




ARTICLE



<https://doi.org/10.1057/s41599-024-04035-9>

OPEN

Towards social sustainability in urban communities: exploring how community parks influence residents' social interaction during the COVID-19 pandemic

Chunyan Yang ^{1,2✉}, Song Shi², Goran Runeson² & Duanfang Lu³

The COVID-19 outbreak and associated lockdowns have heightened the challenges of social isolation in urban communities. Social interaction is recognized as a key factor in promoting people's health, wellbeing, and social sustainability within urban communities. Public open spaces serve as a vital link between communities' environment and individuals' wellbeing. However, there has been limited research exploring how community parks impact residents' social interaction in urban communities during the pandemic, particularly a lack of in-depth qualitative research in this area. To address this gap, this research investigated the impact of community parks on social interaction in master-planned communities in Sydney, using a qualitative case study method. A total of sixteen residents living in two selected communities—Breakfast Point and Liberty Grove—were interviewed during the COVID-19 pandemic in 2022. It was found that three themes and seven underlying subthemes of park-use factors influence residents' social interactions: (1) quality of park spaces (rest spaces, BBQ/picnic recreation spaces, children's playgrounds, sport facilities, and nature amenities), (2) pedestrian integration of parks (interconnected park network and well-dispersed small parks), and (3) pedestrian connectivity with surroundings. The findings provide theoretical, empirical, and practical implications for promoting social wellbeing and community sustainability in the post-COVID era.

¹School of Architecture, Southwest Jiaotong University, Chengdu 611756, China. ²School of Built Environment, University of Technology Sydney, Sydney, NSW 2007, Australia. ³School of Architecture, Design and Planning, The University of Sydney, Sydney, NSW 2006, Australia. ✉email: chunyan.yang@swjtu.edu.cn

Introduction

First identified in December 2019, the COVID-19 outbreak rapidly escalated into a global pandemic. Governments around the world implemented lockdowns, travel restrictions, and social distancing measures. While these measures helped contain the spread of the virus, they caused significant social disruptions and increased mental health issues due to social isolation. As studies have shown, during the COVID-19 lockdowns, park visits increased in many places, particularly for community parks (Geng et al. 2021; Li et al. 2023; Park et al. 2022). The importance of community parks has been amplified due to residents’ increased demand for nearby parks (Geng et al. 2021; Honey-Rosés et al. 2021; Li et al. 2023). This has led us to rethink the importance of community parks for people’s wellbeing and for social cohesion in communities during the pandemic (Farkas et al. 2023; Lopez et al. 2021; Xian et al. 2024). However, there is a lack of studies have examined on how community parks impact on people’s social wellbeing, especially during times of the health crisis (Honey-Rosés et al. 2021; Reyes-Riveros et al. 2021).

Since the COVID-19 outbreak, there have been increasing concerns about rising social isolation in many countries. In Australia, the issue of social isolation was exacerbated by the pandemic (Biddle et al. 2020). Social interaction is recognized as a crucial factor contributing to residents’ health and wellbeing, and social sustainability in urban communities (Ebrahim, 2015; Warner and Andrews, 2019). Previous research defined community sustainability as encompassing three dimensions: environmental, social and economic (Ahvenniemi et al. 2017; Pira, 2021; Somanath et al. 2021). Social sustainability is essential for promoting social cohesion and the viability of communities (Wang and Ke, 2024). With the urban population continuously increasing worldwide, there is an urgent need to deepen our understanding of all aspects of social sustainability within urban communities in the post-COVID era (Geng et al. 2021; Somanath et al. 2021).

Prior research has acknowledged the pivotal role of public open spaces in promoting social sustainability by fostering diverse social activities among residents in communities (Centers and Gómez, 2019). These social activities are instrumental in cultivating sense of community and in reducing residents’ mental health issues (Francis et al. 2014; Kaźmierczak, 2013). However, the question of ‘how public open places impact on social interaction and wellbeing’ is still unclear in the existing literature, particularly in the context of master-planned communities (MPCs) in Australia. MPC can be defined as ‘large scale, integrated housing developments produced by single development entities that include the provision of physical and social infrastructure’ (Francis et al. 2014, p. 186). As a sustainable residential development form in Australia (Smith, 2020), MPC aims at

building a sense of community for residents by providing physical and social infrastructure.

There are several significant knowledge gaps that need to be addressed in the related areas. Firstly, there are limited studies that focus on understanding the complex human–environment relationships within urban communities in the literature. It is necessary to increase our knowledge on what specific features of neighbourhood green open spaces are important for residents’ social interaction (Schmidt et al. 2019). Secondly, studies regarding the impact of community parks on people’s social wellbeing during the health crisis are limited. The COVID-19 pandemic has heightened the importance of green infrastructure on people’s health and wellbeing, but research in this area remains largely unexplored. Thirdly, we know very little about the daily lives and social activities of residents in MPCs in Australia. Lastly, there is a crucial need for more qualitative studies to uncover sociocultural knowledge in the field of social wellbeing and community sustainability research (NatureSustainability, 2020). Recent studies argue that qualitative field work is urgently needed to investigate the effects of the pandemic on social interactions and wellbeing (Honey-Rosés et al. 2021). However, because collecting data on park use through traditional methods was difficult during the COVID-19 period, there is very limited qualitative evidence collected during the pandemic in the field (Li et al. 2023).

This study aims to address these research gaps by exploring the impact of community parks on residents’ social interaction and wellbeing in MPCs in Sydney. In line with the research aim, this paper proposes the research question (RQ): ‘How do community parks influence residents’ social interactions in master-planned communities in Sydney?’, and a conceptual framework to address the research question (see Fig. 1).

To the best of the authors’ knowledge, this is the first study to investigate the relationship between community parks and social interaction in MPCs in Sydney based on qualitative evidence collected during the COVID-19 period. This research provides an important opportunity and evidence to advance the understanding of the complex human–environment relationships and social interaction within MPCs. The data reflects the characteristics of residents’ social activities and park-use behavioural patterns in MPCs during the pandemic. It makes unique contributions to literature by adding specific evidence collected amidst the pandemic. The subsequent sections will delve into various aspects of the study. Firstly, relevant theories and existing literature will be examined. Secondly, an overview of the data and methodology will be presented. Thirdly, the data analysis and results will be outlined and interpreted. Lastly, the findings and implications will be discussed.

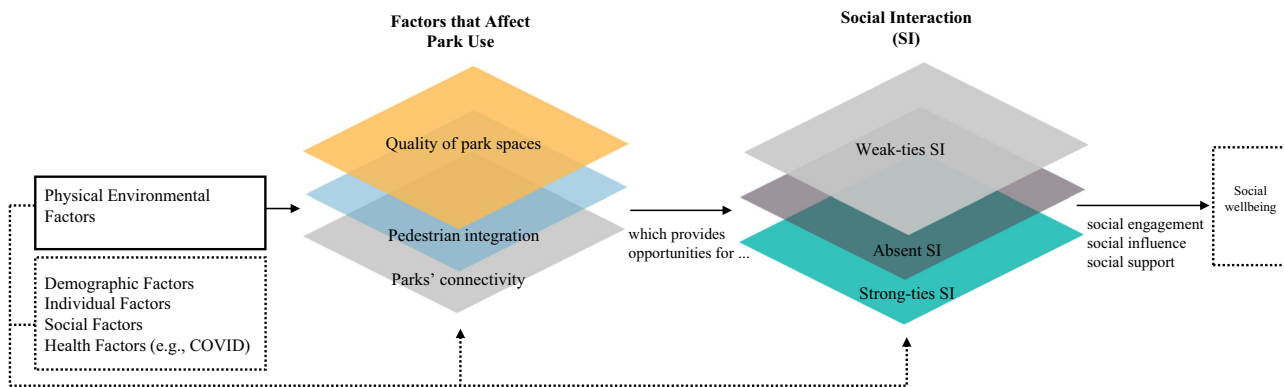


Fig. 1 Theoretical framework—translating model from park use into social interaction. Source: Authors.

Literature review

Theories. Social interaction refers to ‘a process of reciprocal stimulation and interactivity between at least two people’ (Moulay et al. 2017, p. 59). There are several sets of theories that underpin the investigation of neighbourhood social interaction, including micro- and macro-sociology (Moulay et al. 2017; Oldenburg, 1989). This research primarily relies on social ties theory (Granovetter, 1973) and social network theory (Abass et al. 2020; Berkman et al. 2000) to address the research aim.

Social ties theory. This study is based on Granovetter’s (1973) theory of ‘the strength of weak ties’. Granovetter (1973) defined that ‘the strength of a tie is a combination of the amount of time, the emotional intensity, the intimacy, and the reciprocal services which characterise the tie’ (p.1361). In Granovetter’s (1973) theory, social life can be classified into strong, weak, and absent ties. In the neighbourhood context, weak ties are defined as the general, superficial interactions that occur between neighbours who know others but not too well in neighbourhoods (Henning and Lieberg, 1996; Kim, 2017). Strong ties refer to a reliable social network based on thick trust (e.g., family members, kin, friends) that has been developed over time and gains from frequent and substantial support (Kim, 2017; Putnam, 2001). Absent ties refer to ‘the most superficial contacts, meaning for example nodding relationships between people living in the same neighbourhood’ (Alidoust et al. 2018, p. 135). Granovetter (1973) argued that weak ties are likely to be more important than strong ties in social networks.

Following Granovetter’s (1973) social tie theory, past studies found that weak ties are often more plentiful and valuable in neighbourhoods for residents’ social wellbeing (Henning and Lieberg, 1996; Kim, 2017; Weijs-Perrée et al. 2015). For example, Henning and Lieberg (1996) found that the number of weak ties interactions were higher than strong tie interactions within neighbourhoods in a study in Sweden. Kim (2017) revealed that weak ties had a more significant impact on residents’ wellbeing. In contrast, some scholars assert that the majority of social support comes from strong social ties (Benitez-Avila et al. 2023; Kim, 2017). Moreover, absent ties consist of non-verbal general social interaction (e.g., visual contact), which refers to being ‘engaged in social interaction that did not involve verbalised conversations’ (Hickman, 2013, p. 228), such as seeing other people, watching children playing, watching sport or activities. Some scholars suggested that non-verbal absent ties social interaction, like simply seeing other people, can also benefit people’s wellbeing (Gardner, 2011; Hickman, 2013). For example, Gardner (2011) found that some residents enjoyed just seeing others while in outside open spaces, particularly in situations where people felt socially isolated. For example, during the COVID-19 period, people might benefit from simply seeing other people (Lopez et al. 2021). These social ties affect a flow of resources to residents’ social networks within neighbourhood. However, the different types of residents’ social activities in various neighbourhood circumstances remain less understood in the literature. Few studies investigate social ties in the Australian MPC context.

