants expressed the relationship between the quality of green space and associated health benefits (see Plane and Klodawsky, 2013; Peschardt et al., 2016). Moreover, Carter and Horwitz (2014) used a combination of quantitative and qualitative research methods to measure green space.

3.4.3 Measuring the relational dimension of UGS

We divided the selected studies into a relational and a material group, applied across the three categories of measures of green spaces (Figure 3-2). The former acknowledges the existence of mental constructs of multiple perceived realities that are fluid and culturally based. The latter considers the world to be one reality in which objective measurements are possible and fixed patterns can be identified. GIS analyses based on the counting of square meters of green spaces are typical examples of the application of the material perspective. If individuals were asked to state the availability of the green space they experienced, the measurement was considered relational.

Thus, we considered the P1 and P2 subcategories (perceived distance as a measure of the availability of green space) and Q (the quality and characteristics of green space) as relational measures of green space, while other categories were considered material, that is, non-relational.

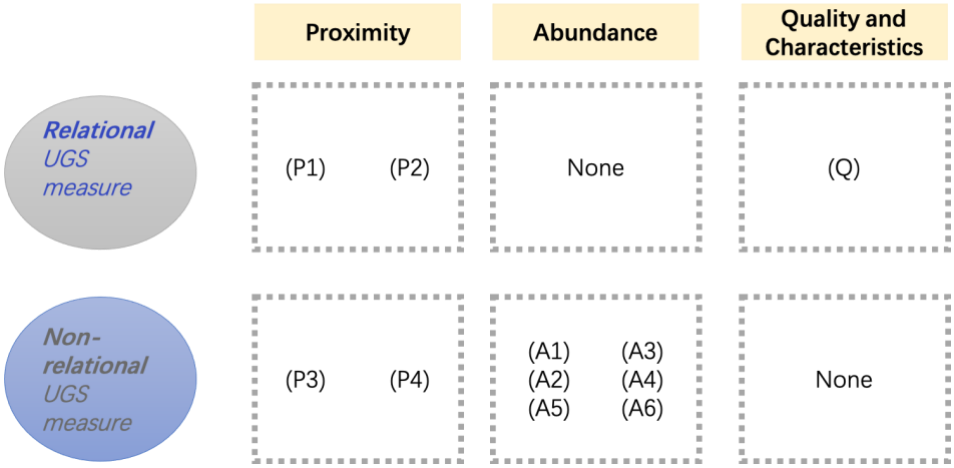

Figure 3-2 Relational and non-relational perspectives across three UGS measures (by author)

Figure 3-3 shows that less than a quarter of the studies adopted a relational approach for measuring green spaces. Moreover, this imbalance did not change during the 20-year study period. Even though the number of studies that measured the relational dimension increased, this rise was attributed to the growing body of studies in this field; the percentage did not, however, increase.

Despite fewer references to the relational dimension, a promising correlation with better health was evident: 83.6% of all of the relational measures of green space demonstrated a positive relationship with health benefits compared with 72.6% of material measures (Table 3-2).

