

Underlying relationships between public urban green spaces and social cohesion: A systematic literature review

Calvin Wan ^{a,c,*}, Geoffrey Qiping Shen ^b, Stella Choi ^c

^a Nottingham Business School, Nottingham Trent University, United Kingdom

^b Department of Building and Real Estate, The Hong Kong Polytechnic University, Hong Kong ^c School of Professional Education and Executive Development, The Hong Kong Polytechnic University, Hong Kong

ABSTRACT

Research has substantiated the positive role of social cohesion on physical health and psychological well-being, and there is increasing interest in how public urban green spaces (“green spaces” hereafter) promote social cohesion. This review synthesized existing empirical evidence to ascertain the impact of green spaces on social cohesion. 51 published studies met the inclusion criteria were reviewed. Physical characteristics, perceptions, and use patterns of green spaces were found directly influencing social cohesion. Findings also suggested that physical characteristics of green spaces intermingle with environmental perceptions and use patterns to further complicate the impact on social cohesion. A model was proposed to conceptualize the complex relationships between green spaces and social cohesion. The review identified current gaps in the literature which further research is needed. It also informs interventions for promoting public health and well-being by enhancing social cohesion in urban natural environments.

1. Introduction

Social cohesion is conceptualized as shared norms and values (Beckley, 1995), positive interactions and relationships among individuals (de Vries, Van Dillen, Groenewegen, & Spreeuwenberg, 2013), and feelings of being accepted and belongings (Forrest & Kearns, 2001) in neighborhood settings. A variety of terms such as social contact, social connection, social interaction, social support, and social ties are used to indicate the value of individuals’ relations with others in a neighborhood context, and expressions like feelings of loneliness and lack of social support are used to represent absence of social cohesion (Elands, Peters, & de Vries, 2018). Social cohesion is also closely related to social capital (Rios, Aiken, & Zautra, 2012). In line with the practice of Hartig, Mitchell, de Vries, and Frumkin (2014), the term *social cohesion* will be used throughout this study; it is because social cohesion put a heavier emphasis on neighborhood context and is more likely to be affected by physical characteristics of the neighborhood such as green spaces (Hartig et al., 2014; Rios et al., 2012) whereas social capital is more an asset of individuals (Elands et al., 2018).

Research has substantiated the positive role of social cohesion on human health and well-being (Kawachi & Berkman, 2000, 2001). For instance, people are more likely to engage in physical activity given that social cohesion is negatively associated with neighborhood violence (Ferreira et al., 2007; Sampson, Raudenbush, & Earls, 1997). Informal social encounters taken in public spaces help city

dweller relief from daily routines, reduce tensions, and strengthen personal resilience (Cattell, Dines, Gesler, & Curtis, 2008; Lee, Jordan, & Horsley, 2015). In addition, social cohesion among neighbors is a particularly important aspect for older adults' well-being because it results in a higher degree of social support (Cramm, van Dijk, & Nieboer, 2013) and reduces mortality risks (Inoue, Yorifuji, Takao, Doi, & Kawachi, 2013).

Green spaces have been suggested contributing to social cohesion by encouraging people to go out and providing opportunities and venues for people to others and undertaking social activities (Elands et al., 2018; Swanwick, Dunnett, & Woolley, 2003). Considerable research has examined the role of the physical environment of the green spaces in facilitating social cohesion. For example, the presence of trees has greater potential to encourage utilization of common spaces and favors positive informal social interactions between visitors (Coley, Kuo, & Sullivan, 1997; Kuo, Sullivan, Coley, & Brunson, 1998; Kweon, Sullivan, & Wiley, 1998). Meanwhile, subjective environmental factors like perceived greenness (de Vries et al., 2013; Sugiyama, Leslie, Giles-Corti, & Owen, 2008) and perception of safety (Dinnie, Brown, & Morris, 2013; Hong, Sallis, et al., 2018) as well as nature dose such as frequency and duration of visiting green spaces (Ka'zmierczak, 2013; Mowen & Rung, 2016; Shanahan et al., 2016) have been found crucial in promoting social cohesion.

While studies have investigated the effects of different green spaces' aspects on social cohesion, specific pathways through which factors impact social cohesion have not been systematically synthesized. Besides, current literature has considered different aspects of green spaces as independent factors to social cohesion; no studies hitherto have explored the possibility of interrelations between these aspects and their joint effects on social cohesion. To address the knowledge gaps, the present literature review aims to (1) identify and summarize different aspects of green spaces that influence social cohesion; and (2) uncover pathways between these aspects and social cohesion. This study will advance our understanding of how do green spaces can function as a system of promoting social cohesion. The elucidated mechanisms between the relationships can be strategized as a means of developing and fostering social cohesion. Urban planners can work on interventions and configure green spaces that enhance social cohesion and meet public health challenges of urbanization by drawing reference to the findings.

2. Method

2.1. Search strategy

A keyword searching was conducted on databases Web of Science (WOS) and PubMed to identify empirical research studies in peer-reviewed English language journals published between 1997 and 2018. The search was conducted in July 2019. It focused on literature that examines social cohesion in public urban green spaces. Two groups of search queries were developed and entered in the Advanced Search text box using the field tag "Topic" for publication identification. The first group of search strings contains keywords related to public urban green spaces. Term variations of social cohesion formed the second group of search queries (Table 1). We used Boolean operator OR in between terms and used the Boolean operator AND to link two sets of search results. Besides from keyword searching, additional studies were identified by using backward and forward reference searching when reviewing full texts of included studies.

2.2. Eligibility and study selection

Study selection was divided into three stages. First, search results from the WOS database were refined to specific fields of study by using the “Web of Science Categories” provided by the academic database search engine. Studies under categories that are readily irrelevant (e.g., Biology, Neuroscience, Energy Fuels) were excluded in this stage. In the PubMed database, we restricted the results to human studies by using the filter “Species”. Second, title and abstract screening was applied to each study after result refinement in the WOS database. The screening aimed to exclude dissertations, conference abstracts, editorials, review articles, and out of scope studies. This process was performed in the PubMed database by first selecting the filter “Article Type” as Journal Article, followed by title and abstract screening. The third stage is a full-text assessment which has applied to outcomes of both databases. A study had to meet the following criteria in order to be included for the literature review: (i) the investigated setting should be exclusively a form of public urban green spaces (e.g., urban parks, common spaces with vegetated cover); (ii) must have public urban green spaces characteristics, either objective or subjective ones, that are being evaluated for the relationships with social cohesion or similar behaviors; (iii) the outcome measure must be social cohesion or similar behaviors.

2.3. Quality assessment

Included studies were checked for methodological quality by using Mixed Methods Appraisal Tool (MMAT) (Hong, Pluye, et al., 2018). The tool was developed for quality appraisal of systematic reviews that include qualitative, quantitative, and mixed methods studies. There are five criteria for assessing each category of study (Appendix B). Reviewers evaluated the quality of a study by rating the criteria of the chosen category (“Yes” = *criterion is met*; “No” = *criterion is not met*; “Can’t tell” = *not enough information for evaluation*). A quality score was calculated by adding up the “Yes” scores for each study. Studies were rated as high quality (HQ) if the score was 5, a score of 3–4 represents medium quality (MQ) and below 3 is low quality (LQ). The assessment results are outlined in Appendix A. Overall, most included studies are of medium quality.

2.4. Data abstraction

The following descriptive items were extracted from each study: (i) authors(s); (ii) year of publication; (iii) journal; (iv) case study location; (v) research design; (vi) outcomes assessed (i.e., operationalization of social cohesion or similar behaviors); (vii) study target; and (viii) sample size. Eligible studies were then read through to elicit factors of public urban green spaces that predict social cohesion or similar behaviors. Meanwhile, the relationships between identified factors and social cohesion were sorted out. The process aimed to explore underlying mechanisms that green spaces factors contribute to social cohesion or similar behaviors. To ensure the quality of the data extraction, the work of study selection, quality assessment, and data extraction was conducted by one of the authors and the work was checked by the other two authors. Disagreements arising from the checking process were resolved

Table 1 Search query.

Search query	Topic terms
1st group of search query	“urban green space*” OR “urban public open space*” OR “urban public green space*” OR “green space*” OR “open green space*” OR “open area*” OR “open space*” OR “neighbo \$rhoo d green space*” OR “neighbo\$rhoo d open space*” OR “neighbbo\$rhoo d park*” OR “greenspace*” OR “neighbo \$rhoo d space*” OR “neighbo\$rhoo d greenness” OR “greenness” OR “urban greenspace*” OR “public greenspace*” OR “green common space*” OR “urban park*” OR “natural outdoor environment*” OR “community garden*”
2nd group of search query	“social cohesion” OR “social coherence” OR “social connection*” OR “social tie*” OR “social capital” OR “social connectedness” OR “social relationship*” OR “social interaction*” OR “social inclusion” OR “social support*” OR “social integration” OR “social contact*”

Note. * = any group of characters, for finding words with any possible ending. \$ = zero or one character, for finding the American and British variation of the term. through discussion between authors.

3. Results

3.1. Search outcomes

The keyword search produced 367 studies by WOS and 118 studies by PubMed (Fig. 1). The search result was narrowed to 281 studies by excluding articles published in irrelevant “Web of Science

Categories” in WOS and non-human studies in PubMed. The title and abstract screening process further removed 212 studies. There were 69 studies that remained for the full-text assessment. By applying the inclusion criteria, 50 studies were relevant for the literature review but 15 of them were overlapped results that should be deleted. An additional 16 studies were identified by using forward and backward reference when conducting the full-text assessment. A total of 51 studies were included for quality assessment and no studies were excluded after quality assessment.