Social network theory. The concept of social networks was originally developed to understand social ties across groups like kinship and residential groups (Barnes, 1954; Bott, 1971). Social network is defined as ‘the web of social relationships that surround an individual and the characteristics of those ties’ (Berkman et al. 2000, p. 847). Berkman et al. (2000) introduced a theoretical framework for understanding how social interactions impact an individual’s health. This model shows that social

networks are shaped by social structural conditions at the macro level, while influencing health and wellbeing through several pathways at the micro-psychosocial level: social support, social influence, social engagement and attachment, and access to resources (Berkman et al. 2000). Overall, social network theory has a valuable lens through which to comprehend relationships among people in social structures like communities (Abass et al. 2020). We argue that one limitation of this model is its neglect to consider the influence of physical factors on social ties within the specific place-based context. This study will enhance this model by adding ‘place’ as a significant dimension of the social network system and utilizing it for analysis.

Association between community parks and social interaction.

Based on the socio-ecological framework (Bronfenbrenner, 1992), previous studies have identified three main categories of factors impacting neighbourhood social interaction: personal factors (e.g., age, sex, education and length of residence); social factors (e.g., health and safety); and physical characteristics of the built environment (Alidoust et al. 2019; Francis et al. 2012; Lauwers et al. 2021). Among them, several built environment factors have been identified associated with residents’ social interaction in neighbourhoods, such as the provision of public open space (Francis et al. 2012; Talen, 2000); the quality of public space (Chitrakar, 2016); land use and density (Rogers and Sukolratanamete, 2009); pedestrian access (Lund, 2002); and neighbourhood connectivity (Abass et al. 2020). Specifically, previous studies have found that the provision of public and open space (e.g., playgrounds and parks) brings residents together and provide opportunities for a variety of social activities (Cao et al. 2018; Francis et al. 2012). New urbanism presents a theoretical connection between the public spaces and social interaction (Hooper et al. 2020; Talen, 2000). For example, Talen (2000) presented a model illustrating the translating relationship from public open space into social interaction, which delineates the process through which public open space leads to the formation of social interaction, mediated by factors related to the use of public spaces.

Three main category factors of community parks have been identified associated with people’s social activities in neighbourhoods in literature: the quality of park space, pedestrian integration and pedestrian connectivity (Centers and Gómez, 2019; Francis et al. 2012) (see Table 1). (1) several crucial aspects of the quality of park space have been identified associated with people’s social wellbeing, including recreation space, children’s playgrounds, rest space, shade facilities, sports facilities and nature amenities (Francis et al. 2012; Zhu and Fu, 2017). UN-Habitat has developed a framework including five dimensions to assess the quality of public open space at the neighbourhood level, based on residents’ needs and social wellbeing: accessibility, amenities, green environment, comfort and safety, use and user (UN-Habitat, 2020). Among them, the objective factors of park quality include accessibility (e.g., inclusive facilities for pedestrians and bikes, etc.), amenities (e.g., quality of seating, recreational structures like playground, etc.), green environment dimensions (e.g., ratio of green coverage, biodiversity like trees, flowers, etc.) (UN-Habitat, 2020). Similarly, an Australian planning model, ‘Classification Framework for Public Open Space’ claims that three functional park spaces can benefit people’s social wellbeing: Nature, Recreation, and Sport spaces (Rutherford et al. 2013). (2) pedestrian integration factors have been identified as influencers of social contact, incorporating parks’ accessibility, distribution, and parks network within neighbourhoods (Centers and Gómez, 2019; Lund, 2002). Quantity of parks, park size, park distance, and walking trails

Table 1 Categories of parks characteristics associated with social wellbeing.

Dimension	Indicator	Item	References
Quality of park spaces	Recreation space	Playgrounds, rest space, shade, quality of seating	(Francis et al. 2012; Reyes-Riveros et al. 2021; UN-Habitat, 2020; Zhu and Fu, 2017)
	Sport space	Sports facilities	
	Nature space	Ratio of green coverage, tree cover, form of trees/flowers, water feature	
Parks' pedestrian integration	Parks' accessibility	Number of parks, the ratio of parks, park size	(Alidoust et al. 2019; Farkas et al. 2023; Reyes-Riveros et al. 2021) (Honey-Rosés et al. 2021; Talen, 2000)
	Park distribution	Clear center park, well-dispersed, small and frequent parks	
	Connected parks network within community	Walking-connected; parks' network	
Parks' connectivity	Walking trails	Quality of paths	(Park et al. 2022; UN-Habitat, 2020)
	Connectivity with surroundings	Being open; Connectivity for gated communities	

are identifies associated with parks accessibility and related social wellbeing (Alidoust et al. 2019; Lopez et al. 2021). (3) Parks connectivity, particularly parks' pedestrian connectivity with surrounding areas, is associated with social interactions in neighbourhoods (Abass et al. 2020; Reyes-Riveros et al. 2021). Parks connectivity is recognised as a key factor to address the issue of socio-spatial segregation in urban communities, especially for MPCs in Australia (Alidoust et al. 2018; Kenna et al. 2017).

However, there remains a lack of empirical studies examining the relationship between public open spaces and social interactions within urban communities, particularly in the context of MPCs in Australia (Farahani and Lozanovska, 2014).

COVID-19 impacts on park use and related social interaction.

Many studies found that people visited parks more frequently during the pandemic in many countries globally (Geng et al. 2021; Li et al. 2023; Park et al. 2022). However, the levels of park visitation varied across countries and specific period during the COVID-19 period (Geng et al. 2021). In countries with fewer COVID-19 cases and less restrictions, such as Canada and Denmark, park visitation consistently increased (Geng et al. 2021). A few studies reported contradicting results of a decrease in park visits at some specific times during the pandemic (Lopez et al. 2021; Park et al. 2022).

Although park visitation levels differed between countries during the pandemic, there are several important common themes emerged from the recent studies globally: Firstly, urban parks have become more important for people's physical and mental health than before the outbreak of the pandemic (Farkas et al. 2023; Geng et al. 2021; Honey-Rosés et al. 2021; Lopez et al. 2021). People's demand for parks and a healthy living environment has increased, due to the impacts of workplace closures and social distancing restrictions during the pandemic (Farkas et al. 2023; Geng et al. 2021). Secondly, compared to the urban parks, community parks at the neighbourhood level have become more important during pandemic (Han et al. 2022; Honey-Rosés et al. 2021; Li et al. 2023). This is because people's options for outdoor activities are limited and tend to focus more on surround accessible areas like neighbourhoods or local communities (Han et al. 2022). Thirdly, the need for outdoor social activity has significantly increased, and people's social behaviour in public has changed (Han et al. 2022; Honey-Rosés et al. 2021). For example, amid the pandemic, residents have devised various ways to maintain social contact and alleviate isolation, such as conversing from balconies or driveways (Honey-Rosés et al. 2021). Fourthly, more studies are beginning to focus on how the quality of parks

may impact people's social wellbeing (Han et al. 2022). Some studies found the various factors influence park use and social interaction, like park size, park distribution, infrastructure, and accessibility (Li et al. 2023; Reyes-Riveros et al. 2021; Yang et al. 2023). Fifthly, the pandemic has prompted academia to pay more attention to the issue of neighbourhood connectivity in open or gated communities (He et al. 2023). Lastly, the COVID-19 pandemic has intensified inequalities in accessing and using public spaces (Honey-Rosés et al. 2021; Yu et al. 2023; Zhao and Gao, 2023). Parks are particularly important to match the needs of the community across different populations, especially for elderly, children and youth, and women (Lopez et al. 2021; Park et al. 2022). For example, Honey-Rosés et al. (2021) pointed out that parks are important for elderly living alone, as they provide opportunities for social interactions that help reduce isolation and loneliness during the pandemic. However, to date, research on the impact of the pandemic on park use and related social behaviours in communities is very limited and just begun.

Sustainable communities: master-planned communities in Australia.

MPC is a dominant form for sustainable residential development in Australian cities, which aims to create a sense of community and a resort lifestyle via the provision of physical and social infrastructure (Cheshire, 2019; Goodman et al. 2010; Rosenblatt et al. 2009). MPCs have several common characteristics: 'a consistent design and aesthetic, and some level of private infrastructure that may include social infrastructure, community facilities and residential amenities' (Thompson, 2013, p. 86). Existing literature analysing MPCs mainly focus on three dimensions: governance mechanisms; housing market; and nature of community (Alidoust and Bosman, 2017). Social sustainability has been an essential and consistent theme on MPC research in literature (Rosenblatt et al. 2009). However, a significant gap exists in understanding how the neighbourhood green features affect residents' social interaction and health outcomes, especially in the context of the COVID-19 pandemic.

Previous studies have recognised the complexity and diversity of the MPC phenomenon in Australian cities (Dowling and McGuirk, 2005). MPCs can be categorised on the enclosure of built form (e.g., open, symbolically enclosed, and gated); density form; and the type of location (e.g., outer- and inner-urban MPC) (Dowling et al. 2010; McGuirk and Dowling, 2011). It is notable that the empirical research is limited across different types of MPC in Australia (Maller et al. 2016). The majority of MPC studies have focused on the outer-suburban greenfield type MPCs in literature, while few have examined inner urban MPCs (Thompson, 2013). This study focuses on inner urban MPCs.

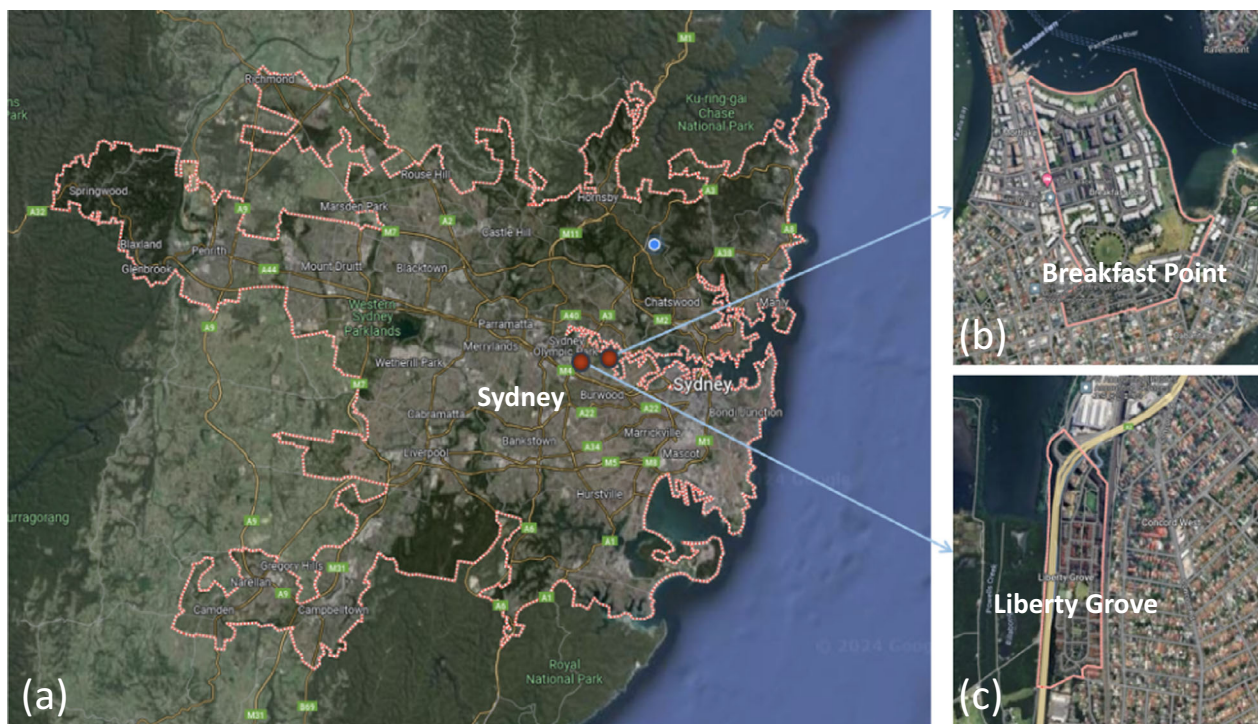


Fig. 2 Map of the study area. **a** Sydney, **b** Breakfast Point, **c** Liberty Grove.