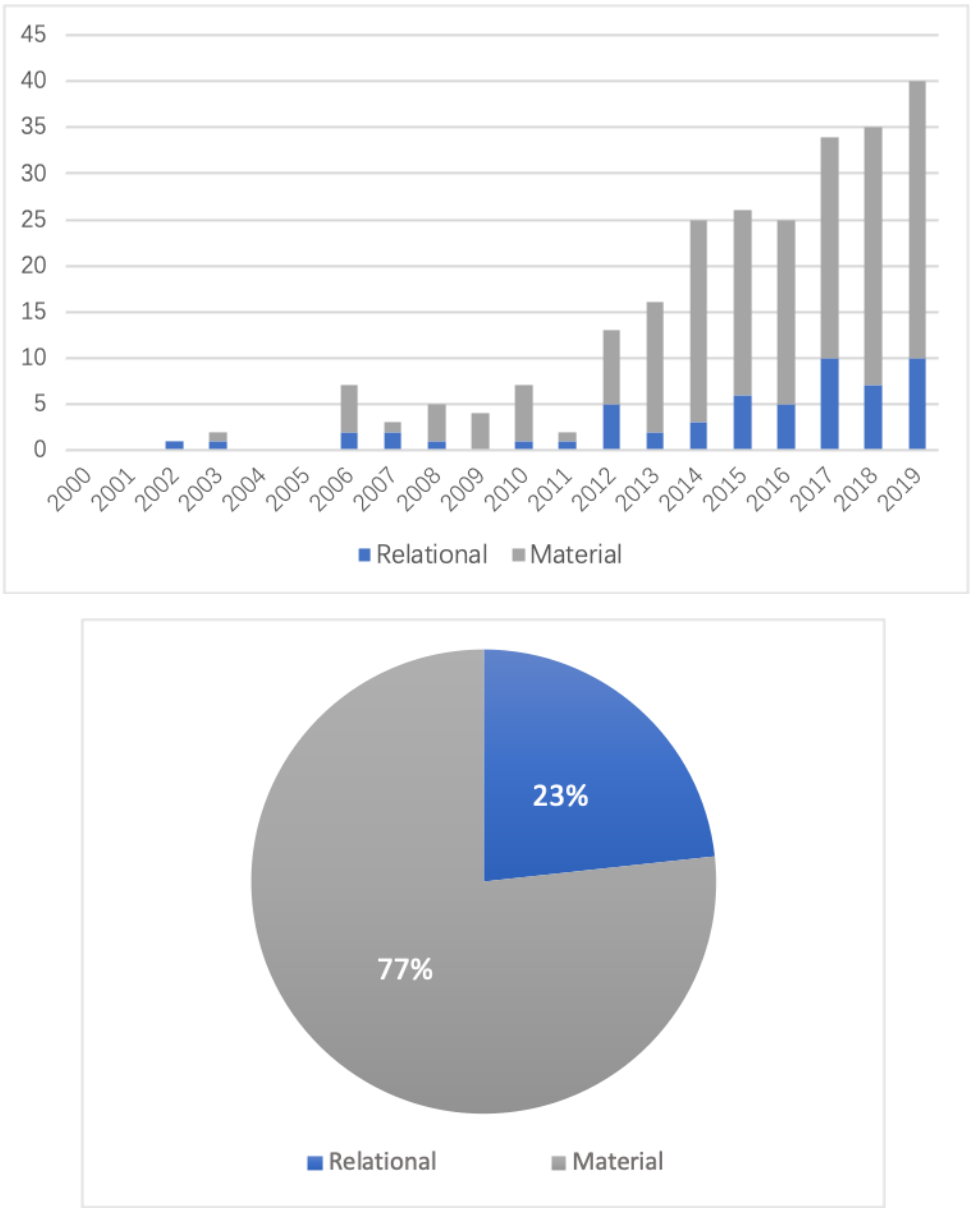

Figure 3-3 References using relational and non-relational measures of green space from 2000 to 2019 (by author)

3.4.4 Impacts of UGS per health-related outcomes

Across the reviewed studies, we identified six categories of health outcomes: *physical health-related outcomes (PH)*, including physical health conditions, body mass index, obesity, and cardiovascular disease; *mental health and well-being (MH); general health and well-being (H&W)*; *mortality/risk of death (M); physical activity level (PA);* and *other health outcomes (O)*, such as sleep problems, screen time, and children's behavioral problems (Table 3-3).

Four categories, namely MH, H&W, M, and O accounted for more than 80% of positive relations between health outcomes and green spaces, whereas relations between health outcomes and green spaces were relatively less positive for the remaining two categories, namely PH (65%) and PA (61%).

The association between each of the health outcome categories with green space was examined from both a relational and a material perspective. Material measures were predominant for each health category, especially for PH, MH, and M. Nevertheless, the percentage of positive correlations identified for relational measures was higher than that for material measures for most categories except for the H&W category. For instance, there were eight references to relational measures of PH, of which 88% were identified as positive, whereas there were 41 references to material measures, of which only 61% were positive. Negative relationships were identified between material measures and PH and PA outcomes.