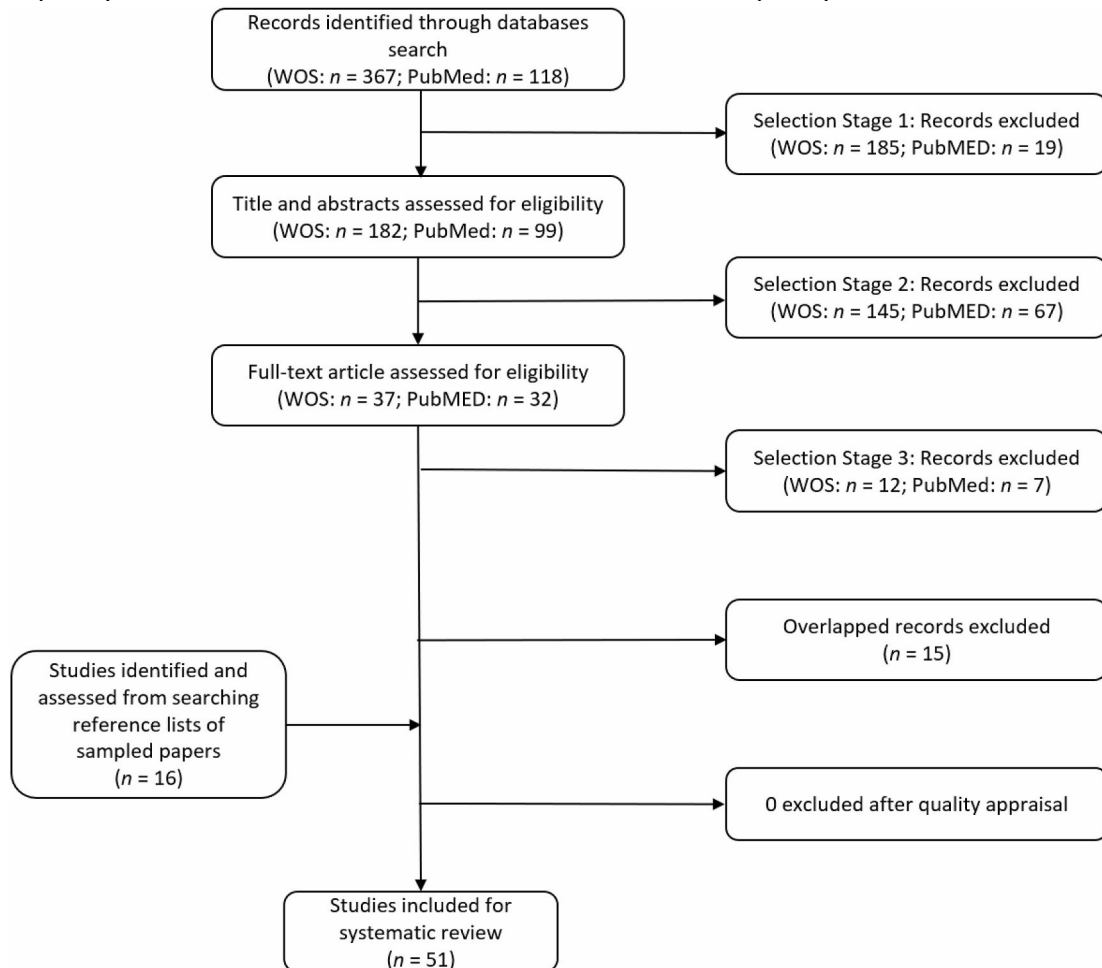


Fig. 1. Flow diagram summarizing the search results and screening workflow.

3.2. Study characteristics

Table 2 shows the descriptive information of sampled publications. There is a notable difference regarding the distribution of countries where retrieved publications were conducted. Most studies were conducted in Europe (19 publications) and North America (15 publications). The rest of the studies were divided between Asia (China, Malaysia, Japan, and Taiwan), Australia, and South America (Chile, Peru). The 51 studies were published in 28 different journals, and over 45% of them (23 studies) were published in Health & Place, Landscape and Urban Planning, International Journal of Environmental Research and Public Health, and Environment and Behavior. Regarding the methodology used, around 53% of the studies applied quantitative research methods for data

collection. Qualitative research literature accounted for about 35% of the included studies. The remaining articles used a mixture of qualitative and quantitative methods. Besides, most retrieved publications were cross-sectional studies.

3.3. Description of outcome assessed

Social cohesion, social interaction, social capital, and social contacts are the most typical terms used for representing the value of individuals' relations with others in neighborhood context. Examples of other terms investigated are social support, social networking, social ties, social relations, social inclusion, and loneliness. Regarding how the outcome variable is being operationalized, nearly 73% of the studies examined the outcome from a single aspect. The remaining studies measured different aspects of the outcome, for example, [Maas, van Dillen, Verheij, and Groenewegen \(2009\)](#) studied social contacts by using the level of loneliness, social support, and extent of social contact. [Sugiyama et al. \(2008\)](#) tested the outcome variable by examining both social coherence and social interaction. Questionnaire items for measuring the outcome variable were partially or fully adopted from one or more validated scales. Among the quoted scales, the Social Cohesion and Trust Scale ([Sampson et al., 1997](#)), Reciprocated Exchange ([Sampson, Morenoff, & Earls, 1999](#)), a general measure of social capital ([Bullen & Onyx, 1998](#)), Duke-UNC Functional Social Support Questionnaire ([Broadhead, Gehlbach, de Gruy, & Kaplan, 1988](#)), and UCLA Loneliness Scale ([Russell, 1996](#)) were most frequently used. For other studies, self-developed measurements were used for assessing the outcomes.

3.4. Identified green spaces' aspects and their impacts on social cohesion

Relationships between social cohesion and different aspects of green spaces had been examined. There are three major aspects of green spaces contributing to the development of social cohesion, namely, physical characteristics, perceptions of the environment, and use patterns. [Appendix C](#) shows the distribution of these factors mentioned by the included studies. The rest of this section will report the findings.

3.4.1. Physical characteristics

A robust literature has established a significant association between the **presence of vegetation** and various forms of social process (e.g., [de Vries et al., 2013](#); [Holtan et al., 2015](#); [Ulmer et al., 2016](#); [Zhang et al., 2018](#); [Jibril & Elfartas, 2018](#); [Kweon et al., 1998](#); [Sullivan et al., 2004](#)). The presence of trees and grass was suggested to encourage greater use

Descriptive information of retrieved publications.

Study (year of publication)	Location	Research similar behaviors methods	Operationalized of social cohesion or
Study target	Sample size		
Astell-Burt et al. (2016)	AUS	QS	•Social networking: 3 items selected from short version of the Duke Social Support Index (Koenig et al., 1993) People living within 5 km of the Western Sydney Parklands $n = 7272$
Cattell et al. (2008)	UK	SE, DG, O, SSI	•Social relations: everyday encounters with others, causal social exchanges in public spaces, and informal social contact between different ethnic groups Residents and community activists $n = 42$ for DG, 6 sites for O, 24 for SSI
Cohen, Inagami, and Finch (2008)	US	QS	•Social cohesion: 5 items adapted from <i>Social Cohesion and Trust Scale</i> (Sampson et al., 1997) General population $n = 2431$
Coley et al. (1997)	US	O	•Social activity: social activities of observed residents in green spaces Residents of public housing $n = 96$
Cox et al. (2017)	UK	QS	•Social cohesion: 17 items adapted from <i>Social Cohesion and Trust Scale</i> (Sampson et al., 1997), <i>Reciprocated Exchange</i> (Sampson, Morenoff, Earls, & Producer, 1999), and a general measure of social capital (Bullen & Onyx, 1998) General population $n = 1000$
Cox, Shanahan, Hudson, Fuller, and Gaston (2018)	UK	QS	•Social cohesion: items adapted from <i>Social Cohesion and Trust Scale</i> (Sampson et al., 1997), <i>Reciprocated Exchange</i> (Sampson et al., 1999), and a general measure of social capital (Bullen & Onyx, 1998) General population $n = 3000$
Dadvand et al. (2016)	ESP	QS	•Social support: 8 questions of the Duke-UNC Functional Social Support Questionnaire (Broadhead et al., General population $n = 3461$

1988)

de Vries et al. (2013)	NLD	O, QS	•Social cohesion: 5 items from <i>Social Cohesion and Trust Scale</i> (Sampson et al., 1997), 4 items about social quality (Intomart, 2001) and 4 items on social well-being (Volker, Flap, " & Lindenberg, 2006)	Neighborhoods' residents	<i>n</i> = 1641 for QS, 320 streets for O
Dinnie et al. (2013)	UK	SSI, WI, VF, VR	•Social interaction: measuring interaction between different people, e.g., socializing, chatting, connecting with others	Greenspace users	<i>n</i> = 10 for all methods
Dzhambov, Hartig, Markevych, Tilov, and Dimitrova (2018)	BGR	QS	•Neighborhood social cohesion: A brief form of the <i>Perceived Neighborhood Social Cohesion</i> questionnaire (Dupuis, Baggio, & Gmel, 2015)	Young people	<i>n</i> = 399
Fan, Das, and Chen (2011)	US	QS	•Social support: measuring years living in the current house and health interfering with socializing	General population	<i>n</i> = 1544
Gobster (1998)	US	O	•Activities and interactions engaged in the park	Park users	<i>n</i> = more than 5000 individuals
Gomez, Baur, Hill, and ' Georgiew (2015)	US	QS	•Psychological Sense of Community: 20 items of 4 subscales including Emotional Connection, Meet Needs/Integration, Membership, and Safety (McMillan & Chavis, 1986)	General population	<i>n</i> = 119
Hale et al. (2011)	US	SSI	•Social networks/social ties/social support: interactions with neighbors, building social networks, sharing fruits with others, and meeting people in the community	Community gardeners	<i>n</i> = 67
Harris, Minniss, and Somerset (2014)	AUS	SSI	•Social connectedness/social capital: a sense of belonging to the community through sharing	African humanitarian migrants	<i>n</i> = 12

			produce and work collaboratively with others		
Holtan, Dieterlen, and Sullivan (2015)	US	QS	• Social capital: 5 items measuring neighborhood social connection and association adapted from <i>Baltimore Ecosystem Study</i> Telephone survey	General population	$n = 361$
A. Hong, Pluye, et al. (2018)	US	QS	• Social capital: 5 items adapted from <i>Social Cohesion and Trust Scale</i> (Sampson et al., 1997) • Social cohesion: Older adults • Social interaction: 3 survey items adapted from Parker et al. (2001)		$n = 647$
Hordyk, Hanley, and Richard (2015)	CAN	D, ST, SSI	• Social cohesion: conversations with neighbors and relationships with friends and acquaintances	Immigrants	$n = 23$ for all methods
Huang (2006)	TW	O	• Social interaction: behavioral interaction among residents including nodding, talking, waving, and friendly physical contact	Residents of high-rise housing	$n = 32,476$
Jibril and Elfartas (2018)	MYS	QS	• Social interaction: factors adapted from Holland, Clark, Katz, and Peace (2007) and Wagner and Peters (2014)	Urban park users	$n = 274$
Ka'zmierczak (2013)	UK	QS, FG	• Social ties: number of friends and acquaintances that respondents had in the investigated areas, how they used the park, how they related to other people there, whether they established any new relations as a result of visitation	Residents of inner-city neighborhoods	$n = 1450$ for QS, 18 for FG
Kemperman and Timmermans (2014)	NLD	QS	• Social contacts: 6 statements measuring respondents' relation with neighbors	Older adults	$n = 1501$

