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The impact of the built environment on loneliness: A systematic review and narrative synthesis

Marlee Bower [a], Jennifer Kent [b,*], Roger Patulny [d], Olivia Green [a], Laura McGrath [e], Lily Teesson [a], Tara Jamalishahni [f], Hannah Sandison [b], Emily Rugel [c]

[a] The Matilda Centre for Research in Mental Health and Substance Use, The University of Sydney, Australia
[b] The University of Sydney School of Architecture, Design, and Planning, The University of Sydney, Australia
[c] Westmead Applied Research Centre, The University of Sydney, Australia
[d] Faculty of the Arts, Social Sciences, and Humanities, University of Wollongong, Australia
[e] Faculty of Arts and Social Sciences, The Open University, Milton Keynes, England; UK
[f] The Centre for Urban Research, RMIT University, Australia

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ABSTRACT

Loneliness is a pressing public health issue. Although quintessentially individual, it is shaped by wider environmental, cultural, socio-economic, and political circumstances. Using a systematic review methodology, this paper draws on interdisciplinary research to conceptualise the relationship between the built environment and loneliness. We present a narrative synthesis of 57 relevant studies to characterise the body of evidence and highlight specific built-environment elements. Our findings demonstrate the need for further conceptual and empirical explorations of the multifaceted ways in which built environments can prevent loneliness, supporting calls for investment into this public-health approach.

1. Introduction

Loneliness has severe negative impacts on health (de Jong Gierveld et al., 2006), with an associated mortality on par with chronic alcohol use and regular smoking (Holt-Lunstad et al., 2015). Loneliness has been linked to a range of adverse physical outcomes, including cardiovascular disease and immune deficiency, as well as to psychological outcomes such as depression, suicide and cognitive decline (Hawkley and Cacioppo, 2010; Lauder et al., 2004; Marangoni and Ickes, 1989; Pressman et al., 2005). International evidence also suggests lonely people use medical services more regularly than their non-lonely counterparts (Geller et al., 1999) and extreme loneliness predicts premature admission to full-time aged care (Russell et al., 1977).

The condition of loneliness is quintessentially individual. Its diagnosis is based on individual perceptions, with treatment based on specific symptoms. Yet, like so many contemporary public-health issues, loneliness is impacted by broader structural, cultural, socio-economic, and political circumstances. Here, we apply an interdisciplinary lens to conceptualise the relationship between one critical factor, the built environment, and loneliness. This effort complements recent reviews on greenspace and loneliness (Astell-Burt et al., 2022a) and on interventions to prevent and treat loneliness (Hsueh et al., 2022) by exploring comprehensive theoretical and empirical connections.

Our principal objective is to systematically review and critically appraise the literature, aligning specific research findings with broader theoretical understandings to develop recommendations for research and practice. To this end, we begin by defining both 'loneliness' and the 'built environment' as constructs before delving into theoretical intersections between the two.

Loneliness can be defined as an averse emotional response occurring when a person feels their current social relationships are inadequate for their needs (Peplau and Perlman, 1981). Recognising the harms of loneliness, scholarly and policy attention has turned to developing a better understanding of its determinants, including the ways wider environments shape experiences such as interaction and belonging (United Kingdom Government, 2018). Although not generally applied explicitly, this attention aligns with the social determinants of health framework (Marmot and Wilkinson, 2005), which describes how individual health is shaped by socio-economic, cultural, and built-environment factors.

In this study, we draw explicitly from Roof and Oleru (2008), who define the built environment as "human-made space(s) in which people live, work and recreate on a day-to-day basis" (p. 24). This includes

* Corresponding author. ; The University of Sydney School of Architecture, Design and Planning, The University of Sydney, Camperdown, NSW, 2006, Australia.
E-mail address: Jennifer.kent@sydney.edu.au (J. Kent).