Theoretical and conceptual framework. Integrating Granovetter's (1973) social tie theory, Berkman's et al. (2000) social network system theoretical model, and Talen's (2000) new urbanism model, this study develops a new conceptual framework to investigate how park use factors influence social interactions among residents in MPCs (Fig. 1).

Methods

Cases study areas. This study employs a qualitative case study method to address the research questions. Two MPC cases were selected based on their similarities, such as similar locations, large-scale (over 500 properties) (Kenna et al. 2017) and high-quality parks. The two cases were selected from different built forms: one is open, and another one is symbolically enclosed or gated. The inclusion of these distinct built forms allows for an exploration of the impact of neighbourhood connectivity and built forms on residents' social activities. As a result, two cases were selected in the inner west of Sydney: Breakfast Point (BP) and Liberty Grove (LG) (Fig. 2). Both are located at the local government area of the City of Canada Bay and were built completed around the year 2000 (Figs. 3 and 4). The two cases differ in their built forms: BP is an open MPC, while LG is a symbolically enclosed MPC. The comparison and characteristics of community features of two cases are summarised in Table 2.

Participants. The qualitative interview data of this study was collected in the midst of the COVID-19 pandemic in 2022. Due to the impact of the health crisis, interviews were conducted via Zoom. Salmons's (2016) 'E-Interview Research Framework' was used as a tool to design the qualitative research and the online interview data collection.

This study selected adult participants from different socio-demographic groups in BP and LG via purposive sampling and snowball sampling. The participants were selected to represent all socio-demographic factors related to social interaction within MPCs, including age, gender, marital status, work status, education, dwelling type, family composition and length of

residency (Francis et al. 2012; French et al. 2014; Hooper et al. 2020). The participant selection inclusion criteria were summarised in Table 3. After each interview, a participant was asked to nominate people who are living in BP or LG and have the key characteristics for an interview by snowball sampling.

The authors accessed the potential participants through two ways: (1) closed social media groups, and (2) a related survey. Firstly, participants were accessed through closed social media groups. The interview invitation letters (including the Qualtrics link and QR code) were posted to the closed neighbourhood Facebook groups. If the residents were willing to do the interview, they could click the Qualtrics link or scan the QR code to read the information sheet and e-sign the consent form. The potential participants who were identified as having the key characteristics were then contacted by email or Facebook messenger by authors. Second, before this interview study, a related survey was conducted in BP and LG in 2021 (approved by the University of Technology Sydney's Human Research Ethics Committees (UTS HREC REF No. ETH20–5480)). In the survey questionnaire, there was a question that asked participants whether they were willing to participate in this follow-up interview study. The participants who were willing to participate in the interview and identified as having the key characteristics were then invited into the interview via email by authors. Interviews were conducted via Zoom which were audio or Zoom recorded.

According to Hagan and Wutich (2017), most themes are usually identified with ten in-depth interviews and the saturation of categories usually takes place around 15–20 interviews or more. As a result, this study's qualitative data saturation occurred after analysing 16 interviews. Out of the total 16 participants, with 8 participants living in BP and 8 in LG, the majority fell within the age range of 20–59, while 3 participants were over the age of 60 (Fig. 5). Education levels varied: 7 participants held bachelor's degrees, 3 had master's degrees, 2 possessed diplomas, 2 attained high school degrees and 1 held a doctor degree. The participants' work status varied, including 7 working full-time, 5 part-time, 1 as a housewife, 1 self-employed, and 1 retired. Regarding the length of residency, 7 participants had resided in BP/LG for 5–10



Fig. 3 Scenes of housing and community parks in Breakfast Point. Source: Photographs taken by authors, 2022.



Fig. 4 Scenes of housing and community parks in Liberty Grove. Source: Photographs taken by authors, 2022.

Table 2 Summary of community features of the two cases.

Dimensions	Case 1—Breakfast Point	Case 2—Liberty Grove
Year of completion	The year 2000	The year 1999
Location	City of Canada Bay, Inner west of Sydney	City of Canada Bay, Inner west of Sydney
Population	4678 (ABS-a, 2021)	2021(ABS-b, 2021)
Scale	Large scale MPC: 2476 dwellings (ABS-a, 2021)	Large scale MPC: 796 dwellings (ABS-b, 2021)
Dwelling structure	Houses (94) Semi-detached/Townhouse (87) Apartment (1955) (ABS-a, 2021)	House (67) Semi-detached/Townhouse (212) Apartment (452) (ABS-b, 2021)
Built form	Open	Symbolically gated
Public space	Connected network of parks Connecting with surrounding areas	Integrated network of parks Relatively enclosed
	Integrated network of parks Pedestrians connected with surrounding neighbourhoods and parks	

Source: Breakfast Point and Liberty Grove websites; Census data (ABS-a, 2021; ABS-b, 2021).

years, while 4 participants had been residents for over 10 years. These diverse demographic characteristics contribute to a varied and representative sample for the conducted interviews. To ensure participant anonymity, proper names and other identifying details have been replaced with numerical codes (P01–P16).

Interview questions. Interview questions are developed based on the related theories and the conceptual framework of this study,

including four sections: community park use, social interaction, neighbourhood connectivity, and participant background information (see Table 4). (1) The section-1 questions were intended to understand the characteristics of residents’ activities, behaviour patterns, needs of park use. (2) The section-2 questions aimed to understand the characteristics of residents’ social ties and its relationship with community park factors in MPCs. (3) The section-3 questions aimed to understand the parks’ socio-spatial

Table 3 The inclusion criteria for interview participants.

Categories	Inclusion criteria Participants were selected from the group of:	References
Age	<input type="radio"/> 20-39 <input type="radio"/> 40-59 <input type="radio"/> 60+	(ABS-a, 2021; ABS-b, 2021; Francis et al. 2012; Hooper et al. 2020; Weijis-Perrée et al. 2015; Zhu and Fu, 2017)
Gender	<input type="radio"/> Male <input type="radio"/> Female	
Marital status	<input type="radio"/> Married /de facto <input type="radio"/> Single resident	
Education	<input type="radio"/> High school graduate or below <input type="radio"/> Diploma, advanced diploma, certificate level <input type="radio"/> Bachelor's degree <input type="radio"/> Master's degree <input type="radio"/> Doctoral degree	
Employment status	<input type="radio"/> Full-time employment <input type="radio"/> Part-time employment <input type="radio"/> Self-employment <input type="radio"/> Away from work (housewife/retired etc)	
Family composition	<input type="radio"/> Family with children (under 15 years) <input type="radio"/> Family without children	
Housing type	<input type="radio"/> House; townhouse <input type="radio"/> Apartment	
Length of residency	<input type="radio"/> <1 year <input type="radio"/> 1-3 years <input type="radio"/> 3-5 years <input type="radio"/> 5-10 years <input type="radio"/> >10 years	

connectivity with surrounding areas 'outside' the MPCs, and to explore the characteristics of residents' activities, and social interaction connecting in surrounding areas. The question in this section was designed specifically to explore the socio-spatial segregation issue in the MPC context. (4) The section-4 questions gathered general information on participants, including age, gender, marital status, work status, education, house type, and length of residency. These questions helped the authors to justify if the interview participants were selected appropriately matching the selection criteria and also helped analyse the descriptive characteristics of the participants. In summary, six semi-structured theme-related questions were developed for interviews. According to participants' responses, some probing questions were asked to explicitly explore participants' perceptions of the research issues.

Interview procedure. The online interviews were conducted by the first author, following several steps: (1) The author checked the Qualtrics platform to ensure the participant signed the consent form before the Zoom meeting. (2) To protect participants' privacy during Zoom interviews, the author used the Zoom waiting room to prevent uninvited persons from joining. (3) When the Zoom started, the researcher suggested participants use a virtual background to protect their confidentiality and privacy. The author reminded the participants that they could shut down their camera during the interview. (4) With the participants' permission, interviews were Zoom- or audio- recorded. (5) When the interview started, after the 'ice-breaker' questions, participants were required to answer a series of questions following the interview protocol (see Table 4). Participants were encouraged to discuss relevant issues. The sequence and contents of questions might change in response to the logical flow of participants' responses. As a result, the length of this section varied from approximately 20-70 min, mainly depending on respondents' experience in the topic area and their communication styles. (6) The audio recordings were later transcribed for recurring themes.

Thematic analysis. All recorded interview data were then transcribed verbatim. Interview transcripts were analysed using NVivo 12 software by thematic analysis method (Braun and Clarke, 2006). Thematic analysis is ideally suited to investigate the subjective perceptions and experiences of participants (Swierad and Huang, 2018). The interview data were analysed in the following steps in thematic analysis: (1) Clean the raw data, (2) Transcribe interviews, (3) Read through the transcript data to gain an overall understanding (pre-coding), (4) Generate initial codes, (5) Cluster initial codes, (6) Group codes into themes (Identify themes), (7) Investigate how the themes relate to each other, (8) Finalize the themes, and (9) Interpret the meaning of the themes (Braun and Clarke, 2006). In step 4 and 5, data were categorised based on the feature of the data. Then initial codes were generated in an iterative process of inductive coding. The process of coding is one of the most important steps of thematic analysis. The codes were then organised in themes and sub-themes. In addition, a code frame was developed to identify important themes (Fig. 6).

Findings

The interviews yielded three key themes: (1) the quality of park space, (2) parks' pedestrian integration, and (3) parks' connectivity. The key findings, which illustrate the psychological mechanisms linking park use into social interaction, including strong, weak, and absent social ties (Fig. 6).

Quality of park spaces. Interviews found five subthemes of quality of park spaces associated with social interaction, including rest spaces, BBQ/picnic recreation spaces, children's playgrounds, sport facilities, and nature amenities. Among them, the rest spaces in parks are the most common subtheme that emerged in the interviews.