Kingsley and Townsend (2006)	AUS	SSI	•Social connections and networks: exploring friendships and support networks among people participating in a community gardening program	Members of community garden	<i>n</i> = 10
(continued)			(continued on next page)		
Korn et al. (2018)	PE	QS	•Social capital: using 36 items of eight subscales including participation in the local community, social agency, feelings of trust and safety, neighborhood connections, friends and family connections, tolerance of diversity, value of life, and workplace connections (excluded) from the <i>Social Capital Scale</i> (Onyx & Bullen, 2000)	Adult community members	<i>n</i> = 44
Krellenberg, Welz, and Reyes-Packeb (2014) "	CHL	QS	•Spatial interaction: contact with different socio- economic status groups	Residents with different socio-economic backgrounds	<i>n</i> = 232 household
Kuo et al. (1998)	US	SI	• Neighborhood Social Ties: 8 items of 3 subscales including Socializing, Nearby Neighbors, and Local Sense of Community • General Social Ties: 2 items measuring residents' broader of social networks (Are you content with the number of close friends you have in general?/Do you have many acquaintances?)	Residents of public housing	<i>n</i> = 145
Kweon et al. (1998)	US	SI	•Social integration: 15 items measuring social ties with neighbors and friends	Older adults	<i>n</i> = 91
Maas et al. (2009)	NLD	QS	•Social contacts: measured by <i>UCLA Loneliness Scale, Social Support List</i> (number of	General population	<i>n</i> = 10,089

			supportive interactions and shortage of social support), and contact with neighbors and friends		
Mangadu, Kelly, Orezzaoli, Gallegos and Matharasi (2017)	US, MX	FG, II, PV, QS	•Social support: interpersonal networks of participants (e.g., “I feel more involved in this neighborhood”, “I spend more time with my family”, “I have made new friends”, “I work better with others on a team”)	Community gardens, parents, youth, individual interviews	<i>n</i> = 223
Moulay, Ujang, and Said (2017)	MYS	QS, O	•Social interaction: measured by types of interactions (e.g., meeting friends, family gathering), engagement with being in park, and types of contact (e.g., greeting, discussion)	Residents living in the vicinity of parks	<i>n</i> = 339 for QS, 2 parks for O
Mowen and Rung (2016)	US	QS	•Social capital: measured by social cohesion, informal social control, social leverage, park organization. Measurements were derived from the <i>Project on Human Development in Chicago Neighbourhoods and the Los Angeles Family and Neighborhood Survey</i> (Carpiano, 2007)	Park users	<i>n</i> = 238
Noone and Jenkins (2017)	UK	O, SI	•Social bonds/social capital/social interaction: connections among individuals, social networks and the norms of reciprocity and trustworthiness that arise from them (Putnam, 2000)	People with dementia, day center staff	<i>n</i> = 13
O’Brien, Burls, Townsend and Ebdon (2011)	UK	O, I, FG	•Social capital/Social networks: participants’ relations with family and/or their local community	Socially marginalized people	<i>n</i> = 88 for O and I, 10 for FG

Orban, Sutcliffe, Dragano, Jockel, and Moebus (2017) "	DE	QS	• Social relations: ◦ Social satisfaction: 1 item (How satisfied are you with your relations to friends, neighbors, acquaintances?) ◦ Neighborhood social capital: 1 item (How satisfied are you with your residential area?)	Participants of the Heinz Nixdorf Recall study conducted in three adjacent cities in Germany	$n = 4480$
Peters (2010)	NLD	O, SSI	• Social interaction: familiarity with spaces, regular use, and conversations between strangers	Native Dutch and immigrants park visitors	$n = 26$ for O, 40 for SSI
Peters, Elands, and Buijs (2010)	NLD	QS, I, O	• Social cohesion: social interaction and place attachment	Native Dutch and immigrants	$n = 618$ for QS, 40 for I, 26 for O
Pleson et al. (2014)	TW	O, SI	• Social engagement: activities of social engagement that occur at the community green spaces, e.g., social interactions, socializing, chatting with friends	Older adults	$n = 1227$ for O, 19 for SI
Ruijsbroek et al. (2017)	ESP, UK, NLD, LTU	QS	• Social cohesion: 5 items adapted from <i>Social Cohesion and Trust Scale</i> (Sampson et al., 1997) • Neighborhood attachment: 3 items (I feel attached to this neighborhood/I feel at home in this neighborhood/I live in a nice neighborhood were people have a sense of belong) • Social contacts: 1 item (How often you had contact with your neighbors?)	General population	$n = 3771$
Seeland, Dübendorfer, and Hansmann (2009)	CHE	QS	• Social inclusion: questions asking about pupils' peer groups and ways of making friends	Young people	$n = 437$
Shanahan et al. (2016)	AUS	QS	• Social cohesion: 17 items adapted from <i>Social Cohesion and Trust Scale</i> (Sampson et al., 1997),	General population	$n = 1538$

<i>Reciprocated Exchange</i> (Sampson et al., 1999), and a general measure of social capital (Bullen & Onyx, 1998)			
Soga, Cox, Yamaura, Gaston, Kurisu, and Hanaki (2017)	JPN	QS	• Social cohesion: 5 items adapted from <i>Social Cohesion and Trust Scale</i> (Sampson et al., 1997)
Sugiyama et al. (2008)	AUS	QS	• Social coherence: 6 items adapted from the
Study (year of publication)	Location	Research methods	Operationalized of social cohesion or similar behaviors
Study target	Sample size		
Allotment gardeners and their neighbors	gardeners, 167 non-gardeners)		
Adults	n = 1895		
<i>Neighborhood Quality of Life Study</i> (du Toit, Cerin,			
<i>(continued on next page)</i>			

(continued)

Study (year of publication)	Location	Research methods	Operationalized of social cohesion or similar behaviors	Study target	Sample size
			Leslie, & Owen, 2007) and <i>Social Cohesion and Trust Scale</i> (Sampson et al., 1997)		
			• Social interaction: the number of days participants performing various informal social activities in the past month		
Sullivan, Kuo, and DePooter (2004)	US	O	• Social activity: 6 general categories of social activity in green spaces including eating, doing chores/repairs, socializing, entertaining, resting/thinking, and playing	Residents of inner-city neighborhoods	$n = 758$
Teig et al. (2009)	US	SSI	• Social processes: social connections, reciprocity, mutual trust, collective	Members of community garden	$n = 47$

			decision-making, social norms, civic engagement, community building, volunteer activity, leadership activity, organized neighborhood activity, recruitment activity		
Triguero-Mas et al. (2015)	ESP	QS	• Social support: 11 questions of the <i>Duke-UNC Functional Social Support Questionnaire</i> (Broadhead et al., 1988)	General population	$n = 8793$
Ulmer et al. (2016)	US	QS	• Neighborhood social cohesion: 3 questions on neighborhood social cohesion	General population	$n = 7910$
van den Berg, van Winsum-Westra, de Vries, and van Dillen (2010)	NLD	QS	• Loneliness: 2 items measuring the frequency of feelings of loneliness and the need for social contacts • Social contacts with friends: 2 items measuring the frequency of contacts with friends and the size of one's circle of friends	Allotment gardeners and their neighbors	$n = 184$ (121 allotment gardeners, 63 non-allotment gardeners)
Veen, Bock, van den Berg, Visser and Wiskerke (2016)	NLD	QS, SSI	• Width of social cohesion: 3 items (The degree to which people know other participants/The number of garden acquaintances participants have/The extent to which they speak to others) • Depth of social cohesion: 1 item (The degree to which participants engage in mutual help)	Members of community garden	$n = 237$ for QS, 63 for SSI
Whatley, Fortune, and Williams (2015)	AUS	O, SSI	• Social inclusion: inquiring how does a neighborhood-located gardening program create a socially inclusive environment	Community garden's staff, participants, external support	$n = 13$ for O, 6 for SSI

			(e.g., bringing people together, worders, creating connections in the volunteers wider community, working with each other)		
Zhang, Zhou, Kwan, Fei, and Lin (2018)	CHN	QS	•Social health: 5 items adapted from Social Cohesion and Trust Scale (Sampson et al., 1997), Social Wellbeing Scale (Volker et al., 2006") and Social Support List-Interactions (Kempen & Van Eijk, 1995)	Adult residents	n = 1003
Zijlema et al. (2017)	ESP, NLD, UK	QS	• Social interaction: 1 item (How often do you have contact with your neighbors?) • Loneliness: 6 statements based on UCLA Loneliness Scale (Russell, 1996) • Neighborhood social cohesion: 5 items adapted from Social Cohesion and Trust Scale (Sampson et al., 1997)	General population	n = 1628

Note. For brevity, the column of journal was not presented in this table. Country code: AUS = Australia; BGR = Bulgaria; CAN = Canada; CHE = Switzerland; CHL = Chile; CHN = China; DE = Germany; ESP = Spain; JPN = Japan; LTU = Lithuania; MYS = Malaysia; MX = Mexico; NLD = Netherlands; PE = Peru; TW = Taiwan; UK = United Kingdom; US = United States. Research methods code: D = Drawing; DG = Discussion Groups; FG = Focus Group Interview; I = Interview; II = Individual Interview; O = Observation; PV = Modified Photovoice methodology; QS = Questionnaire Survey; SE = Scoping Exercise; SI = Structured Interview; SSI = Semi- structured Interviews; ST = Story-telling; VF = Video Filming; VR = Video Review; WI = Walking Interviews.

of outdoor spaces, thereby increasing the possibility of informal social contact with others (Coley et al., 1997). A subsequent research (Kuo et al., 1998) proved that the level of vegetation is positively associated with the use of common spaces and social ties among respondents; the study also empirically confirmed the mediating role of use in the relationship between vegetation and social ties. Other research literature has reported the impact of vegetation on different aspects of social cohesion. Living environment with more parks is strongly associated with a higher level of reported social cohesion (Cohen et al., 2008). Sidewalks with trees are especially important to immigrants because they provide an attractive and pleasant environment for people to linger a while; immigrants

usually start conversations and nurture social relationships with neighbors and acquaintances there (Hordyk et al., 2015). Moreover, individuals living in a more vegetation-covered environment were found feeling less lonely (Maas et al., 2009), receiving more social support (Maas et al., 2009; exception see Fan et al., 2011; Dadvand et al., 2016), and increased neighborhood social capital (Orban et al., 2017). Despite the significant association reported by these studies, a few research (Ruijsbroek et al., 2017; Triguero-Mas et al., 2015) could not replicate the finding.