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areas designated for specific uses—such as homes, workplaces, and recreational infrastructure—and the surrounding urban and natural spaces. Although the built environment's impact on physical health is well-studied and increasingly understood by policymakers (Giles-Corti et al., 2022), less is known about the ways in which built environments influence mental health (Hoisington et al., 2019). Recent psychological research, predominantly within environmental and community psychology, has focused on clarifying the psychological and social processes the built environment supports or threatens, including feelings of connection, belonging, and loneliness (McGrath and Reavey, 2018). In complementary work, research on connections among urban planning, transport, and health also considers the impact of these structures on social interaction, inclusivity, and belonging (Boniface et al., 2015; Kent and Thompson, 2014). Although this research offers significant empirical and conceptual contributions, we still lack common understandings and communication tools connecting psychology and the built environment (Kent and Thompson, 2012).

Recognising this gap, there has been increased attention to the ways in which built environments can prevent or attenuate experiences of loneliness, resulting in newly developed research in need of review. There is a pressing need to summarise this broad body of literature to clarify theoretical conceptualisations and develop practical recommendations. This paper aims to fill this gap via a systematised review of the literature that elucidates the overall relationship between the built environment and subjective experiences of loneliness or social isolation. We identify specific elements of both the structured and lived built environments that impact these outcomes and which have particular relevance to policy and planning.

2. Methods

This study follows the reporting guidance in the 'Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA)' 2020 statement (Page et al., 2021). It was pre-registered with the International Prospective Register of Systematic Reviews on October 7, 2020 and accepted for inclusion on January 11, 2021 (PROSPERO: [reference removed for review]).

The review aimed to explore two distinct, but related, research questions:

1 What structural elements of the built environment impact loneliness?
2 What is the relationship between the built environment and loneliness?

2.1. Eligibility criteria

Studies were eligible if they reported empirical quantitative or qualitative data on the built environment and *subjective* experiences of loneliness or social isolation in a peer-reviewed, English-language publication. Using a PECO (population, exposure, comparator, and outcomes) framework, the population of interest was individuals aged 18+, although studies that included some younger participants were also eligible. Studies examining transitory populations, such as students or migrants, were similarly eligible.

In terms of exposures, some aspect of the built environment was required to be a primary focus of each study. The definition of 'built environment' described in this paper's introduction was operationalised so that the search included articles assessing any permanent but potentially modifiable component of a neighbourhood or community, comprising internal and external features, public and private spaces, daily movement (e.g., public transit), and technological aspects (e.g., smart information boards). Because we aimed to inform neighbourhood- or community-level urban research and policy, studies solely based in an institution, such as a hospital or residential-care facility, were excluded. Qualitative studies were not required to examine specific elements of the built environment explicitly; however, quantitative studies that failed to examine exposure to specific elements (or exposure levels) were excluded.

Our primary outcomes of interest were *subjective* experiences of loneliness or social isolation, meaning studies that defined isolation objectively (e.g., fewer than ten friends) were ineligible. In quantitative studies, subjective loneliness and/or isolation was typically measured via a question or scale, such as the UCLA Loneliness Scale. In qualitative studies, loneliness and/or isolation was required to represent a significant aspect of inquiry within interviews or focus groups. For our narrative synthesis, studies were initially grouped by specific aspect(s)—such as housing design, natural spaces, and public amenities—before being grouped into two broader categories: 1) the structured environment; and 2) the lived environment.

2.2. Information sources and search strategy

A systematic search of the Scopus (Elsevier), Web of Science (Clarivate), Ovid PsycINFO, Ovid MEDLINE, Embase (Elsevier), CINAHL (EBSCOHost), and ProQuest Central databases was conducted between 1 September and September 30, 2020 using bespoke, database-specific Boolean search queries (see Table 1). To ensure our findings reflected the most-recent evidence, this search was repeated in November 2021.

Reflecting growing sophistication in this field of research, the search was limited to studies published after January 2000. In addition, database results were supplemented by cross-checking references in recent and key publications to identify peer-reviewed articles that had not yet been indexed, as well as potentially relevant grey literature.