Rest spaces in parks. The interview data showed that rest spaces in parks was the most commonly cited reason for visiting parks and

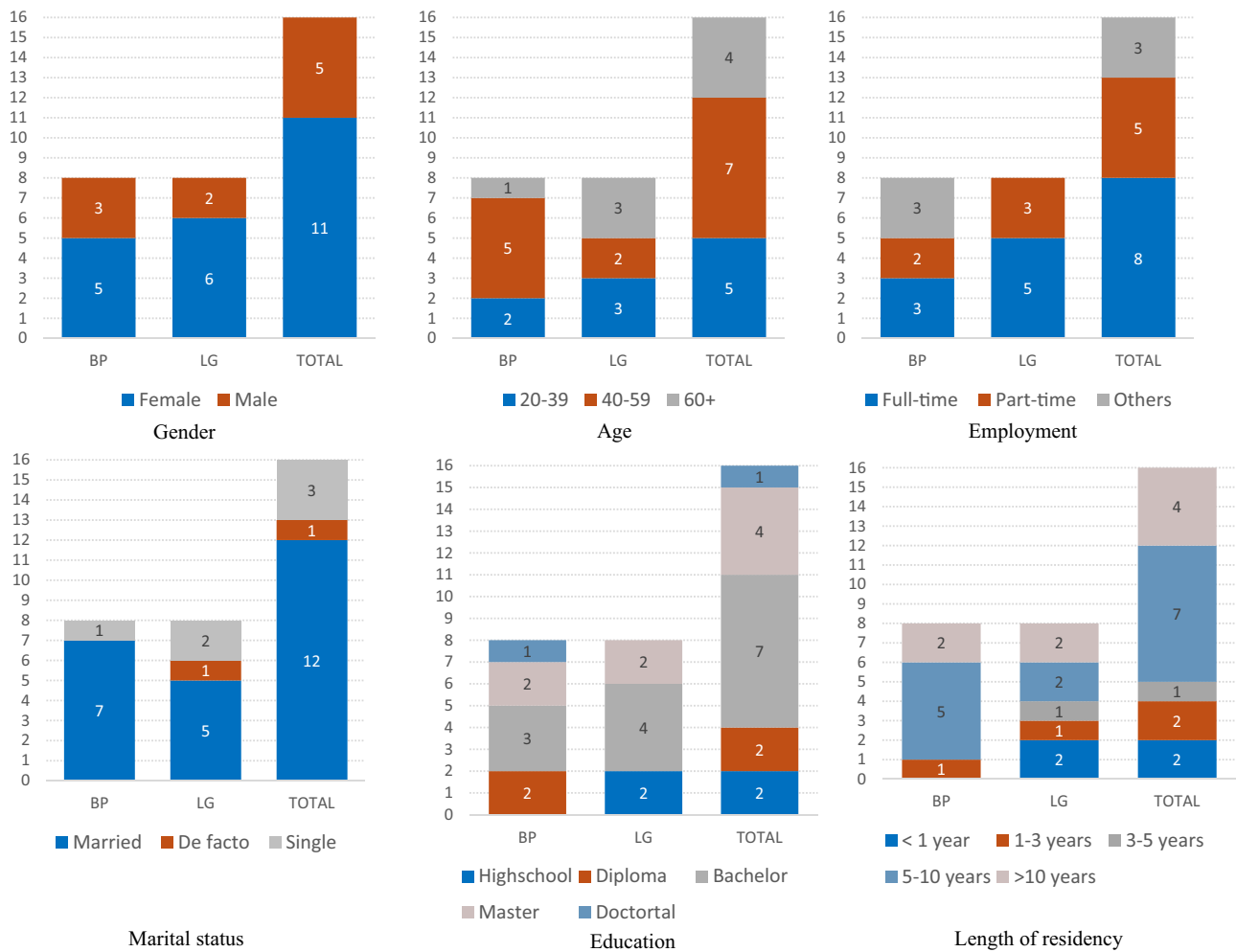


Fig. 5 Summarised the demographic profile of the interview participants. Source: Authors.

social connections for residents in MPCs. Many social interactions among neighbours occur in rest spaces in parks, including weak-ties and strong-ties social interactions, and group activities. These findings indicated the importance of rest facilities in community parks as facilitators of social interaction.

First, weak-ties social interaction (e.g., greeting, brief conversations) often happens in rest spaces in community parks. More than half of the respondents mentioned that they used the parks for sitting, along with casual social interaction activities, such as greeting, short conversations, or observing children playing. This type of interaction was highlighted as one of the most prevalent park activities across interviews. For example, some of the participants stated:

‘Sometimes I will just go to the park and sit for a few minutes. (...) Some people sit and watch the parties there.’ (LG, age 60 s).

‘My favourite part about parks is just sitting there and watching kids playing.’ (LG, age 60 s, P11).

Second, strong-ties social interaction also occurs in the rest spaces. Some participants mentioned that they used rest facilities for meeting friends, where they would sit and talk, gather with friends, or hold gatherings. For example, when asked about activities they enjoy doing with family or friends in the community parks, as one participant responded:

‘We like to sit in the park and talk.’ (LG, age 40–59).

Third, community participation often takes place in rest spaces as well. Some participants noted that they use the rest area for some community social activities, such as group activities. As one participant reported:

‘We use rest facilities for social interactions, mainly in park pavilions. (...) If there is a group gathering, they would choose a pavilion or similar places with shade and better-quality rest facilities.’ (BP, age 40–59).

Both BP and LG residents mentioned that there is a need for more seatings in the community parks, because seating facilities are consistently needed for residents. As one BP participant and one LG participant expressed:

‘One suggestion I have is to increase the number of benches in this area. Because in Breakfast Point, we didn’t have much seating around the walking paths. Therefore, adding more benches would be helpful.’ (BP, age 60+).

In addition, it is notable that participants from both BP and LG reported the lack of shade or shelter for seatings. Inadequate shade might have a negative impact on park usage and on social interaction. Quite a few participants from both MPCs suggested more covered seating are needed in parks, as two participants responded:

Table 4 Interview protocol.

Dimensions	Themes	Questions
Section-1 Community park	Park-use behaviours	Q1: What do you like to do in community parks?
Section-2 Social interaction	Quantity of social interaction	Q2: How often do you usually have social interaction with neighbours in community parks (before or during the COVID-19 period)? Sub-questions: - Are you satisfied with the frequency of your social interactions occur in community parks? - Why do you feel that way?
	Quality of social interaction	<i>Social interaction types:</i> Q3: Could you please describe what types of social interaction that occur in community parks you are involved with (before or during the COVID-19 period)? Sub-questions: - Are you satisfied with your social interactions occur in community parks? - Why do you feel that way? <i>Interaction and social wellbeing:</i> Q4: Which type of social interactions in community parks give you a sense of social support, or a sense of community? Sub-question: - Why do you feel that way?
	Park-use and social interaction	Q5: What features of community parks encourage you to get various types of social interaction with others? Sub-question: - Why do you feel that way? / Could you please provide some examples?
Section-3 Neighbourhood connectivity	Surrounding park-use behaviours	Q6: Please describe the public open spaces (like parks) in surrounding areas of BP/LG. What do you like to do in the parks in the surrounding areas (if have)? Sub-questions: - Please describe what types of social interaction that occur in public open spaces in surrounding areas.
Section-4 General information	Participant background information	Individual information, such as: - Which housing type are you living in? - How long have you lived in BP/LG?

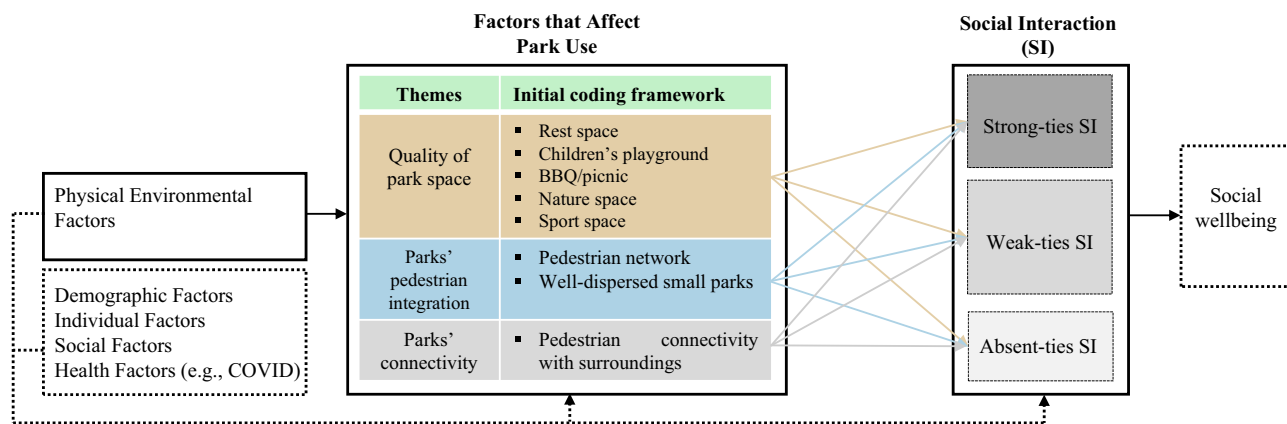


Fig. 6 Coding framework of the thematic analysis findings. Source: Authors.

‘They should get more sheltered seating since some summertimes are quite hot, and the sunlight is too strong.’ (BP, age 40–59).

‘There are a couple of uncovered rest areas. They can be very hot during the summer.’ (LG, age 40–59).

Recreation (BBQ/picnic) spaces in parks. Interview data revealed that social interactions often occur in BBQ and picnic spaces within community parks, especially strong-ties social interactions and community participation. Most participants agreed that they often use BBQ and picnic facilities to meet friends or host family gatherings. As exemplified by two participants:

‘We use parks for picnic and parties with friends or families.’ (BP, age 20–39, P08).

‘(BBQ) would be one of the major attractions to me, because I’ve got a very large family. Now my children are grown-up who have children. I’ve got ten grandkids. When they come to visit me, we use all the benefits out there in the barbecue. We go (to the parks) and have the barbecue and spend time there.’ (LG, age 60+, P11).

However, both BP and LG participants expressed the concern of insufficient BBQ and picnic facilities in the parks, which are highly needed for residents. For example, in LG, the limited number of picnic tables led to them being occupied frequently.

Residents faced difficulty finding an available BBQ spot. As two participants shared their perspectives:

‘There are not many BBQ facilities in Breakfast Point. I think only one or two in the whole neighbourhood. If you run a big group barbecue, you need to go to the parks in surrounding area near BP.’ (BP, age 50–69).

‘It is really good, but I hope they could have more picnic tables (...) Most of the time there are already people there (at picnic areas). (...) So you need to go there really early to get one, because there are only two or three (picnic tables).’ (LG, age 20–39).

Participants also raised concerns that the BBQ facilities in parks might create noise disturbances to neighbouring residents when being used for gatherings. Some respondents mentioned that the proximity of the BBQ facility to apartment buildings could lead to excessive noise and cause inconvenience for neighbours.

Children’s playgrounds in parks. Participants reported that they often interacted with neighbours when visiting children’s playgrounds in community parks, especially for young families with kids. Children’s playgrounds and play facilities were considered attractive features that motivated residents with children to visit parks and engage in social interactions. As one resident noted:

‘The community park is so important to us because my son can interact with other people there. (...) for our growing kids, they need the interaction; they need people; they need friends. (...) My son plays every day in the parks.’ (LG, age 40–59).