Literature has investigated the influence of **distance** to green spaces on social cohesion. A significant negative relationship between residential distance to natural outdoor environment and neighborhood social cohesion was proved by Zijlema et al. (2017). According to Coley et al. (1997), trees closer to residences promote greater use of outdoor spaces by mixed age groups comprising adults and youth. The authors inferred from the finding that a close distance of trees results in more people spending time in outdoor spaces, which creates ongoing opportunities for social interactions among neighbors. Moreover, visitors in nearby green spaces are usually from surrounding residences; people are more likely to get a feeling of comfort, familiarity, togetherness, and get acquainted with neighbors when using green spaces, resulting in the possibility of enhanced social cohesion (Peters, 2010). Meanwhile, some studies have revealed that the objective measurement of distance does not significantly influence social support (Astell-Burt, Feng, & Kolt, 2015; Dadvand et al., 2016; Fan et al., 2011) or social cohesion (Dzhambov et al., 2018).

Compared to vegetation and distance, the **size** of green environments

relevant to social cohesion received less attention. A larger area supports more social activities. [Peters \(2010\)](#) observed that visitors in a bigger size park in the Netherlands tend to have more social contact with other visitors through different activities whereas users in a small neighborhood park merely socialize with their groups without bothering others. [Fan et al. \(2011\)](#) empirically proved that park acreage has a significant effect on both physical activity and social support, and the positive impact on social cohesion is even greater than those of neighborhood vegetation level. However, [Peters et al. \(2010\)](#) found no remarkable differences in terms of the intensity of interactions regardless of the size of parks, though there is contact among people in both neighborhood and bigger size parks.

Accessing to different **types of green space** may have significant effects on the intensity of social contact and social relationships with others. For example, community gardens and allotment gardens are guaranteed for bringing people from diverse backgrounds together and creating opportunities for socialization ([Kingsley & Townsend, 2006](#); [Teig et al., 2009](#); [van den Berg et al., 2010](#); [Veen et al., 2016](#); [Whatley et al., 2015](#)). It is the social processes such as involvement in garden-related activities, exchange of information, sharing advice about gardening practices that contribute to the development of social ties with other participants. Meanwhile, [Holtan et al. \(2015\)](#) discovered that only urban tree canopy remarkably contributes to social capital while the presence of parks and green yards have no significant association with self-reported social capital in their study conducted in Maryland, the United States. To conclude, it is unlikely that every type of green space is capable of facilitating social cohesion.

Layout and structure affect our perceptions of the environment and the intention we would like to socialize with others. [Kingsley and Townsend \(2006\)](#) noted that layout and design can promote social interactions and connection among gardeners in the community garden. Taking Finlathen Park located in the United Kingdom as an example, [Dinnie et al. \(2013\)](#) illustrated that a more natural and quieter environment resulted from the park's layout and location gives rise to safety concern and lowers the utilization rate, reducing the levels of involvement with others. Recently, [Moulay et al. \(2017\)](#) conducted surveys in neighborhood parks in Malaysia and found that parks with higher clarity of structure positively influence duration of use and contribute to social interactions among park users.

Facilities on offer is a prerequisite for developing quality social interactions in public spaces ([Cattell et al., 2008](#)). Research literature has provided a positive relationship between the supply of facilities and various forms of social processes. For instance, community gardens are in itself a place where participants can build up new friendship over an interest of gardening, sharing their produces with others, spending more time gardening with their families, and meeting up with their neighbors, which all contribute to improved social ties and social support ([Hale et al., 2011](#); [Mangadu et al., 2017](#); [Noone & Jenkins, 2017](#)). Moreover, the availability of benches, tables, and playground facilities in community gardens forms a social friendly area where individuals can socialize with each other ([Kingsley & Townsend, 2006](#)). Provision of playgrounds not only increases social interactions among children but also interactions between their guardians ([Huang, 2006](#)). Revealed by respondents of a focus group discussion conducted in the United Kingdom, bleak landscape which lacks facilities would limit the use of park for pleasure and opportunities of social interactions ([Ka'zmierczak, 2013](#)). In contrast, parks with a full range of facilities serve diverse users, providing opportunities for contact

between people with different racial and ethnic backgrounds (Gobster, 1998). In sum, facilities in green spaces encourage visitations and promote social interactions among visitors. They are indispensable in promoting social cohesion in urban green environments.

Well maintenance of green spaces promotes their use as recreational areas and realizes the potential of supporting social interactions (Ka'zmierczak, 2013). Poor-managed green spaces would have negative impact on the evaluation of the environmental quality and intention of use, together they are not conducive to the development of social cohesion. For example, green spaces that are poorly managed would be perceived as unsafe and visually low quality that affect outdoor activities, which in turn fails to support social contact among neighbors (Kemperman & Timmermans, 2014). By contrast, well-maintained green spaces were found to be frequently visited by all status groups, and are significant for the enhancement of interactions between different socio-economic status groups (Krellenberg et al., 2014).

3.4.2. *Perceptions of the environment*

Physical milieu can influence individuals' perceptions of green spaces. Literature showed that perceptions of the environment significantly relate to social cohesion. The psychological aspect here is concerned with subjective evaluations and personal judgment of the physical environment. They may even be stronger in predicting social cohesion compared to objective features of the environment (e.g., Dadvand et al., 2016; de Vries et al., 2013). In this review, perceived greenness, perceived proximity, and perceived safety were identified as commonly investigated perceptions of the environment that predict social cohesion.

Perceived greenness is the subjective evaluation of the green spaces. Sugiyama et al. (2008) emphasized the importance of green spaces quality such as aesthetic pleasantness and its impact on social cohesion; the study added the quality of the environment into the greenness construct and found that social cohesion is more likely to occur if the places were perceived to be greener and more natural. According to findings by de Vries et al. (2013), the quality of street greenery added predictive value and made the quantity measurement redundant in predicting social cohesion. Greenness can motivate participation in outdoor activity and facilitate social contact among neighbors. Thus, older respondents in the Netherlands (Kemperman & Timmermans, 2014) and in the United States (Hong, Sallis, et al., 2018) were found to have more social contact with their neighbors if they possessed a higher level of perceived greenness. Besides older people, a positive linear relationship was found among young participants (aged 15–25) in a study conducted in Plovdiv, Bulgaria (Dzhambov et al., 2018). Recently, Ruijsbroek et al. (2017) put the construct in a wider context for testing; among four surveyed European cities, the positive influence of perceived greenness on social cohesion was further confirmed in the city of the Netherlands and the United Kingdom.

Perceived proximity, referred as the psychological distance to the green spaces, positively affects the use of and social benefits derived from the green spaces. Unlike the objective measured *distance*, the subjective measurement indicated a consistent result across studies. Gomez et al. (2015) ' found that perceived proximity significantly contributes to the development of a psychological sense of community, a concept primarily related to the feeling of belonging to a group. According to the authors, a perceived barrier-free physical environment promotes greater use and a higher psychological sense of community. A readily available green environment is important to teenagers

for socialization. In Switzerland, the development of inter-racial friendships between pupils is related to participation in urban forests and parks that are perceived as easily reached (Seeland et al., 2009). More important, Dadvand et al. (2016) confirmed that it is subjective residential proximity rather than objective proximity associated with perceived social support. The finding provides evidence to the argument that perceptions of the environment may have stronger power than objective measurements in predicting behaviors and benefits of green spaces.

Perceived safety is a primary concern when deciding whether to visit green spaces or not. Green spaces perceived as safe are likely to cultivate social interactions. Perceived safety has been considered as one of the quality attributes that encourages greater use of natural environments and leads to enhanced social cohesion (Jibril & Elfartas, 2018). Parents were found to get more spare time and opportunities to socialize with others in a safe green environment where minimal supervision for their children is needed (Kingsley & Townsend, 2006). The perceived pedestrian safety has showed a significant beneficial effect on both social interactions and social cohesion among older adults in green spaces in America (Hong, Sallis, et al., 2018). Nevertheless, the perceived threat of personal safety sets barriers and hinders people from using green spaces. For example, threats such as harassment or a feeling of being unsafe reduce the time spending in green areas (Dinnie et al., 2013) or limit the necessary activities in the green spaces (Ka'zmierczak, 2013). As a result, the effects of green spaces in facilitating social interactions among individuals may be mitigated.

3.4.3. *Use patterns*

To understand how social cohesion is cultivated in green spaces we must get insight into the ways that individuals participate in there. Patterns and intensity of use become all the most important in determining the levels of social relationships. Current literature has provided extensive evidence of visitation behaviors on social cohesion. The use patterns have been predominantly operationalized as frequency of use, duration of visitation, type of activities, and public participation in green spaces.

Frequency of use refers to how often people make a visit to the public urban green environments. Frequent visit increases the opportunities to interact with others. Routine social encounters can maintain ties between neighbors (Cattell et al., 2008). In this connection, regular visitors tend to have more friends in the neighborhood (Ka'zmierczak, 2013). Frequent visitors were also found to have higher perceived social cohesion (Cox et al., 2017; Cox et al., 2018; Mowen and Rung, 2016; Shanahan et al., 2016; exceptions see; Gomez et al., 2015; Soga et al., 2017). By contrast, low frequency of visit may weaken the role of the green environments as spaces for developing social interactions (Ka'zmierczak, 2013). Moreover, the frequency of visit was suggested to be affected by physical characteristics of green spaces such as distance (Zijlema et al., 2017) and the presence of vegetation (e.g., Coley et al., 1997; Kuo et al., 1998).