2.3. Selection process

Identified studies were exported into EndNote to combine results from distinct databases and remove duplicates. Titles and abstracts were screened in Covidence (Veritas Health Innovation; Melbourne, VIC, Australia) by a single reviewer before full-text articles were independently assessed for eligibility by two reviewers, with any disagreements resolved by a third. Among the 8909 records identified in the original search (plus 21 found via citation-tracking), 952 were included in the full-text review, with 57 papers included in our final analyses (see Fig. 1).

2.4. Data collection process, data items, and effect measures

Study details were independently extracted by two reviewers using a bespoke extraction form. The form was initially piloted by four team members before undergoing an iterative development process, resulting in the inclusion of items capturing: 1) publication details; 2) study design; 3) participants; 4) loneliness and social isolation measures; 5) built-environment elements; 6) methods; 7) results; and 8) other (see Table S1 for the complete form).

2.5. Study risk-of-bias assessment

Each study's quality and risk of bias were assessed independently by

Table 1
Search terms used for the systematic search in Scopus.

Main keywords	Search terms
Built environment	"third place[a]" OR "neighbo[a]rhood" OR "public space" OR "green space[a]" OR "blue space[a]" OR street OR housing OR "living arrangement[a]" OR residence OR walkability OR "built environment" OR liveability OR "urban environment[a]" OR "urban planning" OR "rural environment" OR accessibility OR architecture
Loneliness	AND lonel[a] OR "social??isolat[a]"

[a] Truncation symbol used to search all possible variations.

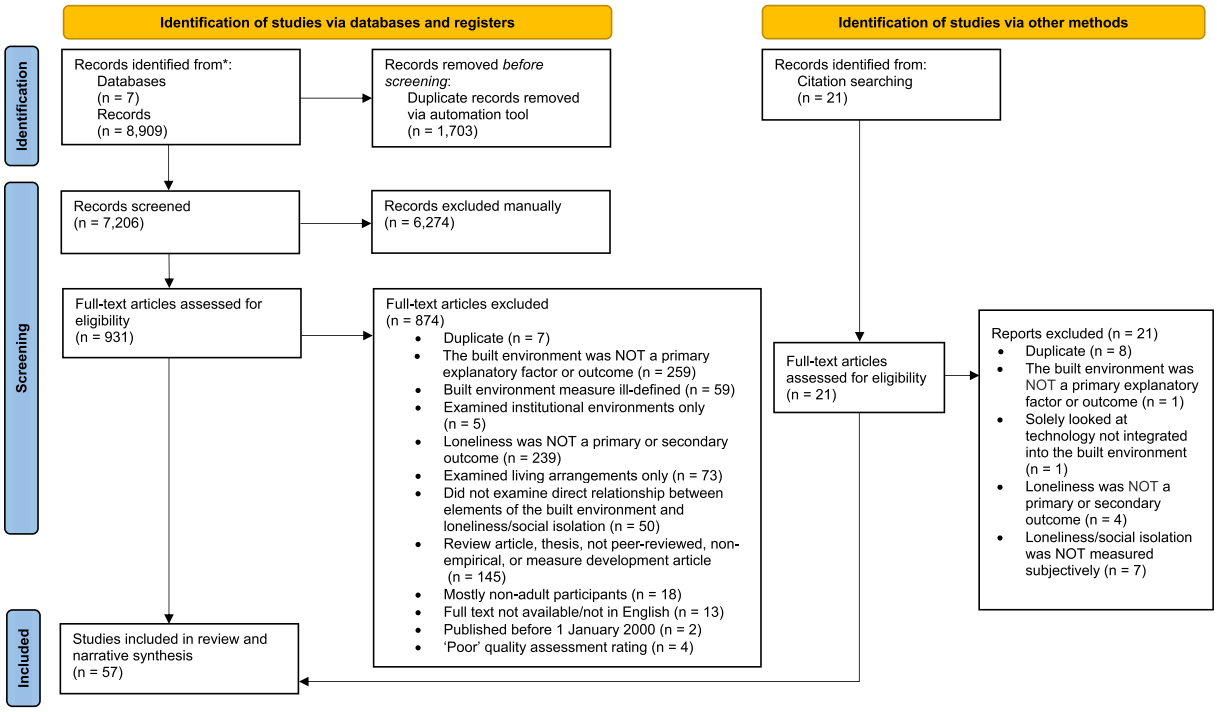

Fig. 1. PRISMA flow diagram.