Table 3-3 Health outcomes and their relation to green space measurements

	Physical health (PH)			Mental health (MH)		General health and well-being (H&W)	Mortality (M)		Physical activity (PA)		Others (O)		
	+	0	-	+	0	+	0	+	0	+	0	-	+	0
P1	2	0	0	3	0	2	0	0	0	5	0	0	3	0
P2	0	0	0	1	0	1	0	0	0	1	0	0	0	0
Q	5	1	0	12	3	12	3	1	0	7	2	0	4	0
Relational	7	1	0	15	3	16	3	1	0	13	2	0	7	0
Positive (%)	88 %			84%		84%	100%			87%	100%			
A1	12	5	1	19	3	10	0	5	0	12	8	1	17	3
A2	1	0	0	3	0	2	0	4	1	0	0	0	1	0
A3	6	3	1	14	4	6	1	6	2	2	3	0	5	1
A4	0	1	0	1	0	0	0	0	0	0	1	0	0	0
A5	1	1	0	2	1	0	1	0	0	2	1	0	1	0
A6	0	0	0	1	0	0	0	0	0	1	1	0	0	0
P3	5	3	0	3	2	4	1	0	1	1	5	0	3	3
P4	0	1	0	3	0	2	1	0	0	4	0	0	2	1
Material	25	14	2	46	10	24	4	15	4	22	19	1	29	8
Positive (%)	61%			82%		86%	79%			52%	78%			
In total	32	15	2	62	13	40	7	16	4	35	21	1	36	8
positive (%)	65%			83%		85%	80%			61%	82%			

Notes: + means positive outcomes; - means negative outcomes (only identified for PH and PA); 0 means null/mixed results.

(by author)

3.5 Discussion

3.5.1 Main findings

We conducted a scoping review of the literature over the first two decades of this century to identify which measures of green spaces (relational or material) were applied in the reviewed studies and whether the strengths of their correlations with health outcomes differed. The literature search and screening yielded 189 papers (with 245 references to measures of green space). Our results showed that almost half of the included papers were conducted in a European context. Most of the studies were cross-sectional, indicating potential pathways between the UGSs and health outcomes rather than a causal relationship.

3.5.1.1 The three categories of UGS measures (P, A, and Q)

We observed a growing number of studies on the research topic during the study period. Abundance was the most widely used measure of green spaces in these studies, followed by proximity and, lastly, the quality and characteristics of UGSs. One explanation for these differences could be the extensive use of GIS and remote-sensing techniques, resulting in an exponential increase in studies that measured the physical presence of green spaces. Our findings also indicated that less attention was paid to the quality of green spaces, which is an important determinant of health. For example, studies have pointed to the need to take the quality of greenness into account when considering associations between green spaces and health outcomes (Feng&Astell-Burt, 2018; Yin, 2019). In recent studies, the quality aspect has been measured by assessing people's UGS perception through a survey with Likert scale questions (Zhang et al., 2017; Cleary et al., 2019; Feng et al., 2022), undertaking site evaluation by following governmental guidance (Brindley et al., 2019) or hiring developed evaluation tools (Wood et al., 2018; Zhang et al., 2022a) such as the Neighborhood Green Space Tool (Gidlow et al., 2012), conducting a site survey to identify plant community structure (Ta et al., 2021), and extracting UGS relevant data from social media such as Twitter (Brindley et al., 2019). However, despite the growing body of research focusing on the qualitative aspects of

green spaces, most material studies treat green spaces as homogenous. There is relatively little focus on the quality as opposed to the quantity of green spaces (Brindley et al., 2019). Balanced measures could indicate pathways linking UGSs to health outcomes. Nevertheless, mere areas of green space or the number of parks cannot be considered to have benefits equal to those obtained from daily exposure to urban greenness (Lu et al., 2019).