Social cohesion is also subject to the **duration of visit** to green spaces. The length of time that people spend in green spaces determines the quality and strength of social relationships with others (Kingsley & Townsend, 2006). Studies revealed that the number of acquaintances (Ka'zmierczak, 2013) and perceived social cohesion (Cox et al., 2017, Cox et al., 2018; Mowen & Rung, 2016; Shanahan et al., 2016) will be higher if people spent more time in green spaces. Despite the fruitful evidence, the duration of visitation is not always a stable predictor of social contact (Kweon et al.,

1998) or social cohesion (Soga et al., 2017). Besides, perceptions of the environments can influence the time spending in green spaces. Dinnie et al. (2013) observed that perceived safety affects duration of visit, leading to either just walking through or never entering into green spaces.

Activities in green spaces afford opportunities for socialization and connecting people (Dinnie et al., 2013; Peters, 2010; Teig et al., 2009; Pleson et al., 2014; O'Brien et al., 2011). Different types of activities undertaken in green spaces may have varying effects on interactions and social ties. Mowen and Rung (2016) emphasized that exchanges take place more easily if park visitors had sedentary activities. It is because sitting around provides park visitors with opportunities for face-to-face social contact; by contrast, park users having active activities such as running may not encourage socialization between people because of the limited time of using recreational facilities. Besides, engaging in social activities held in green spaces can facilitate social interactions and strengthen social ties. Immigrants found it particularly important because activities invite them to be outdoors and offer them unique opportunities for meeting others from their home country (Hordyk et al., 2015). Sharing of produce and work collaboratively with other members of community gardens help refugees build community connections and social connectedness in new countries (Harris et al., 2014). Visitors engage in social activities tend to have a higher number of acquaintances compared to those only with necessary activities (e.g., to pass through on the way elsewhere) (Kaźmierczak, 2013). The finding echoes the work by Huang (2006) that spaces designed for activities can support more social interactions. Moreover, the layout of green spaces such as the design contributes to the differences of activities because it facilitates certain kinds of activities but also limits other kinds of activities (Peters et al., 2010).

Public participation was found to affect the use of green spaces and social interactions among users (Peters et al., 2010). People were found to be more familiar with green spaces and have increased social interactions with different ethnic groups if they participated in the design work of the spaces (Peters et al., 2010). Participating in the operation of community gardens such as securing funds for garden development (Teig et al., 2009) and working together to maintain paths (Veen et al., 2016) was suggested to cultivate social processes and deepen social cohesion among neighbors. Residents of urban slums would be benefited from improved mental health because of the increased overall social capital as a result of participating in the construction processes of household gardens (Korn et al., 2018). In general, social cohesion is observed in green spaces where active public participation is taken place.

4. Discussion

4.1. Underlying pathways between green spaces and social cohesion

Three aspects of green spaces were found to have **direct impact** on the development of social cohesion. Physical characteristics including the presence of vegetation, distance, size, type of green spaces, layout and structure, facilities, and maintenance in general significantly predicted social cohesion although conflicting findings were reported by a few numbers of studies. Since the context of included studies is culturally and geographically diverse, socio-demographic variations, cultural backgrounds of the targeted population, or different aspects of social cohesion being measured may be responsible for the deviated results. Aside from the objective aspect, subjective factors do matter

in determining the degree of social cohesion. Perceptions of greenness, proximity, and safety of green spaces have been linked to social cohesion. Research literature also found that our behaviors in green spaces such as frequency of visit, duration of visit, activities taken place, and participation in green spaces create opportunities for and facilitate social processes among visitors.

Meanwhile, it is possible that the physical environment of green spaces might affect social cohesion via *indirect pathways*. We inferred that perceptions of the environment and use patterns may mediate the relationships between physical characteristics and social cohesion. The mediating role of perceptions of the environment was implicitly mentioned by some reviewed studies. Physical characteristics shape the ways we evaluate the green spaces and result in varying degrees of social cohesion. For example, the presence of parks in the neighborhood may perceive as threat of crime or unappealing; the green spaces would therefore not serve as an agent of providing opportunities for informal interactions and hence not facilitating the creation of social capital (Holtan et al., 2015). Kemperman and Timmermans (2014) highlighted that maintenance of green spaces affects perceived greenness which has been proven to be of major importance for social contact between investigated residents. These examples illuminated the potential role of perceived environment mediating the relationships between physical characteristics and social cohesion. Regarding the use patterns, physical characteristics may determine our use behaviors and in turn affect social cohesion. For instance, lack of facilities reduces both the intention of use and the chances of social contact (Kaźmierczak, 2013). Moulay et al. (2017) proved that a higher clarity of structure increases the length of visitation, which is positively connected to social interactions among individuals. Some research literature has put a step forward and conducted a mediation test (Kuo et al., 1998; Kweon et al., 1998); the results indicated that the presence of trees increases greater use of common space and in turn enhances social ties among neighbors. Thus, it is confident to suggest that use patterns mediate the impact of physical characteristics on social cohesion in green spaces.

Aside from single mediation, the indirect pathways from physical characteristics of green spaces to social cohesion may involve serial mediation (cf. Dzhambov et al., 2018). Rather than considering perceptions of the environment and use patterns as independent mediators, a more complex relationship between the two sets of mediators was observed and it has been subtly discussed by some reviewed studies. Specifically, physical characteristics were suggested to influence perceptions before affecting use patterns, which in turn cultivate social cohesion (i.e., physical characteristics → perceptions → use patterns → social cohesion). For example, poor layout and location of the green spaces give rise to safety concerns and result in “pass-through” visiting behavior or lower the desire to engage in the green spaces, which has been suggested to be unfavorable for social interactions (Dinnie et al., 2013). Alternatively, physical characteristics may affect the use patterns first and then the perceptions of the environment, which in turn influence the development of social cohesion (i.e., physical characteristics → use patterns → perceptions → social cohesion). As Krellenberg et al. (2014) has found, the provision of well-maintained facilities contributes to intensive use of green spaces, and results in a higher valuation of green spaces and favors social interactions as well. Therefore, two sets of identified mediators are potential antecedents of each other and form serial mediations in between the relationships. They may facilitate or inhibit the effects of physical characteristics on social relationships in green spaces.

To conceptualize the relationships between different aspects of green spaces and social cohesion, a model based on evidence synthesized from reviewed studies and our inferences was proposed (Fig. 2). Direct impact of physical characteristics, perceptions of the environment, and use patterns on social cohesion was empirically proved. Meanwhile, perceptions and use patterns were considered as potential mediators that further explain mechanisms behind the relationships. Moreover, the potential mediators may work as antecedents of each other and form serial mediation in between the relationships. Although only a few numbers of studies have empirically tested the proposed single and serial mediation pathways, the inferred relationships provide a foundation for further investigation and discussion in the future by unpacking the impact of green spaces on social cohesion. Apart from the direct impact, the proposed parsimonious model demonstrates how social cohesion in green spaces may be jointly affected by the intermingling of physical settings, perceptions of the environments, and the ways we use the green spaces. The model advances our understanding of the complex influences of green spaces on social cohesion while informing the development of possible interventions for more green space visitation and positive social interactions with others.

4.2. Recommendations for policy makers

Physical structures of green spaces remain core factors contributing to the development of social cohesion. The presence of vegetation is positively associated with the use of green spaces and social cohesion.

Both the amount and quality of greenery need to be increased for making the public spaces more attractive, thereby providing a favorable environment for social interactions. Meanwhile, unmaintained vegetation may cause safety concerns (Sreetheran & van den Bosch, 2014) which highlights the importance of maintenance issues. Sound maintenance not merely improves safety perception but increases aesthetic quality of the environment which is a pre-condition of engaging in green spaces and nurturing social interactions. Besides, the provision of a full range of facilities that serve different groups of people would have important consequences for cultivating social cohesion. The facilities increase the attractiveness and utilization of green spaces by people with different backgrounds.

Land resources are valuable, especially in highly urbanized areas. Adding or relocating green spaces may not be a prioritized option for promoting social cohesion but changing the form of green spaces may have implications for the enhancement of social cohesion. Community garden is a form of green spaces in urban societies which almost by definition encourages social interactions among participants (Hartig et al., 2014). By participating in activities held in the community gardens, people get more opportunities to chat with neighbors, provide mutual help to each other, and share information on common interest; a sense of community is expected to increase accordingly. Thus, we suggest setting up more community gardens, especially within those urban parks which have a low utilization rate. In this connection, these urban parks would become more vibrant and less threatening if gardening activities were taken place there. The improved environment would encourage greater use and create additional opportunities for social contact among users. In addition, the provision of pocket neighborhood parks would be another possible solution. On one hand, visitors of pocket parks from nearby residential areas tend to be more familiar with the

environment and other users from the community, thereby increasing the possibility of more social contact among visitors. On the other hand, the provision of pocket parks shortens the geographical distance and minimizes unequal access to green spaces.

The current study suggested that perceptions of the environment and use patterns may mediate the relationships between green spaces and social cohesion. Interventions targeted at these two factors may be more flexible and effective in cultivating social cohesion. Positive perceptions of the environment contribute to a higher level of social cohesion. As revealed from the findings, landscape architects should make it a priority to address people's perception of greenery, proximity, and safety. To improve the quality of planting greenery and provide more information on the location of green spaces could increase the overall attractiveness of and shorten the psychological distance to the green spaces. Regarding the perception of safety, a sufficient lighting system and a clean environment are prerequisites for acquiring a sense of security which is positively connected to social cohesion.