two reviewers using bespoke assessment tools, with versions separately developed for quantitative and qualitative studies. The quantitative tool was based on the Downs and Black Quality Index (1998), as amended by Ferro and Speechley (2009), as well as on the NHLBI Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies (NHLBI, 2021). The qualitative tool's design was based on the CASP Qualitative Appraisal Tool (CASP, 2018). Mixed-methods studies were appraised via both tools; additional details on each are reported in Tables S2 and S3. Reviewers provided a quality rating of poor, fair, or good for each individual element. Discrepancies between ratings for a specific element were resolved by deferring to the higher level of bias; differences in the overall study rating were discussed by both reviewers to reach consensus.

2.6. Synthesis methods, reporting bias, and certainty assessment

Due the varied nature of studies, encompassing both quantitative and qualitative methods, a narrative synthesis approach was used to summarise key outcomes. Studies that received a quality rating of poor (n = 5) were removed from analyses. A table summarising the study details, risk-of-bias and quality appraisals, relationships between the built environment and loneliness and/or social isolation, and any policy or planning recommendations was prepared before establishing a set of preliminary groupings. Although the protocol countenanced sensitivity analyses based on demographic subgroups, no individual built-environment element was reported across enough studies examining subgroups to conduct this step. Next, reviewers with the greatest expertise in specific built-environment elements created a draft summary of relevant findings, paying attention to overall quality, potential heterogeneity (e.g., variation in definitional metrics or outcome scales), and concerns about reporting or bias. Finally, the full review team refined the approach to categorising findings, delved more deeply into the results, and developed recommendations with application to the fields of urban planning, public health, and community psychology.

3. Results

3.1. Study characteristics and risk of bias

The final 57 studies were published between 2002 and 2022. Seventeen used qualitative methods, 36 used quantitative methods, and four were mixed-methods. Among quantitative studies, sample sizes ranged from 120–13,828 participants, with an average of 1144 (two studies did not report a sample size). Participant ages ranged from 12 to 101, with a mean of 28–83 among those reporting this statistic (45%). Just over half of studies examined older adults, defined as ages 50+ (n = 13) to 60–70+ (n = 17). The remaining half examined loneliness across the adult lifespan, with two enrolling young adults (18+) and ten failing to report an age range. Among studies detailing participants' gender (81%), 35–100% of participants were women (median = 58%). Complete details on participant characteristics are captured in Table 2, along with each study's design, measures, outcomes, results, and quality.

Studies ranged in design and methodology: 32 were cross-sectional, three were comparison-group, and three cohort; none used randomised controlled trials or pre/post designs. Most took place in nations belonging to the Organisation for Economic Co-operation and Development (OECD): 26 from Europe/United Kingdom, 17 from North America, and four from Oceania. Among the remainder, three were from East Asia, two from Southeast Asia, two from Sub-Saharan Africa, one from South America, and one from the Middle East and North Africa. There were no studies from South Asia. One study spanned Europe and North America.

Mixed understandings of loneliness have translated into diverse measurement approaches across disciplines, a heterogeneity reflected in our findings. The most used loneliness measure, the UCLA-R Loneliness Scale, is unidimensional (Russell, 1996), although researchers have reported it often shows multidimensional structure (Cramer and Barry, 1999). Some included loneliness measures can generate both unidimensional and multidimensional scores (e.g., the de Jong Gierveld Loneliness Scale); others, multidimensional loneliness scores alone (e.g., the Social and Emotional Loneliness Scale). In all, 16 studies measured loneliness using a version of the UCLA-R Loneliness Scale, nine via a

Table 2
Selected characteristics of included studies.