Regarding weak ties social interaction, some respondents mentioned that they often had short conversations with other parents while their children were playing in the parks. This form of socialising was particularly common among young residents. For example, a young mother who visited the children’s playground almost daily with her 3-month-old baby noted that she enjoyed conversing with other parents when their babies were playing there. She felt that this type of social interaction offered a valuable source of social support for her, especially during the pandemic period. Another participant shared a similar experience:

‘If we know the children and parents or see them often, we may start some short talks. It’s a good opportunity for the neighbours in LG to have some social interactions.’ (LG, age 40–59, P06).

Regarding strong ties social interaction, some mentioned that their children have friends of the same age in the community. They often arranged playdates with these friends, which was much more fun than bringing their own children to the park alone. Playing with their friends in the community has become one of the main ways of socialising for these children. Some community or group activities were held in the children’s play areas in parks, such as parent group gatherings, and children’s birthday parties. As one woman said:

‘We often have activities with children and other parents in the community parks. (...) We choose the play facilities with other parents together.’ (BP, age 40–59).

Sports facilities in parks. The findings highlighted the significance of sports facilities in parks for promoting physical activities and social interactions among neighbours, especially for strong ties social interactions. There are two types of sports facilities in

MPCs: open for public use and exclusively for residents’ use. Sports facilities available for public use in parks consist of football, basketball, cricket pitches, bicycle paths and other facilities. Some MPC sports facilities are exclusively accessible to resident’s swipe cards to access and use, such as the swimming pool, tennis court and gym. Overall, the facilities are maintained and governed by community strata. The sports facilities in parks provide residents opportunities to engage in social activities with their neighbours, including strong ties and weak ties social interactions.

In the context of strong ties social interaction, many respondents expressed their desire to participate in sports activities with friends and close neighbours in parks, such as playing football or tennis. For example, a young resident mentioned his weekly tennis games with neighbours, which turned initially unfamiliar neighbours into friends. This interaction played a crucial role in establishing a social network within the community, as exemplified by the following statement:

‘I play tennis with a lot of older people within the community every week. I think the space is pretty good.’ (BP, age 20–39).

In terms of community participation, respondents indicated that there are various sports group activities organized by residents within local parks, including yoga and tai chi groups. Additionally, several respondents noted the frequent occurrence of sports competitions held in parks. Furthermore, a number of respondents reported instances of sports-related gatherings taking place in parks, utilizing facilities such as the basketball court. Participating in these community activities and using the park’s sports facilities proved to be an effective way to get acquainted with neighbours and engaging in social interactions within the community. The sports-based social activities had a positive impact on residents’ physical and mental wellbeing, particularly on young people. As a teenager’s mother stated:

‘My son and friends around him made the best use of the parks by having sports parties. We are several professional sports persons to come with kids like soccer or stuff like that.’ (LG, age 40–59).

In the context of weak and absent ties social interaction, respondents reported having short conversations with others when exercising or watching sports. This type of casual social interaction often happens in sporting areas of the parks. Furthermore, watching other people playing sports also generates a sense of social engagement. As two older women reported:

‘There are some exercise groups in the parks. I observe them from a distance. Sometimes I join them.’ (LG, age 60+).

‘I like just sitting there, watching sports activities in community parks.’ (LG, age 60+).

However, some participants expressed concerns about the inadequacy of sport facilities, especially for children and young people. One resident argued:

‘I used to play with the sports facilities there. But I haven’t been playing basketball because there are always people there.’ (LG, age 40–59).

Some residents emphasised the need for sports facilities to cater to the diverse age groups of children. For instance, one resident mentioned that he had two children, a teenage girl and an 8-year-old boy, each with different needs for sports facilities. He said:

‘If we can have some basketball courts, volleyball courts, or other multi-function sporting courts, it would be much

better for kids. (...) Breakfast Point doesn't have too many facilities for kids.' (BP, age 40–59).

Nature amenities in parks. Nature amenities within community parks help enhance the experience of visitors and provide opportunities for various activities or social interactions. These amenities can include walking trails, picnic areas, viewpoints, bird-watching platforms, and other infrastructure designed to promote engagement with the natural surroundings. This research found that nature amenities not only encourage people to appreciate, explore, and learn from the natural environment around them, but also provide opportunities for residents to interact with neighbours, including weak ties and strong ties social interactions. In terms of weak ties social interaction, many residents stated that they enjoy walking in nature and green spaces, which provide additional opportunities for casual social interaction while strolling. Some participants mentioned that they not only appreciated the scenery, but also enjoyed encountering park-goers and exchanging greetings with neighbours in parks. These spontaneous social interactions gave them a sense of social engagement and, in turn, benefited their health and wellbeing.

For strong ties social interaction, many respondents mentioned that they enjoyed walking with close neighbours or friends along green spaces or waterside parks, especially during the pandemic. They expressed feelings of happiness and security when meeting with friends in open green spaces. In addition, quite a few community activities, such as yoga group activities, continued to be held in green areas. As one participant stated:

'While I walk with my son (in the parks), I think it is very relaxing. I really like gathering with friends in the green area as well.' (LG, age 20–39).

It is noticed that some apartment residents emphasised the vital role of nature facilities in their social life within the neighbourhood. Parks and green spaces provide additional opportunities for activities in apartment-living settings. As one participant noted:

'There're a lot of good green spaces in Breakfast Point...it's so much green spaces and it's so wide in Breakfast Point. I guess people went around about feeling quite relaxed. (...) Having those spaces helps for apartment living.' (BP, age 20–39).

COVID-19 impacts on park use and related social interaction. Most interviewees reported that during the pandemic, they still used BBQs and picnic areas to maintain strong-ties social interactions with close family and friends. As two participants shared their experience:

'It was good, even in the COVID lockdown time, you can still go to the parks to have a BBQ with friends.' (BP, age 40–59, P03).

'During COVID, we just grab food from IGA [supermarket], and then sit down in a park, not so much a formal picnic'. (BP, age 20–39, P08).

Moreover, some participants mentioned that group events or parties were often held in picnic areas in parks as well, such as block group gathering, and activities organised by immigrant groups. During the pandemic, those areas provided outdoor places for gatherings, benefiting residents' mental health. One participant in BP noted:

'I think there are some really nice parks in Breakfast Point. (...) They are good for picnics. It was good that during the

COVID lockdown, we have nearby places to visit. (...) We meet with friends and have picnics there. (...) it was nice to be able to catch up with friends [during the pandemic].' (BP, age 40–59, P03).

Many respondents mentioned that they were more inclined to turn to nature amenities for weak ties social interaction during the pandemic. For those isolated due to the COVID-19 lockdowns, spending time in natural and green spaces became a way of connecting with others. For example, one respondent stated the nature facilities are important for her social needs during the pandemic.

'During COVID, it is helpful to go out into nature. It makes me feel relaxed to see beautiful sceneries, to walk and chat with neighbours in open green spaces that are helpful for my physical and mental health. It is a good way to reduce stress [during the lock down] instead of being confined to the room.' (BP, age 40–59, P07).

In particular, interviews highlighted the importance of nature amenities for vulnerable people, such as the elderly, children, pregnant women, or people recovering from COVID-19. For example, a parent resident (BP, age 40 s) mentioned that during the pandemic, children not being able to play with their peers most of time which may causes significant psychological pressure. Social interaction in the community is crucial for children's social and physical wellbeing, so they take their children to the park every day in hopes of seeing other playmates there. As a young mother stated:

'We used to meet up with some of my daughter's friends and their parents. (...) During COVID, people were facing mental health challenges. At times, we would go out for a walk to see if my daughter's friends were also out at the same time. Due to the lockdown, they couldn't be together most of time. [These chance meetings] would really brighten my daughter's day.' (BP, age 20–39, P08).

In another example, an elderly respondent elaborated on how parks benefit her social wellbeing during the COVID-19 period:

'I think community parks are helpful for social interaction because they offer grassy areas where you can walk and exercise your dog. (...) I find that parks are very nice places for walking, which naturally encourages social interaction, especially when you walk there once or twice a day.' (BP, age 70+, P04).

A pregnant woman had recently recovered from COVID-19, who reported that she could not engage in many social interactions during her isolation period. Visiting neighbourhood natural and green spaces every day helped her to get some weak or absent ties social interactions in communities. She shared her experience:

'When we got COVID, we had to isolate for two weeks while I was pregnant. It was a really bad time for me. When we were free, we walked around in these green areas and parks. It's a really good place to go during COVID. At least we have some people that we could say hello to.' (LG, age 20–39, P12).

Parks' pedestrian integration. Interview data revealed the significance of pedestrian integration in promoting park use and social interactions. Park integration enables people to move between parks, facilitating opportunities for social interactions. Two specific subthemes were identified that can promote pedestrian integration in parks: (1) interconnected park network,

and (2) well-dispersed small parks. The integrated park network provides connected places for residents to engage in various activities, such as strolling, walking dogs or riding bicycles.

Interviews showed that a clear central park may increase residents' engagement in community activities. Respondents explained that centrally located parks are easier to identify and serve as convenient meeting points for friends and event participation. Almost all respondents in BP and LG stated that the walkability of the central park was important for community park use and social interaction in MPCs. This is because most organised events were held in the neighbourhood central park. Accessibility to the central park makes it easy for all residents to attend community activities. An elderly respondent confirmed that the annual community festival was usually held in the central park. Because of its proximity to her residence, she was more inclined to participate in those events, as she stated:

'I would normally go out to it (the spring festival event) because it is not far away'. (BP, age 60+).

Most respondents mentioned that they frequently make use of the small parks dispersed between the block buildings because of their accessibility. Well-dispersed small parks between buildings enhance accessibility to parks and in turn encourage community park use and social interaction. It is worth noting that a well-dispersed distribution of parks is important for apartment residents to access the community parks. Many participants appreciated the fact that their neighbourhood featured a spatial arrangement of parks between buildings, which enhanced their accessibility to these parks and fostered more social interactions, as three respondents stated:

'Apart from a big park in the centre, there are a lot of small parks between the buildings. We can always get there, very easy to do it.' (BP, age 40–59).

'There are a lot of parks including a large one and some smaller ones in the neighbourhood.' (LG, age 60+).

'The park spaces that we have in Breakfast Point are pretty nice. There's quite a lot of open sorts of green spaces in between. For example, where we were going to walk out of the apartment, between our apartment into the one opposite us, there's like a big wild green space. (...) We are really close to that park. I think there's a lot of good green spaces.' (BP, age 20–39).

Parks' pedestrian connectivity with surrounding areas. Interview data highlighted the significance of pedestrian connectivity with the surrounding areas for residents' park use and social interactions. As an extension of the community park network, surrounding parks can provide richer choices for residents' activities, resulting in more social interactions. Respondents reported that they would extend their activities such as strolling, dog walking, having BBQs, children playing and so on, to surrounding parks. Most respondents agreed that walkability to the surrounding parks can increase their social interaction, especially with friends or close neighbours. Many respondents confirmed that going for walks with friends in the surrounding parks is a common form of exercise and social interaction for them. It was also common for residents to use BBQ facilities and have parties in surrounding parks. Furthermore, respondents also mentioned that their children met their friends to play in the surrounding parks, where additional amenities the facilities provided children more activity options and increased the probability of social interaction, as one BP resident stated:

'The parks connected the inside and outside of the community. The surrounding parks are also well connected. There are no fences and blocks separating Breakfast Point. We naturally walk around in the surrounding areas.' (BP, 40–59).