Use patterns are connected to social contact and interactions among visitors. Promoting both frequency and duration of visit would be important for nurturing social cohesion. For instance, organizing social- oriented activities such as festival events in green spaces not only attract more visitors and connect people from different backgrounds but also

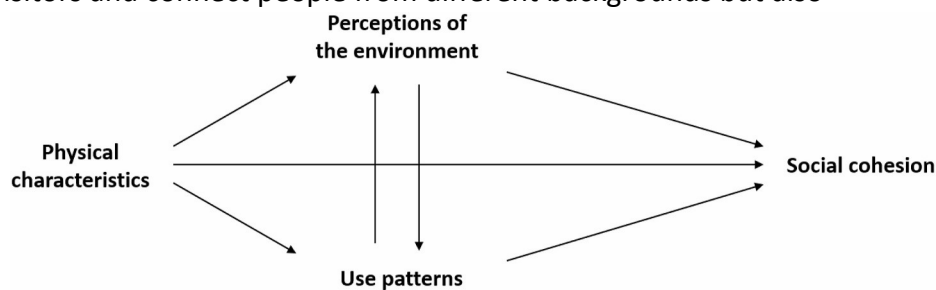


Fig. 2. A model conceptualizing the relationships between different aspects of green spaces and social cohesion.

keep them to stay longer in the green spaces, in turn creating more opportunities for social contact. In addition, given that public involvement such as participating in design work of the environment was found relevant to social cohesion, incorporating constructive public input into green spaces planning would create a hybrid mode of public participation that engages citizens from different spheres and values. The continuing participatory processes and collaboration between citizens and management officials imply that different parties meet the need of each other rather than forcing one to fit the patterns set by any of the parties; the decentralized decision-making process also builds and fosters trust among different parties. Overall, social cohesion in green spaces is a complex phenomenon which could be jointly shaped by different aspects of the environment.

Despite the identified aspects of the green environment, policymakers should be aware of the impact of contextual and cultural factors which may limit the generalizability of the inferences and prompt framework refinements. For example, living context around the green spaces such as traffic volume and pedestrian infrastructure can potentially influence park use (Baran et al., 2014), which in turn complicates the already complex relationship identified in this review. Cultural factors such as to avoid seeking support from others for saving face and maintaining norms may significantly influence variations in social cohesion (Thoits, 2011). Demographic profile of park users is another major concern. Gender and age structure, for instance, have been found to moderate the association between green spaces and mental health (Bos, van der Meulen, Marieke, & Jeronimus, 2016). The findings suggest that only certain demographic groups may have the opportunity to make use of their green living environment and thus influence the development of social cohesion across population groups. Policymakers should therefore take into account context-specific variations and the associated impact on social cohesion when formulating strategic interventions.

4.3. Limitations and recommendations for researchers

There are limitations in the present study that may cause the conclusions deviated from accuracy and comprehensiveness. First, keyword search has its limitations in article collection. For example, studies may not mention the proposed keywords in their title, abstract, or keywords section. As a result, researchers are not able to retrieve relevant studies for literature review. The limitation suggests that using different sources to retrieve articles is preferred. Second, conflicting results were found in some identified factors and the differences may reduce the generalization power of the proposed model. As suggested in the discussion section, the conflicting results may be due to the diverse study context, socio-demographic differences of respondents, and cultural backgrounds. Future studies may benefit from taking factors other than those

Appendix A. Quality assessment of included studies

related to green spaces into consideration.

Regarding the future research direction, first, reviewed studies are predominated by cross-sectional evidence that the extent to which green spaces' impact on social cohesion is unknown. Future studies are suggested using more longitudinal methods to investigate the dynamics of social cohesion taking place in green spaces. Second, although indirect impact was discussed between

5. Conclusion

Acknowledgements

Study	Methodological Quality Criteria															Quality Score	Quality Rating					
	1. Qualitative					3. Quantitative non-randomized					4. Quantitative descriptive							5. Mixed methods				
	1.1	1.2	1.3	1.4	1.5	3.1	3.2	3.3	3.4	3.5	4.1	4.2	4.3	4.4	4.5			5.1	5.2	5.3	5.4	5.5
Astell-Burt et al. (2015)											+	+	+	CT	-						3	MQ
Cattell et al. (2008)	+	+	-	+	+																4	MQ
Cohen et al. (2008)											+	+	+	+	+						5	HQ
Coley et al. (1997)	+	-	+	+	+																4	MQ
Cox et al. (2017)											+	-	+	CT	+						3	MQ
Cox et al. (2018)	-	-	+	CT	2 LQ																	
Dadvand et al. (2016)														+	CT	+	+	+	+	4 MQ		
de Vries et al. (2013)	-	+	+	+	-																3 MQ	

Gomez et al. (2015)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
---------------------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Noone and Jenkins (2017)	+	+	+	+	+								5	HQ					
O’Brien et al. (2011)	+	–	+	–	+								3	MQ					
Orban et al. (2017)							+	+	+	CT	+		4	MQ					
Peters (2010)	+	+	–	+	+								4	MQ					
Peters et al. (2010)												+	+	+	+	+	5	HQ	
Pleson et al. (2014)	+	+	+	+	+								5	HQ					
Ruijsbroek et al. (2017)							+	+	+	CT	+		4	MQ					
Seeland et al. (2009)							–	–	+	+	+		3	MQ					
Shanahan et al. (2016)							+	+	+	CT	+		4	MQ					
Soga et al. (2017)												+	+	+	+	+	5	HQ	
Sugiyama et al. (2008)							+		CT	+	+	+	4	MQ					
Sullivan et al. (2004)	+	+	+	+	+								5	HQ					
Teig et al. (2009)	+	+	+	+	+								5	HQ					
Triguero-Mas et al. (2015)							+		CT	+	+	+	4	MQ					
Ulmer et al. (2016)							+	+	+	CT	+		4	MQ					
van den Berg et al. (2010)												+	+	+	+	–	4	MQ	
Veen et al. (2016)													–	+	+	+	–	3	MQ
Whatley et al. (2015)	+	+	+	–	+								4	MQ					
Zhang et al. (2018)							+	+	+	CT	+		4	MQ					
Zijlema et al. (2017)							+	+	+	CT	+		4	MQ					

Study	Methodological Quality Criteria															Quality	Quality					
																Score	Rating					
	1. Qualitative					3. Quantitative non-randomized					4. Quantitative descriptive					5. Mixed methods						
	1.1	1.2	1.3	1.4	1.5	3.1	3.2	3.3	3.4	3.5	4.1	4.2	4.3	4.4	4.5	5.1	5.2	5.3	5.4	5.5		
Dzhambov et al. (2018)											+	-	+	+	+						4	MQ
Fan et al. (2011)											+	+	+	-	+						4	MQ
Gobster (1998)	+	+	-	-	+																3	MQ

Dinnie et al. (2013) + - - + + + 5 HQ Note. + = "Yes"; - = "No"; CT = "Can't tell". HQ = High quality; MQ = Medium quality; LQ = Low quality. No included studies use quantitative randomized controlled trials research method; thus, corresponding criteria 2.1.-2.5. were omitted in the table.

Appendix B. Mixed methods appraisal tool: assessment criteria (adopted from Hong, Pluye, et al., 2018)

1. Qualitative

- 1.1. Is the qualitative approach appropriate to answer the research question?
- 1.2. Are the qualitative data collection methods adequate to address the research question?
- 1.3. Are the findings adequately derived from the data?
- 1.4. Is the interpretation of results sufficiently substantiated by data?
- 1.5. Is there coherence between qualitative data sources, collection, analysis and interpretation?

2. Quantitative randomized controlled trials

- 2.1. Is randomization appropriately performed?
- 2.2. Are the groups comparable at baseline?
- 2.3. Are there complete outcome data?
- 2.4. Are outcome assessors blinded to the intervention provided?
- 2.5. Did the participants adhere to the assigned intervention?

3. Quantitative non-randomized

- 3.1. Are the participants representative of the target population?
- 3.2. Are measurements appropriate regarding both the outcome and intervention (or exposure)?
- 3.3. Are there complete outcome data?
- 3.4. Are the confounders accounted for in the design and analysis?
- 3.5. During the study period, is the intervention administered (or exposure occurred) as intended?

4. Quantitative descriptive

- 4.1. Is the sampling strategy relevant to address the research question?
- 4.2. Is the sample representative of the target population?

-
- 5.2. Are the different components of the study effectively integrated to answer the research question?
- 5.3. Are the outputs of the integration of qualitative and quantitative components adequately interpreted?
- 5.4. Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?
- 5.5. Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?
-

Appendix

C. Identified green spaces' aspects that promote social cohesion

5. Mixed methods
- 4.3. Are the measurements appropriate?
- 4.4. Is the risk of nonresponse bias low?
- 4.5. Is the statistical analysis appropriate to answer the research question?
- 5.1. Is there an adequate rationale for using a mixed methods design to address the research question?

Study	Physical characteristics	Distance	Size	Types of green space	Layout & structure	Facilities	Maintenance
Astell-Burt et al. (2015)		£					
Cattell et al. (2008)						£	
Cohen et al. (2008)	£						
Coley et al. (1997)	£	£					
Cox et al. (2017)							
Cox et al. (2018)							
Dadvand et al. (2016)	£	£					
de Vries et al. (2013)	£						
Dinnie et al. (2013)					£		

Dzhambov et al. (2018)		£					
Fan et al. (2011)	£	£	£				
Gobster (1998)						£	
Gomez et al. (2015)							
Hale et al. (2011)						£	
Harris et al. (2014)							
Holtan et al. (2015)	£		£				
A. Hong, Pluye, et al. (2018)							
Hordyk et al. (2015)	£						
Huang (2006)						£	
Jibril and Elfartas (2018)	£						
Ka'zmierczak (2013)						£	£
Kemperman and Timmermans (2014)							£
Kingsley and Townsend (2006)			£	£	£		
Korn et al. (2018)							
Krellenberg et al. (2014)							£
Kuo et al. (1998)	£						
Kweon et al. (1998)	£						
Mangadu et al. (2017)						£	
Maas et al. (2009)	£						
Moulay et al. (2017)				£			
Mowen and Rung (2016)							
Noone and Jenkins (2017)						£	
O'Brien et al. (2011)							
Orban et al. (2017)	£						
Peters (2010)		£	£				

Peters et al. (2010)		£			
Pleson et al. (2014)					
Ruijsbroek et al. (2017)	£				
Seeland et al. (2009)					
Shanahan et al. (2016)					
Soga et al. (2017)					
Sugiyama et al. (2008)					
Sullivan et al. (2004)	£				
Teig et al. (2009)			£		
Triguero-Mas et al. (2015)	£				
Ulmer et al. (2016)	£				
van den Berg et al. (2010)			£		
Veen et al. (2016)					
Whatley et al. (2015)			£		
Zhang et al. (2018)	£				
Zijlema et al. (2017)		£			
Astell-Burt et al. (2015)					
Cattell et al. (2008)			£		
Cohen et al. (2008)					
Coley et al. (1997)			£		
Cox et al. (2017)			£	£	
Cox et al. (2018)			£	£	
Dadvand et al. (2016)		£			
de Vries et al. (2013)	£				
Dinnie et al. (2013)			£	£	£
Dzhambov et al. (2018)	£				
Fan et al. (2011)					
Gobster (1998)					
Gomez et al. (2015)		£	£		