Author (Date)	Study Location	Sample Size	Participant Characteristics	Study Design	Loneliness Measurement	Built Environment Measurement	Outcomes	Results	Overall Quality Rating
Abrams et al. (2019)	Scotland	NR	100% Female; Mean Age: NR, Range: NR	Qualitative	Interviews	Experiences living in high-rise apartments	Social isolation; Economic dependence	Women in high-rise apartments found it difficult to maintain social networks and form new friendships	Fair
Abshire et al. (2022)	Washington State, USA	616	NR% Female; Mean Age: NR, Range: 18-96	Quantitative; Cross-sectional	UCLA Loneliness Scale (20 items)	Rural or urban areas via governmental classification scheme	Loneliness	Risk of loneliness did not depend on rurality	Good
Astell-Burt et al. (2022a)	Australia	8049 overall; 6766 for loneliness	54% Female; Mean Age: NR, Range: 15–75+	Quantitative; Cohort	"I often feel very lonely" (Likert-scale)	Greenspace percentage near residence	Incident loneliness; Relief from loneliness	No direct relationship between greenspace and loneliness	Good
Bergefurt et al. (2019)	The Netherlands	200	73% Female; Mean Age: NR, Range: 18–65+	Quantitative; Cross-sectional	UCLA Loneliness Scale (3-items)	Neighbourhood Environment Walkability Scale (4 items); Frieling's social cohesion index (7 items)	Loneliness; Life satisfaction	People who use public spaces are less likely to feel lonely	Good
Bower et al. (2021)	Australia	2065	66% Female; Mean Age: 44, Range: 18-88	Mixed-methods; Cross-sectional	de Jong Gierveld Loneliness Scale (6 items)	Questions adapted from Australian Housing Conditions dataset; Neighbourhood Belonging Scale (7 items)	Loneliness; Anxiety; Depression	Housing affected loneliness across neighbourhood demographics and environments; Participants reported that feeling disconnected from neighbours was connected to loneliness	Good
Cao et al. (2020)	USA	346	64% Female; Mean Age: 65, Range: 50-100	Quantitative; Cross-sectional	"I frequently feel disconnected from my community" (Likert-scale)	Study-specific questions on access to public spaces and accessibility	Disconnection from community	Older adults with access to ramps to enter buildings experience less loneliness	Good
Chen and Gong (2022)	China	3229	49% Female; Mean Age: 51, Range: 18-75	Quantitative; Cross-sectional	Chinese version of de Jong Gierveld Loneliness Scale (6 items)	Population density; Neighbourhood types	Emotional loneliness; Social loneliness	Population density and tenure of the town associated with loneliness; Participants from towns with higher GDP were less lonely	Good
Choi et al. (2008)	USA	65	77% Female; Mean Age: 825, Range: 65-99	Qualitative	Interviews	Housing tenure and type; Rurality	Depression; Loss of independence; Social isolation; Loneliness	Residents of nursing homes reported increased feelings of loneliness via a lack of privacy and autonomy; Rural residents experienced less loneliness	Good
Cimino et al. (2020)	Canada	30	36% Female; Mean Age: 62, Range: 24-88	Qualitative	Interviews	Neighbourhood accessibility	Perceived social isolation; Loneliness	Participants reported that a lack of accessibility to public spaces, a lack of public transport, and a lack of public services to deal with weather conditions resulted in loneliness	Good
Cotter et al. (2012)	Ireland	163	58% Female; Mean Age: 73, Range: NR	Qualitative; Comparison-group	NR	State of residence and heating use	Loneliness; Mental health; Social wellbeing	Older people who reported that their homes were too cold were more likely to report loneliness	Fair
Domènech-Abella et al. (2020)	Poland, Finland, Spain	5912	55% Female; Mean Age: NR, Range: 50+	Quantitative; Cross-sectional	UCLA Loneliness Scale	Courage Built Environment questionnaire (CBE-SR) (5 items)	Depression; Loneliness	Greater neighbourhood walkability related to lower levels of loneliness	Good
Domènech-Abella et al. (2021)	Belgium	869	49% Female; Mean Age: 75, Range: 60+	Quantitative; Cross-sectional	de Jong Gierveld Loneliness Scale	Neighbourhood Environment Walkability Scale (4 items)	Mental health; Social loneliness; Emotional loneliness	Loneliness was mediated by accessibility, social cohesion and participation, and safety	Good
El-Bialy and Mulay (2015)	Canada	10	50% Female; Mean Age: NR, Range: NR	Qualitative	Interviews	Resettlement in an urban centre	Social isolation; Safety	Participants reported culture shock and feelings of isolation after moving, but reported the small size of new community supported feelings of	Good