However, there were differences in the interview data between the two MPCs regarding the pedestrian connectivity to the surrounding areas. Almost all BP respondents highlighted the excellent pedestrian connectivity between BP and surrounding parks, allowing them to extend their activities to outside of BP seamlessly. Because many visitors of surrounding parks came from BP, residents maintained a good sense of socialization and community even in these external areas, as one BP respondent noted:

'There are two large parks in surrounding areas. We go there to have a BBQ with friends sometimes.' (BP, 40–59).

In comparison, LG respondents indicated that they need to cross traffic roads to access the surrounding parks, which raises safety concerns, especially for children. This non-connectivity affected their visiting parks in surrounding areas and social interactions. Some respondents noted that due to the absence of neighbour social ties in the surrounding parks, they had less social interaction than inside LG. As one LG respondent reported:

'I walk, talk, and have some social interactions there (in LG parks). But not in parks outside of Liberty Grove, as I don't know people there.' (LG, age 40–59).

In summary, the two cases examined in this study exhibit distinct characteristics in terms of pedestrian connectivity to the surrounding areas. BP, an open MPC with robust pedestrian connections to the surrounding public parks, facilitates extensive resident activities in these areas and fosters positive social interactions. By contrast, in LG, a symbolically gated MPC relatively isolated from the surrounding parks by traffic roads, social interactions in the surrounding areas for LG residents are significantly less.

Discussion

Interview data revealed three themes of community park use influencing social interactions among residents: (1) quality of park spaces, (2) pedestrian integration, and (3) pedestrian connectivity with surroundings.

Quality of park spaces. Interviews found five subthemes of quality of park spaces associated with social interaction, including rest spaces, recreation spaces, playgrounds, sport facilities, and nature spaces. Rest spaces in parks were the most common subtheme emerged in interviews, which highlights the significant role of rest spaces in parks in facilitating residents' social interactions in MPCs. This aligns with previous findings, which identified rest and seating areas as being associated with social interactions in neighbourhoods (Kazmierczak, 2013; Schmidt et al. 2019). The findings are consistent with that of Schmidt et al. (2019), which found that the use of park seating can benefit social interaction in neighbourhoods, especially among older residents. The rest spaces in community parks may provide opportunities for residents to engage in various forms of social interactions, including weak ties, strong ties social interaction, and community participation activities. Weak ties social interaction often occurs in these areas in community parks, such as sitting in the park to observe others, exchanging waves and greetings, or engaging in brief conversations, this aligns with Granovetter's (1973) weak ties theory. These casual interactions

contribute to residents' sense of neighbourhood involvement and contribute to their mental wellbeing, consistent with findings by Hickman (2013). In addition, the interviews also indicated that rest facilities in parks are commonly used for strong ties social interaction and community activities, such as sitting down for conversations with close neighbours, socialising with friends, and hosting group activities.

This research found that recreational areas (e.g., BBQ and picnic facilities), sports facilities, nature facilities, and children's playgrounds also influence residents' social interactions. These findings are consistent with Kaźmierczak (2013), who found children play facilities, activity spots, natural settings and recreational facilities positively impact social interaction among residents. The findings are also align with previous studies that identified nature factors associated with social interaction (Comstock et al. 2010).

The interviews suggested that the design of park spaces needs to take into account the diverse needs associated with different types of social activities' needs, which reflects the finds of (Yu et al. 2023). For example, the presence of shade in rest areas emerged as particularly crucial, which may be related to the sunny weather and high summer temperatures in Australia. Therefore, this study advocates for careful planning of MPCs, emphasizing the importance of the quantity and quality of rest facilities (e.g., location, provision of shading) to enhance the social sustainability in urban communities.

Parks' pedestrian integration. Interviews revealed that the parks' pedestrian integration plays a pivotal role in fostering residents' social interactions. This finding is consistent with Lund (2002), who found that residents walking within their local community are more likely to interact socially with neighbours to establish social bonds. Similar findings are reported by previous studies (Ebrahim, 2015; Kim and Kaplan, 2004; Talen, 2000).

Interviews of this study highlights the significance of a well-dispersed small parks in promoting parks' pedestrian accessibility and social wellbeing. This finding aligns with those of previous studies of Talen (2000), Ebrahim (2015), and Wang et al. (2023), which emphasised the importance of well-defined neighbourhood public open space with a clear centre and edges in fostering a sense of community and social interaction. This study shows that residents would often use some small parks dispersed between the block buildings due to their easy accessibility. This finding is consistent with that of Talen (Talen, 2000), which confirmed that small and frequent public open spaces are preferable to residents overlarge-sized public spaces.

This study shows that the integrated park network provides connected places where residents can engage in various walking activities, like exercise, dog walk or cycling. The ability to walk between parks may facilitate weak ties social interactions, which are consistent with Granovetter's (1973) weak ties theory. However, this finding contrasts with that of Schmidt et al. (2019), which found a negative association between walking and social interaction among the elderly in a study in Copenhagen. They explained that this might be because older adults' preference for sitting down during social activities.

Parks' pedestrian connectivity with surroundings. Interviews identified a strong association between pedestrian connectivity with surrounding areas and social interaction among neighbours. This finding is consistent with that of Abass et al. (2020), who found a positive association between neighbourhood connectivity

and social interaction in Australian suburbs. This study indicated that this might be attributed to well-connected surrounding parks, which can provide more opportunities for residents to extend their activities in surrounding spaces or parks. As a result, the residents may enhance their social interaction and sense of community.

The findings reflect of existing studies on Australian MPC, like Dowling and McGuirk (2005) which showed that neighbourhood connectivity is primarily influenced by social and spatial segregation issues rather than on safety concerns, as discussed by Newman (1972). The findings are consistent with Maller et al.'s (2016) findings in a study in Australia, which found that the lack of pedestrian connectivity with surrounding areas restricted most individual and social activities to the geographic boundaries of the MPCs. This perspective is also reported by Goodman and Douglas (2008), who noted that MPCs' open space and recreational facilities often seem 'relating to exclusivity, separation from the wider community' (p. 521). This study contends that this is not always the case. Enhancing pedestrian connectivity to the surrounding areas might offer a promising avenue to address the issue of spatial and social separation prevalent in MPCs.

COVID-19 impacts on park use and related social interaction.

This study highlights the importance of community parks in preserving people's social wellbeing amidst the pandemic. These results reflect several recent studies of Geng et al. (2021), Lopez et al. (2021) and Farkas et al. (2023) which found that parks, especially community parks, have become more important since the COVID-19 outbreak. A possible explanation for this is that people tend to visit nearby parks to connect with nature and others, helping to reduce the negative impacts during the COVID-19 lockdowns, such as stress, social isolation, and mental health issues. It has been reported in many studies recently, like Geng et al. (2021), Volenec et al. (2021), and Lopez et al. (2021).

One possible explanation for this is that people tend to visit nearby parks to connect with nature and others, helping to alleviate the negative effects of quarantine.

This study found that parks' recreation, sport, and nature spaces play crucial roles to benefit residents' social wellbeing during COVID-19, which is in accordance with the 'Classification Framework for Public Open Space' model (Rutherford et al. 2013). The results show that COVID-19 has intensified the inadequacy of facilities (e.g., BBQ, sports, and children's playgrounds) within both MPCs in meeting the diverse needs of residents across different age groups. The findings are consistent with Volenec et al. (2021) who found that increases in park visitation during COVID-19 were primarily driven by the lack of other recreational options. This study found many residents do more sports in parks during COVID-19, but the sports facilities are limited for residents use in two cases in this study. Because sports spaces provide opportunities for people's strong ties and weak ties social interactions, community parks may need to be designed to provide more spaces and facilities for recreational and team sports, this is also suggested by recent studies like Honey-Rosés et al. (2021). This study argues that MPC planning needs to consider the quality of park spaces which associated with weak ties social interaction, like sittings, playground parents' sitting areas, sports areas.

For park accessibility, this study found that dispersed small parks are more beneficial for improving accessibility and residents' social wellbeing during COVID-19, especially for apartment residents. This may be because people's demand for nearby parks has increased and been amplified by the pandemic,

especially for residents living in higher density areas, which is also reported by Li et al. (2023) and Park et al. (2022). Therefore, this paper argues that planning more dispersed small parks and connecting them to each other within the community would be more beneficial for enhancing residents' wellbeing. In addition, this study found that the connected park network contributes to promoting walking activities and weak ties social interaction during the COVID-19 pandemic. The accessibility issues of parks have received widespread attention in COVID-19 literature, like Lopez et al. (2021), Reyes-Riveros et al. (2021) Li et al. (2023). This is consistent with recent research findings of Honey-Rosés et al. (2021) and Lopez et al. (2021), which indicate a significant increase in the demand for parks' walk, running or bike spaces within communities.

The results emphasise the importance of parks' connectivity with surroundings for people's social interaction during COVID-19. This study therefore argues that being open and connecting with surrounding areas has a positive influence on residents' social wellbeing, which is consistent with recent findings of Reyes-Riveros et al. (2021).

This study highlights the value of parks' amenities for vulnerable people across different population groups during COVID-19, such as the elderly, children and youth, pregnant women, and people recovering from COVID-19, as reported by Yu et al. (2023) and Su et al. (2024). In particular, children and young people depend more on public open spaces for social interaction and recreation during COVID-19. This is consistent with many recent studies, like Honey-Rosés et al. (2021) and Park et al. (2022), who asserted that public open spaces are particularly significant for the elderly, children and women. This study agrees with Lopez et al. (2021)'s suggestion that future park planning and management should match the needs of the community across different populations to address inequality issues regarding the availability of parks.

Conclusions

This study highlights the significance of community parks in promoting positive social interactions among residents within urban communities during the COVID-19 pandemic. It shows how specific park-related factors influence social interaction in MPCs. The key findings can be summarised as follows:

- Social interaction is a significant reason why residents frequent community parks in MPCs.
- The presence of rest spaces in parks is crucial for enabling weak-ties and strong-ties social interactions.
- The attributes of recreation spaces, including playgrounds, sports facilities, and natural features within parks, are linked to enhanced social interactions in MPCs.
- An integrated network of parks significantly boosts community park usage and fosters social interactions among residents.
- Residents value small, easily accessible parks spread throughout their community.
- Pedestrian links to surrounding areas are closely tied to increased social interactions, providing residents with diverse activity options and fostering more casual social encounters with neighbours.