	Presence of vegetation	Distance	Size	Types of green space	Layout & structure	Facilities	Maintenance
Hale et al. (2011)							
Harris et al. (2014)						£	
Holtan et al. (2015)							
A. Hong, Pluye, et al. (2018)	£		£				
Hordyk et al. (2015)						£	
Huang (2006)						£	
Jibril and Elfartas (2018)			£				
Ka'zmierczak (2013)			£	£	£	£	
Kemperman and Timmermans (2014)	£						
Kingsley and Townsend (2006)			£		£		
Korn et al. (2018)							£
Krellenberg et al. (2014)							
Kuo et al. (1998)				£			
Kweon et al. (1998)					£		
Mangadu et al. (2017)							
Maas et al. (2009)							
Moulay et al. (2017)							
Mowen and Rung (2016)				£	£	£	
Noone and Jenkins (2017)							
O'Brien et al. (2011)						£	
Orban et al. (2017)							
Peters (2010)						£	
Peters et al. (2010)						£	£
Pleson et al. (2014)						£	
Ruijsbroek et al. (2017)	£						

Seeland et al. (2009)	£		
Shanahan et al. (2016)		£	£
Soga et al. (2017)		£	£
Sugiyama et al. (2008)	£		
Sullivan et al. (2004)			
Teig et al. (2009)		£	£
Triguero-Mas et al. (2015)			
Ulmer et al. (2016)			
van den Berg et al. (2010)			
Veen et al. (2016)			£
Whatley et al. (2015)			
Zhang et al. (2018)			
Zijlema et al. (2017)		£	
Study	Physical characteristics		

Note. × = indicating identified factors appeared in sampled studies.

References

- Astell-Burt, T., Feng, X., & Kolt, G. S. (2015). Large-scale investment in green space as an intervention for physical activity, mental and cardiometabolic health: Study protocol for a quasi-experimental evaluation of a natural experiment. *BMJ Open*, 5, Article e009803.
- Baran, P. K., Smith, W. R., Moore, R. C., Floyd, M. F., Bocarro, J. N., Cosco, N. G., et al. (2014). Park use among youth and adults: Examination of individual, social, and urban form factors. *Environment and Behavior*, 46(6), 768–800.
- Beckley, T. M. (1995). Community stability and the relationship between economic and social well-being in forest-dependent communities. *Society & Natural Resources*, 8(3), 261–266.
- van den Berg, A. E., van Winsum-Westra, M., de Vries, S., & van Dillen, S. M. (2010). Allotment gardening and health: A comparative survey among allotment gardeners and their neighbors without an allotment. *Environmental Health*, 9(74), 1–12.
- Bos, E. H., van der Meulen, L., Marieke, W., & Jeronimus, B. F. (2016). A primrose path? Moderating effects of age and gender in the association between green space and mental health. *International Journal of Environmental Research and Public Health*, 13, 492.
- Broadhead, W. E., Gehlbach, S., de Gruy, F. V., & Kaplan, B. H. (1988). The duke-UNC functional social support questionnaire. *Medical Care*, 26(7), 709–723.
- Bullen, P., & Onyx, J. (1998). *Measuring social capital in five communities in NSW A practitioner's guide*. from <http://www.mapl.com.au/pdf/SocialCapitalPracGuideBullen&Onyx.pdf>.

- Carpiano, R. M. (2007). Neighborhood social capital and adult health: An empirical test of a Bourdieu-based model. *Health & Place, 13*, 639–655.
- Cattell, V., Dines, N., Gesler, W., & Curtis, S. (2008). Mingling, observing, and lingering: Everyday public spaces and their implications for well-being and social relations. *Health & Place, 14*, 544–561.
- Cohen, D. A., Inagami, S., & Finch, B. (2008). The built environment and collective efficacy. *Health & Place, 14*, 198–208.
- Coley, R. L., Kuo, F. E., & Sullivan, W. C. (1997). Where does community grow? The social context created by nature in urban public housing. *Environment and Behavior, 29*(4), 468–494.
- Cox, D. T. C., Shanahan, D. F., Hudson, H. L., Fuller, R. A., Anderson, K., Hancock, S., et al. (2017). Doses of nearby nature simultaneously associated with multiple health benefits. *International Journal of Environmental Research and Public Health, 14*(2), 172–184.
- Cox, D. T. C., Shanahan, D. F., Hudson, H. L., Fuller, R. A., & Gaston, K. J. (2018). The impact of urbanisation on nature dose and the implications for human health. *Landscape and Urban Planning, 179*, 72–80.
- Cramm, J. M., van Dijk, H. M., & Nieboer, A. P. (2013). The importance of neighborhood social cohesion and social capital for the well being of older adults in the community. *The Gerontologist, 53*(1), 142–152.
- Dadvand, P., Bartoll, X., Basagana, X., Dalmau-Bueno, A., Martinez, D., Ambros, A., et al. (2016). Green spaces and General Health: Roles of mental health status, social support, and physical activity. *Environment International, 91*, 161–167.
- Dinnie, E., Brown, K., & Morris, S. (2013). Community, Cooperation and conflict: Negotiating the social well-being benefits of urban greenspace experiences. *Landscape and Urban Planning, 112*, 1–9.
- Dupuis, M., Baggio, S., & Gmel, G. (2015). Validation of a brief form of the perceived neighborhood social cohesion questionnaire. *Journal of Health Psychology, 22*(2), 218–227.
- Dzhambov, A., Hartig, T., Markevych, I., Tilov, B., & Dimitrova, D. (2018). Urban residential greenspace and mental health in youth: Different approaches to testing multiple pathways yield different conclusions. *Environmental Research, 160*, 47–59.
- Elands, B., Peters, K., & de Vries, S. (2018). Promoting social cohesion – increasing well-being. In M. van den Bosch, & W. Bird (Eds.), *Oxford textbook of nature and public health*. Oxford, United Kingdom: Oxford University Press.
- Fan, Y., Das, K. V., & Chen, Q. (2011). Neighborhood green, social support, physical activity, and stress: Assessing the cumulative impact. *Health & Place, 17*, 1202–1211.
- Ferreira, I., Van Der Horst, K., Wendel-Vos, W., Kremers, S., Van Lenthe, F. J., & Brug, J. (2007). Environmental correlates of physical activity in youth – a review and update. *Obesity Reviews, 8*, 129–154.
- Forrest, R., & Kearns, A. (2001). Social cohesion, social capital and the neighbourhood. *Urban Studies, 38*(12), 2125–2143.
- Gobster, P. H. (1998). Urban parks as green walls or green magnets? Interracial relations in neighborhood boundary parks. *Landscape and Urban Planning, 41*(1), 43–55.

- Gomez, E., Baur, J. W. R., Hill, E., & Georgiew, S. (2015). Urban parks and psychological sense of community. *Journal of Leisure Research*, 47(3), 388–398.
- Hale, J., Knapp, C., Bardwell, L., Buchenau, M., Marshall, J., Sancar, F., et al. (2011). Connecting food environments and health through the relational nature of aesthetics: Gaining insight through the community gardening experience. *Social Science & Medicine*, 72, 1853–1863.
- Harris, N., Minniss, F. R., & Somerset, S. (2014). Refugees connecting with a new country through community food gardening. *International Journal of Environmental Research and Public Health*, 11(9), 9202–9216.
- Hartig, T., Mitchell, R., de Vries, S., & Frumkin, H. (2014). Nature and health. *Annual Review of Public Health*, 35, 207–228.
- Holland, C., Clark, A., Katz, J., & Peace, S. (2007). *Social interactions in urban public places*. Bristol, UK: The Policy Press.
- Holtan, M. T., Dieterlen, S. L., & Sullivan, W. C. (2015). Social life under cover: Tree canopy and social capital in Baltimore, Maryland. *Environment and Behavior*, 47(5), 502–525.
- Hong, Q., Pluye, P., Fabregues, S., Bartlett, G., Boardman, F., Cargo, M., et al. (2018). *Mixed methods appraisal tool (MMAT)*. version 2018, from http://mixedmethodsappraisaltoolpublic.pbworks.com/w/file/attach/127916259/MMAT_2018_criteria-manual_2018-08-01_ENG.pdf.
- Hong, A., Sallis, J. F., King, A. C., Conway, T. L., Saelens, B., Cain, K. L., et al. (2018). Linking green space to neighborhood social capital in older adults: The role of perceived safety. *Social Science & Medicine*, 207, 38–45.
- Hordyk, S. R., Hanley, J., & Richard, E. (2015). Nature is there; its free": Urban greenspace and the social determinants of health of immigrant families. *Health & Place*, 34, 74–82.
- Huang, S.-C. L. (2006). A study of outdoor interactional spaces in high-rise housing. *Landscape and Urban Planning*, 78, 193–204.
- Inoue, S., Yorifuji, T., Takao, S., Doi, H., & Kawachi, I. (2013). Social cohesion and mortality: A survival analysis of older adults in Japan. *American Journal of Public Health*, 103(12), e60–e66. December 1, 2013.
- Intomart. (2001). *Gebiedsmonitor leefbaarheid en veiligheid [Area Monitor Liveability and Safety]*. Hilversum: Intomart.
- Jibril, J. D., & Elfartas, H. O. (2018). Contextual predictors of urban park utilisation among Malaysian ethnic groups. *International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies*, 9(3), 197–209.
- Kawachi, I., & Berkman, L. F. (2000). Social cohesion, social capital, and health. In L. F. Berkman, & I. Kawachi (Eds.), *Social epidemiology* (pp. 174–190). New York: Oxford University Press.
- Kawachi, I., & Berkman, L. F. (2001). Social ties and mental health. *Journal of Urban Health*, 78(3), 458–467.
- Kaźmierczak, A. (2013). The contribution of local parks to neighbourhood social ties.