3.5.1.2 Relational versus material dimension

We found that although the relational measures attracted less research attention than the material measures during the 20-year period covered by the review, they did show more convincing impacts on health outcomes. In total, 83.6% of the relations found between green spaces and health outcomes in the relational studies were positive, compared with 72.6% of relations in material studies. Specifying to each health outcome category, the argument still held: five out of six categories of health outcomes (PH, MH, M, PA, and O) evidenced more positive relations with the relational measures than they did with the material measures (Table 3-3).

The rate of confirmed positive relationships in the included studies suggests that the impacts of relational measures of green spaces on health warrant more attention than material measures in studies of the relationships between UGSs and health. This argument that relational measures of green spaces have the potential to indicate health outcomes more effectively than material measures is not new. One study found that subjective variables were stronger predictors of visits to green spaces than objectively measured quantities of residential green spaces (Bloemsma et al., 2018). Another study found that material approaches may not completely capture the image of UGSs (Xie et al., 2018). As Barton et al. (2006) indicated, health is determined by multiple factors; not only the physical presence of parks and green spaces but also the socio-personal contexts of individuals impact on their health.

Balanced measures that include both perspectives can better capture the entire pathway between UGSs and people's health. The material aspect is a crucial enabler of health, but the relational aspect is clearly necessary for health effects to emerge. The findings of our review suggest that by including green place-

thinking in studies on green spaces and health, the relationship between them may become clearer, and research findings may be more conclusive.

3.5.1.3 The importance of green-place thinking

The manner in which green spaces are measured in health-related studies indicates which pathways between UGSs and health outcomes are recognized by scholars and to what extent the right pathway would reflect the actual mechanism by which green spaces act on human health. Accordingly, we argue that a more comprehensive examination of the relationship between green spaces and health-related outcomes that incorporates green place-thinking is needed to advance understanding of this relationship.

The insight that green space-thinking needs to be supplemented with green place-thinking serves as a call for researchers to expand the prevailing epistemological approach to incorporate a more relational perspective. Currently, dominant practices are based on the assumption that individuals' health and well-being outcomes are physically provided by nearby green spaces. A more relational approach may contribute to an understanding of how users' perceptions, the qualities of nearby green spaces, and their emotional attachment to these spaces may contribute to their health and well-being, and how they assign meanings to nearby green spaces.

3.5.2 Strength and limitations of the study

This review had several strengths. We adopted a broad view of the literature published over the last two decades, providing up-to-date research findings. The methodology that we applied in the scoping review enabled us to include both qualitative and quantitative studies. To the best of our knowledge, this is also the first review that focuses on relational measures of green spaces. Therefore, our findings can contribute evidence of pathways linking green spaces to multiple health outcomes.

This review also had some limitations. Geographical differences can affect the relationships between green spaces and health outcomes, leading to varied results. However, we did not differentiate the results according to geographical

locations. Nor did we categorize the health impacts of green space according to particular features of individuals, such as their age or gender, which could mediate the impacts of green spaces on individuals' health. Future studies could further explore health of specific groups of people in relation to green spaces to advance understanding of the causal chain. In this way, a more significant health impact with less physical presence might be achieved.

3.6 Conclusion

This 20-year scoping review aimed at exploring which UGS measures were applied within the literature and how they relate to health outcomes. We identified 189 papers and observed a clear increase in studies over the years. Moreover, we found that measures of the proximity of UGSs to residences were applied most frequently in the reviewed studies. Furthermore, although relational measures showed higher correlation with better health-related outcomes than material measures, they appeared less frequently in the literature. We would emphasize the importance of the quality aspects of green spaces. We also advocate a greater focus on relational measures of green space that incorporate the concept of "place," which encompasses both the affective meanings that people attach to green spaces and their unique individual experiences and practices within green settings, supported by physical and social-environmental features. In other words, combining *place*-thinking with the prevailing *space*-thinking in studies on green spaces and health reveals a more complete picture of the relationship and provides guiding inputs that can help practitioners and policy makers to build healthy and livable cities.