This study has made several original contributions to the field. Theoretically, this study tested the applicability of Granovetter's (1973) weak ties theory, integrating Berkman et al.'s (2000) social network system theoretical model and Talen's (2000) new urbanism theoretical model, within the context of Australian

MPCs. By providing empirical evidence that supports these theoretical models, the study has affirmed their relevance and demonstrated the theories' applicability in the Australian MPC setting. This validation is crucial for advancing our theoretical foundations in urban planning and community development. This research provides new insights on the complex relationship between people and their living environments in Australian MPCs, challenging the notion of MPCs as isolated entities and advocating for enhanced pedestrian connectivity to broader community areas. Practically, this study's examination of residents' perspectives on community park usage and their social activities within MPCs during the pandemic is both timely and relevant. It has shed light on how communities adapt and interact in response to external crises, such as a global pandemic. By offering valuable data and insights into residents' experiences during this unprecedented time, the research contributes to our understanding of resilience and adaptability within urban communities.

Based on these insights, the following planning strategies are recommended:

- Expand community parks to meet the rising demand for outdoor spaces, enhancing their accessibility to serve diverse communities effectively.
- Upgrade the amenities within parks, such as improving shade, sports facilities tailored for various ages, seating arrangements, and broader walking paths to promote residents' physical and social wellbeing.
- Develop more well-dispersed small parks and integrate them into a cohesive network, focusing on proximity to high-density residential areas.
- Foster open communities by enhancing park connectivity with the surrounding areas.

This study has two limitations. Firstly, there could be inter-related dynamics among the strong, weak, and absent ties. However, this study did not specifically examine the internal relationships among these three social ties. Future research is needed to explore the complex inter-related relationships among these ties. Secondly, due to this study only focusing on a limited number of cases, the findings can only be generalised to similar submarkets in Sydney. There is limited applicability of the findings to other residential contexts.

In conclusion, the study's multifaceted contributions to the close relationship between human interactions and community parks enhance the understanding of Australian MPCs and have broader implications for urban planning and development worldwide. Its findings offer practical and evidence-based insights for policymakers, urban planners, scholars, and developers engaged in urban community development. The qualitative dimension adds depth and context to the study's findings, making it a valuable resource for those interested in gaining a holistic perspective on urban community life. By uncovering the nuances of community dynamics, social networks, and the impact of external factors like pandemics, the research equips decision-makers with valuable information to inform their planning and development strategies. It can guide the creation of more vibrant, resilient, and sustainable urban communities. The results of the study suggest that enhancing pedestrian connectivity within park networks and improving the quality of diverse park amenities will be crucial for promoting positive social interactions among residents in urban communities. Certainly, the mechanisms of how social interaction in parks influence individuals' wellbeing remain to be elucidated, especially at the community level. Given the significance of community parks in promoting social and health

wellbeing, more further studies are needed to explore the complexed dynamics of human-environment relationships across different residential settings in the post-COVID era.

Data availability

The data supporting the findings of this study are included in this published article.

Received: 27 November 2023; Accepted: 30 October 2024;

Published online: 08 November 2024

References

- Abass ZI, Andrews F, Tucker R (2020) Socializing in the suburbs: Relationships between neighbourhood design and social interaction in low-density housing contexts. *J Urban Des* 25(1):108–133. <https://doi.org/10.1080/13574809.2019.1592663>
- ABS-a (2021) Australian Bureau of Statistics (Census 2021). Retrieved from <https://abs.gov.au/census/find-census-data/quickstats/2021/SAL10554>
- ABS-b (2021) Australian Bureau of Statistics (Census 2021). Retrieved from <https://abs.gov.au/census/find-census-data/quickstats/2021/SAL12324>
- Ahvenniemi H, Huovila A, Pinto-Seppä I, Airaksinen M (2017) What are the differences between sustainable and smart cities? *Cities* 60:234–245. <https://doi.org/10.1016/j.cities.2016.09.009>
- Alidoust S, Bosman C (2017) Master planned communities for the ageing population: how sociable are they? *Cities Health* 1(1):38–46. <https://doi.org/10.1080/23748834.2017.1393242>
- Alidoust S, Bosman C, Holden G (2018) Talking while walking: an investigation of perceived neighbourhood walkability and its implications for the social life of older people. *J Hous Built Environ* 33:133–150. <https://doi.org/10.1007/s10901-017-9558-1>
- Alidoust S, Bosman C, Holden G (2019) Planning for healthy ageing: how the use of third places contributes to the social health of older populations. *Ageing Soc* 39(7):1459–1484. <https://doi.org/10.1017/S0144686X18000665>
- Barnes JA (1954) Class and committees in a Norwegian island parish. *Hum Relat* 7(1):39–58. <https://doi.org/10.1177/001872675400700102>
- Benitez-Avila C, Schuberth F, Copeland S (2023) Mastery and social position: factors in negotiating urban social resilience. *Human Soc Sci Commun* 10(1):701. <https://doi.org/10.1057/s41599-023-02217-5>
- Berkman LF, Glass T, Brissette I, Seeman TE (2000) From social integration to health: Durkheim in the new millennium. *Soc Sci Med* 51(6):843–857. [https://doi.org/10.1016/S0277-9536\(00\)00065-4](https://doi.org/10.1016/S0277-9536(00)00065-4)
- Biddle N, Edwards B, Gray, M & Sallis K (2020) Mental health and relationships during the COVID-19 pandemic. ANU Centre for Social Research and Methods, Australian National University. <http://hdl.handle.net/1885/213189>
- Bott E (1971) Family and social network: roles, norms, and external relationships in ordinary urban families. Tavistock Publications
- Braun V, Clarke V (2006) Using thematic analysis in psychology. *Qual Res Psychol* 3(2):77–101. <https://doi.org/10.1191/1478088706qp063oa>
- Bronfenbrenner U (1992) Ecological systems theory. In: Six theories of child development: revised formulations and current issues. Jessica Kingsley Publishers, London. pp 187–249
- Cao X, Wu X, Yuan Y (2018) Examining built environmental correlates of neighborhood satisfaction: a focus on analysis approaches. *J Plan Lit* 33(4):419–432. <https://doi.org/10.1177/0885412218765443>
- Centers KT, Gómez E (2019) Exploring the relationship between an urban neighborhood park and psychological sense of community. *Recreat Parks Tour Public Health* 3(1):113–138. <https://www.muse.jhu.edu/article/811768>
- Cheshire L (2019) The limits to authority: developer interventions and neighbour problems on a master planned estate. *Hous Theory Soc* 36(1):92–111. <https://doi.org/10.1080/14036096.2017.1383933>
- Chitrakar RM (2016) Meaning of public space and sense of community: the case of new neighbourhoods in the Kathmandu Valley. *ArchNet-IJAR Int J Archit Res* 10(1):213. <https://doi.org/10.26687/archnet-ijar.v10i1.807>
- Comstock N, Dickinson LM, Marshall JA, Soobader M-J, Turbin MS, Buchenau M et al. (2010) Neighborhood attachment and its correlates: exploring neighborhood conditions, collective efficacy, and gardening. *J Environ Psychol* 30(4):435–442. <https://doi.org/10.1016/j.jenvp.2010.05.001>
- Dowling R, Atkinson R, McGuirk P (2010) Privatism, privatisation and social distinction in master-planned residential estates. *Urban Policy Res* 28(4):391–410. <https://doi.org/10.1080/08111146.2010.508870>
- Dowling R, McGuirk PM (2005) Situating master-planned estates. Paper presented at the Refereed Proceedings of the 2nd Bi-Annual National Conference on The State of Australian Cities, Brisbane, Australia. Griffith University. <https://ro.uow.edu.au/sspapers/2345>
- Ebrahim N (2015) Sense of community in new urbanism neighbourhoods: a review. *Open House Int* 40(4):25–29. <https://doi.org/10.1108/OHI-04-2015-B0005>
- Farahani L, Lozanovska M (2014) A framework for exploring the sense of community and social life in residential environments. *ArchNet-IJAR Int J Archit Res* 8(3):223–237. <https://hdl.handle.net/10536/DRO/DU:30069682>
- Farkas JZ, Hoyk E, de Moraes MB & Csomós G (2023) A systematic review of urban green space research over the last 30 years: a bibliometric analysis. *Heliyon* 9(2). <https://doi.org/10.1016/j.heliyon.2023.e13406>
- Francis J, Giles-Corti B, Wood L, Knuiman M (2012) Creating sense of community: the role of public space. *J Environ Psychol* 32(4):401–409. <https://doi.org/10.1016/j.jenvp.2012.07.002>
- Francis J, Giles-Corti B, Wood L, Knuiman M (2014) Neighbourhood influences on mental health in master planned estates: a qualitative study of resident perspectives. *Health Promot J Aust* 25(3):186–192. <https://doi.org/10.1071/HE14036>
- French S, Wood L, Foster S, Giles-Corti B, Frank L, Learnihan V (2014) Sense of Community and Its Association with the Neighborhood Built Environment. *Environ Behav* 46(6):677–697. <https://doi.org/10.1177/0013916512469098>
- Gardner PJ (2011) Natural neighborhood networks—important social networks in the lives of older adults aging in place. *J Aging Stud* 25(3):263–271. <https://doi.org/10.1016/j.jaging.2011.03.007>
- Geng D, Innes J, Wu W, Wang G (2021) Impacts of COVID-19 pandemic on urban park visitation: a global analysis. *J Forest Res* 32:553–567. <https://doi.org/10.1007/s11676-020-01249-w>
- Goodman R, Douglas K (2008) Privatised Communities: the use of owners corporations in master planned estates in Melbourne. *Aust Geogr* 39(4):521–536. <https://doi.org/10.1080/00049180802419229>
- Goodman R, Douglas K, Babacan A (2010) Master planned estates and collective private assets in Australia: research into the attitudes of planners and developers. *Int Plan Stud* 15(2):99. <https://doi.org/10.1080/13563475.2010.490666>
- Granovetter MS (1973) The strength of weak ties. *Am J Sociol* 78(6):1360–1380. <https://doi.org/10.1086/225469>
- Hagaman AK, Wutich A (2017) How many interviews are enough to identify metaphemes in multisited and cross-cultural research? Another perspective on Guest, Bunce, and Johnson's (2006) landmark study. *Field Methods* 29(1):23–41
- Han S, Song D, Xu L, Ye Y, Yan S, Shi F et al. (2022) Behaviour in public open spaces: a systematic review of studies with quantitative research methods. *Build Env Behav*. <https://doi.org/10.1016/j.buildenv.2022.109444>
- He J, Zhang Y, Yi Z (2023) Towards resilient neighbourhood governance: social tensions in Shanghai's gated communities before and during the pandemic. *Human Soc Sci Commun* 10(1):568. <https://doi.org/10.1057/s41599-023-02085-z>
- Henning C, Lieberg M (1996) Strong ties or weak ties? Neighbourhood networks in a new perspective. *Scand Hous Plan Res* 13(1):3–26. <https://doi.org/10.1080/02815739608730394>
- Hickman P (2013) “Third places” and social interaction in deprived neighbourhoods in Great Britain. *J Hous Built Environ* 28(2):221–236. <https://doi.org/10.1007/s10901-012-9306-5>
- Honey-Rosés J, Anguelovski I, Chireh VK, Daher C, Konijnendijk van den Bosch C, Litt JS et al. (2021) The impact of COVID-19 on public space: an early review of the emerging questions—design, perceptions and inequities. *Cities Health* 5(sup1):S263–S279. <https://doi.org/10.1080/23748834.2020.1780074>
- Hooper P, Foster S, Knuiman M, Giles-Corti B (2020) Testing the impact of a planning policy based on New Urbanist planning principles on residents' sense of community and mental health in Perth, Western Australia. *Environ Behav* 52(3):305–339. <https://doi.org/10.1177/0013916518798882>
- Każmierczak A (2013) The contribution of local parks to neighbourhood social ties. *Landsc Urban Plan* 109(1):31–44. <https://doi.org/10.1016/j.landurbplan.2012.05.007>
- Kenna T, Goodman R, Stevenson D (2017) Privatising the suburbs: examining the trends and implications of 20 years of private residential development in Sydney, Australia. *Geogr Res* 55(3):269–282. <https://doi.org/10.1111/1745-5871.12224>
- Kim HHS (2017) ‘Strength of weak ties’, neighborhood ethnic heterogeneity, and depressive symptoms among adults: a multilevel analysis of Korean general social survey (kgss) 2012. *Soc Sci* 6(2):65. <https://doi.org/10.3390/socsci6020065>
- Kim J, Kaplan R (2004) Physical and psychological factors in sense of community: new urbanist Kentlands and nearby Orchard Village. *Environ Behav* 36(3):313–340. <https://doi.org/10.1177/0013916503260236>
- Lauwers L, Leone M, Guyot M, Pelgrims I, Remmen R, Van den Broeck K et al. (2021) Exploring how the urban neighborhood environment influences