- Landscape and Urban Planning*, 109, 31–44.
- Kempen, G. I. J. M., & Van Eijk, L. M. (1995). The psychometric properties of the SSL12-I, a short scale for measuring social support in the elderly. *Social Indicators Research*, 35 (3), 303–312.
- Kemperman, A., & Timmermans, H. (2014). Green spaces in the direct living environment and social contacts of the aging population. *Landscape and Urban Planning*, 129, 44–54.
- Kingsley, J., & Townsend, M. (2006). ‘Dig in’ to social capital: Community gardens as mechanisms for growing urban social connectedness. *Urban Policy and Research*, 24 (4), 525–537.
- Koenig, H. G., Westlund, R. E., George, L. K., Hughes, D. C., Blazer, D. G., & Hybels, C. (1993). Abbreviating the Duke social support index for use in chronically ill elderly individuals. *Psychosomatics*, 34(1), 61–69.
- Korn, A., Bolton, S. M., Spencer, B., Alarcon, J. A., Andrews, L., & Voss, J. G. (2018). Physical and Mental Health Impacts of Household Gardens in an Urban Slum in Lima, Peru. *International Journal of Environmental Research and Public Health*, 15(8), 1751.
- Krellenberg, K., Welz, J., & Reyes-Packeb, S. (2014). Urban green areas and their potential for social interaction – a case study of a socio-economically mixed neighbourhood in Santiago de Chile. *Habitat International*, 44, 11–21.
- Kuo, F. E., Sullivan, W. C., Coley, R. L., & Brunson, L. (1998). Fertile ground for community: Inner-city neighborhood common spaces. *American Journal of Community Psychology*, 26(6), 823–851.
- Kweon, B.-S., Sullivan, W. C., & Wiley, A. R. (1998). Green common spaces and the social integration of inner-city older adults. *Environment and Behavior*, 30(6), 832–858.
- Lee, A. C. K., Jordan, H. C., & Horsley, J. (2015). Value of urban green spaces in promoting healthy living and wellbeing: Prospects for planning. *Risk Management and Healthcare Policy*, 8, 131–137.
- Maas, J., van Dillen, S. M. E., Verheij, R. A., & Groenewegen, P. P. (2009). Social contacts as a possible mechanism behind the relation between green space and health. *Health & Place*, 15(2), 586–595.
- Mangadu, T., Kelly, M., Orezza, M. C. E., Gallegos, R., & Matharasi, P. (2017). Best practices for community gardening in a US-Mexico border community. *Health Promotion International*, 32(6), 1001–1014.
- McMillan, D. W., & Chavis, D. (1986). Sense of community: A definition and theory. *Journal of Community Psychology*, 14, 6–23.
- Moulay, A., Ujang, N., & Said, I. (2017). Legibility of neighborhood parks as a predictor for enhanced social interaction towards social sustainability. *Cities*, 61, 58–64.
- Mowen, A. J., & Rung, A. L. (2016). Park-based social capital: Are there variations across visitors with different socio-demographic characteristics and behaviours? *Leisure/Loisir*, 40(3), 297–324.
- Noone, S., & Jenkins, N. (2017). INTERDEM Academy special section - digging for Dementia: Exploring the experience of community gardening from the perspectives of people with dementia. *Aging & Mental Health*, 22(7), 881–888.

- O'Brien, L., Burls, A., Townsend, M., & Ebdon, M. (2011). Volunteering in nature as a way of enabling people to reintegrate into society. *Perspectives in Public Health*, 131 (2), 71–81.
- Onyx, J., & Bullen, P. (2000). Measuring social capital in five communities. *The Journal of Applied Behavioral Science*, 36(1), 23–42.
- Orban, E., Sutcliffe, R., Dragano, N., Jockel, K.-H., & Moebus, S. (2017). Residential" surrounding greenness, self-rated health and interrelations with aspects of neighborhood environment and social relations. *Journal of Urban Health*, 94, 158–169.
- Parker, E. A., Lichtenstein, R. L., Schulz, A. J., Israel, B. A., Schork, M. A., Steinman, K. J., et al. (2001). Disentangling measures of individual perceptions of community social dynamics: Results of a community survey. *Health Education & Behavior*, 28(4), 462–486.
- Peters, K. (2010). Being together in urban parks: Connecting public space, leisure, and diversity. *Leisure Sciences*, 32, 418–433.
- Peters, K., Elands, B., & Buijs, A. (2010). Social interactions in urban parks: Stimulating social cohesion? *Urban Forestry and Urban Greening*, 9(2), 93–100.
- Pleson, E., Nieuwendyk, L. M., Lee, K. K., Chaddah, A., Nykiforuk, C. I. J., & Schopflocher, D. (2014). Understanding older adults' usage of community green spaces in Taipei, Taiwan. *International Journal of Environmental Research and Public Health*, 11, 1444–1464.
- Putnam, R. (2000). *Bowling alone: The collapse and revival of American community*. New York, NY: Simon & Schuster.
- Rios, R., Aiken, L. S., & Zautra, A. J. (2012). Neighborhood contexts and the mediating role of neighborhood social cohesion on health and psychological distress among hispanic and non-hispanic residents. *Annals of Behavioral Medicine*, 43, 50–61.
- Ruijsbroek, A., Mohnen, S. M., Droomers, M., Kruize, H., Gidlow, C., Gražulevičienė, R., et al. (2017). Neighbourhood green space, social environment and mental health: An examination in four European cities. *International Journal of Public Health*, 62(6), 657–667.
- Russell, D. W. (1996). UCLA loneliness scale (version 3): Reliability, validity, and factor structure. *Journal of Personality Assessment*, 66(1), 20–40.
- Sampson, R. J., Morenoff, J. D., Earls, F., & Producer,). (1999). *Reciprocated exchange*. Retrieved from [https://cyfar.org/sites/default/files/PsychometricsFiles/Sampson-Reciprocated%20Exchange%20\(Ages%2018-older\)_0.pdf](https://cyfar.org/sites/default/files/PsychometricsFiles/Sampson-Reciprocated%20Exchange%20(Ages%2018-older)_0.pdf).
- Sampson, R. J., Raudenbush, S. W., & Earls, F. (1997). Neighborhoods and violent crime: A multilevel study of collective efficacy. *Science*, 277(5328), 918–924.
- Seeland, K., Dübendorfer, S., & Hansmann, R. (2009). Making friends in Zurich's urban forests and parks: The role of public green space for social inclusion of youths from different cultures. *Forest Policy and Economics*, 11, 10–17.
- Shanahan, D. F., Bush, R., Gaston, K. J., Lin, B. B., Dean, J., Barber, E., et al. (2016). Health benefits from nature experiences depend on dose. *Scientific Reports*, 6, 28551.
- Soga, M., Cox, D. T. C., Yamaura, Y., Gaston, K. J., Kurisu, K., & Hanaki, K. (2017).

- Health benefits of urban allotment gardening: Improved physical and psychological well-being and social integration. *International Journal of Environmental Research and Public Health*, 14(71), 1–13.
- Sreetheran, M., & van den Bosch, C. C. K. (2014). A socio-ecological exploration of fear of crime in urban green spaces – a systematic review. *Urban Forestry and Urban Greening*, 13(1), 1–18.
- Sugiyama, T., Leslie, E., Giles-Corti, B., & Owen, N. (2008). Associations of neighbourhood greenness with physical and mental health: Do walking, social coherence and local social interaction explain the relationships? *Journal of Epidemiology & Community Health*, 62, e9.
- Sullivan, W. C., Kuo, F. E., & DePooter, S. F. (2004). The fruit of urban nature: Vital neighborhood spaces. *Environment and Behavior*, 36(5), 678–700.
- Swanwick, C., Dunnett, N., & Woolley, H. (2003). Role and value of green space in towns and cities: An overview. *Built Environment*, 29(2), 94–106.
- Teig, E., Amulya, J., Bardwell, L., Buchenau, M., Marshall, J. A., & Litt, J. S. (2009). Collective efficacy in Denver, Colorado: Strengthening neighborhoods and health through community gardens. *Health & Place*, 15, 1115–1122.
- Thoits, P. A. (2011). Mechanisms linking social ties and support to physical and mental health. *Journal of Health and Social Behavior*, 52(2), 145–161.
- du Toit, L., Cerin, E., Leslie, E., & Owen, N. (2007). Does walking in the neighbourhood enhance local sociability? *Urban Studies*, 44(9), 1677–1695.
- Triguero-Mas, M., Dadvand, P., Cirach, M., Martínez, D., Medina, A., Mompert, A., et al. (2015). Natural outdoor environments and mental and physical health: Relationships and mechanisms. *Environment International*, 77, 35–41.
- Ulmer, J. M., Wolf, K. L., Backman, D. R., Tretheway, R. L., Blain, C. J., O’Neil- Dunne, J. P., et al. (2016). Multiple health benefits of urban tree canopy: The mounting evidence for a green prescription. *Health & Place*, 42, 54–62.
- Veen, E. J., Bock, B. B., van den Berg, W., Visser, A. J., & Wiskerke, J. S. C. (2016). Community gardening and social cohesion: Different designs, different motivations. *Local Environment*, 21(10), 1271–1287.
- Volker, B., Flap, H., & Lindenberg, S. (2006). When are neighbourhoods communities? Community in Dutch neighbourhoods. *European Sociological Review*, 23(1), 99–114.
- de Vries, S., Van Dillen, S. M. E., Groenewegen, P. P., & Spreeuwenberg, P. (2013). Streetscape greenery and health: Stress, social cohesion and physical activity as mediators. *Social Science & Medicine*, 94, 26–33.
- Wagner, L., & Peters, K. (2014). Feeling at home in public: Diasporic Moroccan women negotiating leisure in Morocco and The Netherlands. *Gender, Place & Culture*, 21(4), 415–430.
- Whatley, E., Fortune, T., & Williams, A. E. (2015). Enabling occupational participation equation modeling. *International Journal of Environmental Research and Public Health*, and social inclusion for people recovering from mental ill-health through community 15(10), 2323.
- gardening. *Australian Occupational Therapy Journal*, 62, 428–437. Zijlema, W. L., Triguero-Mas, M., Smith, G., Cirach, M., Martinez, D., Dadvand, P., et al.
- Zhang, L., Zhou, S., Kwan, M.-P., Fei, C., & Lin, R. (2018). Impacts of individual daily (2017). The relationship between natural outdoor environments and cognitive greenspace exposure on

health based on individual activity space and structural functioning and its mediators.
Environmental Research, 155, 268–275.