- mental well-being using walking interviews. *Health Place* 67:102497. <https://doi.org/10.1016/j.healthplace.2020.102497>
- Li L, Li X, Niu N, He J (2023) Uneven impacts of COVID-19 on residents' utilization of urban parks: a case study of Guangzhou, China. *Appl Geogr* 153:102905. <https://doi.org/10.1016/j.apgeog.2023.102905>
- Lopez B, Kennedy C, Field C, McPhearson T (2021) Who benefits from urban green spaces during times of crisis? Perception and use of urban green spaces in New York City during the COVID-19 pandemic. *Urban Forest Urban Green* 65:127354. <https://doi.org/10.1016/j.ufug.2021.127354>
- Lund H (2002) Pedestrian environments and sense of community. *J Plan Educ Res* 21(3):301–312. <https://doi.org/10.1177/0739456x0202100307>
- Maller C, Nicholls L, Strengers Y (2016) Understanding the materiality of neighbourhoods in 'healthy practices': outdoor exercise practices in a new Master-planned Estate. *Urban Policy Res* 34(1):55–72. <https://doi.org/10.1080/08111146.2015.1081846>
- McGuirk P, Dowling R (2011) Governing social reproduction in masterplanned estates: urban politics and everyday life in Sydney. *Urban Stud* 48(12):2611–2628. <https://doi.org/10.1177/0042098011411950>
- 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. <https://doi.org/10.1016/j.cities.2016.11.007>
- NatureSustainability (2020) Make the most of qualitative research. *Nat Sustain* 3(2):73–73. <https://doi.org/10.1038/s41893-020-0482-0>
- Newman O (1972) *Defensible space: crime prevention through urban design*. Macmillan, New York
- Oldenburg R (1989) *The great good place: cafés, coffee shops, community centers, beauty parlors, general stores, bars, hangouts, and how they get you through the day*. Paragon House Publishers
- Park AH, Zhong S, Yang H, Jeong J & Lee C (2022) Impact of COVID-19 on physical activity: a rapid review. *J Glob Health* 12. <https://doi.org/10.7189/jogh.12.05003>
- Pira M (2021) A novel taxonomy of smart sustainable city indicators. *Human Soc Sci Commun* 8(1):197. <https://doi.org/10.1057/s41599-021-00879-7>
- Putnam R (2001) Social capital: measurement and consequences. *Can J Policy Res* 2(1):41–51
- Reyes-Riveros R, Altamirano A, De La Barrera F, Rozas-Vásquez D, Vieli L, Meli P (2021) Linking public urban green spaces and human well-being: a systematic review. *Urban Forest Urban Green* 61:127105. <https://doi.org/10.1016/j.ufug.2021.127105>
- Rogers GO, Sukolratnametee S (2009) Neighborhood design and sense of community: comparing suburban neighborhoods in Houston Texas. *Landsc Urban Plan* 92(3–4):325–334. <https://doi.org/10.1016/j.landurbplan.2009.05.019>
- Rosenblatt T, Cheshire L, Lawrence G (2009) Social interaction and sense of community in a master planned community. *Hous Theory Soc* 26(2):122–142. <https://doi.org/10.1080/14036090701862484>
- Rutherford J, Carter M, Christidis K (2013) Classification framework for public open space. *Australas Parks Leis* 16(1):34–36. <https://search.informit.org/doi/10.3316/informit.291049567067960>
- Salmons J (2016) *Cases in online interview research*. SAGE, Los Angeles
- Schmidt T, Kerr J, Schipperijn J (2019) Associations between neighborhood open space features and walking and social interaction in older adults—a mixed methods study. *Geriatrics (Basel)* 4(3):41. <https://doi.org/10.3390/geriatrics4030041>
- Smith P (2020) Governmentality and resident experience in an eco-themed master-planned estate. *Geogr Res* 58(3):226–239. <https://doi.org/10.1111/1745-5871.12408>
- Somanath S, Hollberg A, Thuvander L (2021) Towards digitalisation of socially sustainable neighbourhood design. *Local Environ* 26(6):770–789. <https://doi.org/10.1080/13549839.2021.1923002>
- Su Y, Zhang X, Xuan Y (2024) Linking neighborhood green spaces to loneliness among elderly residents—A path analysis of social capital. *Cities* 149:104952. <https://doi.org/10.1016/j.cities.2024.104952>
- Swierad EM, Huang TT (2018) An exploration of psychosocial pathways of parks' effects on health: a qualitative study. *Int J Environ Res* 15(8):1693. <https://doi.org/10.3390/ijerph15081693>
- Talen E (2000) Measuring the public realm: a preliminary assessment of the link between public space and sense of community. *J Archit Plan Res* 17(4):344–360. <https://www.jstor.org/stable/43030552>
- Thompson C (2013) Master-planned estates: privatization, socio-spatial polarization and community. *Geogr Compass* 7(1):85–93. <https://doi.org/10.1111/gec3.12021>
- UN-Habitat (2020) *Public space site-specific assessment: guidelines to achieve quality public spaces at neighbourhood level*
- Volenc ZM, Abraham JO, Becker AD, Dobson AP (2021) Public parks and the pandemic: How park usage has been affected by COVID-19 policies. *PLoS ONE* 16(5):e0251799. <https://doi.org/10.1371/journal.pone.0251799>
- Wang K & Ke Y (2024) Social sustainability of communities: a systematic literature review. *Sustain Product Consumpt*. <https://doi.org/10.1016/j.spc.2024.04.031>
- Wang X, Ouyang L, Lin J, An P, Wang W, Liu L et al. (2023) Spatial patterns of urban green-blue spaces and residents' well-being: the mediating effect of neighborhood social cohesion. *Land* 12(7):1454. <https://doi.org/10.3390/land12071454>
- Warner E, Andrews FJ (2019) Surface acquaintances": parents' experiences of social connectedness and social capital in Australian high-rise developments. *Health Place* 58:102165. <https://doi.org/10.1016/j.healthplace.2019.102165>
- Weijs-Perrée M, van Den Berg P, Arentze T, Kemperman A (2015) Factors influencing social satisfaction and loneliness: a path analysis. *J Transp Geogr* 45:24–31. <https://doi.org/10.1016/j.jtrangeo.2015.04.004>
- Xian Z, Nakaya T, Liu K, Zhao B, Zhang J, Zhang J et al. (2024) The effects of neighbourhood green spaces on mental health of disadvantaged groups: a systematic review. *Human Soc Sci Commun* 11(1):488. <https://doi.org/10.1057/s41599-024-02970-1>
- Yang C, Shi S, Runeson G (2023) Towards sustainable urban communities: investigating the associations between community parks and place attachment in master-planned estates in Sydney. *Sustain Cities Soc* 96:104659. <https://doi.org/10.1016/j.scs.2023.104659>
- Yu L, Zhao P, Tang J, Pang L, Gong Z (2023) Social inequality of urban park use during the COVID-19 pandemic. *Human Soc Sci Commun* 10(1):423. <https://doi.org/10.1057/s41599-023-01918-1>
- Zhao P, Gao Y (2023) Discovering the long-term effects of COVID-19 on jobs-housing relocation. *Human Soc Sci Commun* 10(1):633. <https://doi.org/10.1057/s41599-023-02155-2>
- Zhu Y, Fu Q (2017) Deciphering the civic virtue of communal space: neighborhood attachment, social capital, and neighborhood participation in urban China. *Environ Behav* 49(2):161–191. <https://doi.org/10.1177/0013916515627308>

Acknowledgements

Open access funding was provided by Guangzhou Sci-tech Innovation Committee (201807010034).

Author contributions

Chunyan Yang: conceptualization, methodology, literature review, data collection, data analysis, data curation, investigation, software, visualization, writing (original draft) and writing (revising and editing). Song Shi: conceptualization, methodology, revising, editing and supervision. Goran Runeson: conceptualization, methodology, revising, editing and supervision. Duanfang Lu: conceptualization, methodology, revising and editing.

Competing interests

The authors declare no competing interests.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The ethics approval was obtained by the Human Research Ethics Committee of the University of Technology Sydney (Approval NO. ETH21-6087, Approval date: 13 July 2021). Due to COVID-19 restrictions during 2021–2022, an additional ethics amendment approval was obtained from the Human Research Ethics Committee of the University of Technology Sydney to change the data collection method from face-to-face to Zoom or online interviews (Approval No. ETH21-6736, Approval date: 14 December 2021). The ethics approval and its amendment covered all aspects of the study, including participant recruitment, methodologies, data collection and analysis. All procedures were conducted in line with these regulations to ensure the protection of participants' rights, confidentiality, and informed consent throughout the research.

Informed consent

Written informed consent was obtained from all participants through the Qualtrics platform prior to their participation in the study. The informed consent process was conducted from December 2021 to June 2022 by the research team, in accordance with the ethical standards. All participants were provided with clear information about the study's objectives, procedures, potential risks (low risks), and participants' rights,

highlighting the voluntary nature of participation and the right to withdraw at any time during the study. Participants were assured that their anonymity and confidentiality would be strictly protected, and that any publications would be fully anonymous. As a token of appreciation, participants who completed the interview received an AUD 30 (approximately USD 20) gift card for Woolworths supermarket to thank them for their time. This gift was provided solely as a gesture of gratitude and was approved by the Human Research Ethics Committee of the University of Technology Sydney in the ethics approvals of this study.

Additional information

Correspondence and requests for materials should be addressed to Chunyan Yang.

Reprints and permission information is available at <http://www.nature.com/reprints>

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Open Access This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

© The Author(s) 2024