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Table 2 (*continued*)

Author (Date)	Study Location	Sample Size	Participant Characteristics	Study Design	Loneliness Measurement	Built Environment Measurement	Outcomes	Results	Overall Quality Rating
								familiarity and safety following initial adjustment period	
Fagan and Trudeau (2014)	USA	152	100% Female; Mean Age: NR, Range: NR	Mixed-methods; Cross-sectional	Sense of Community Scale	Neighbourhood accessibility	Division of labour; Sense of community	Accessible community spaces decrease burden of domestic labour on women, reducing loneliness	Good
Finlay et al. (2020)	USA	38	70% Female; Mean Age: 71, Range: 55-92	Qualitative	Interviews	Neighbourhood accessibility	Safety and comfort; Service access; Social connection; Stimulation	Participants reported that living farther from family and friends and lacking links to physical environment increased loneliness	Good
Finlay and Kobayashi (2018)	USA	124	69% Female; Mean Age: 72, Range: 55-93	Mixed-methods; Cross-sectional	"Do you feel lonely?" (yes or no)	Neighbourhood Design Characteristics Checklist	Social isolation; Loneliness	Living in large, isolated, suburban homes far from family and friends related to greater feelings of loneliness	Good
Gibney et al. (2019)	Ireland	10,540	NR% Female; Mean Age: NR, Range: NR	Quantitative; Cross-sectional	UCLA Loneliness Scale (5 items)	WHO age-friendly indicators	Loneliness	Participants who had difficulty walking or accessing social services or public transport had greater loneliness	Good
Gibney et al. (2020)	Ireland	2094	55% Female; Mean Age: NR, Range: 55+	Quantitative; Cross-sectional	UCLA Loneliness Scale (5 items)	Age-friendly Urban Index (AFUI) (3 items)	Quality of life; Social wellbeing	Participants living in age-friendly neighbourhoods were less likely to report loneliness	Good
Grenier et al. (2021)	Canada	65	NR% Female; Mean Age: NR, Range: 60-96	Qualitative	Interviews; Focus groups	Neighbourhood accessibility	Social isolation	Fears of safety and lack of public services, accessibility to public places, and affordable rent contributed to loneliness	Good
Hagan (2020)	Northern Ireland	11	91% Female; Mean Age: 81, Range: 62-87	Qualitative; Cross-sectional	Interviews	Access to public transport	Loneliness	Participants reported use of community-transport bus reduced feelings of loneliness via increased mobility and a place to make friends	Good
Kalina (2021)	South Africa	NR	NR% Female; Mean Age: NR, Range: NR	Qualitative; Cross-sectional	Focus groups; Group drawing exercises	Subsidised aged housing	Qualitative interviews	Buildings that prevented people from personalising space, lacked sufficient space, or were poorly lit increased loneliness	Good
Kearns et al. (2015)	Scotland	4302	58% Female; Mean Age: NR, Range: 40+	Quantitative; Cross-sectional	Loneliness frequency	Study-specific questions on housing type and neighbourhood physical and service/amenity components; Social dimensions of local environment	Loneliness	Housing type was not significantly associated with loneliness after adjusting for sociodemographics	Good
Kemperman et al. (2019)	The Netherlands	182	56% Female; Mean Age: NR, Range: 65+	Quantitative; Cross-sectional	de Jong Gierveld Loneliness Scale (6 items)	Study-specific questions on neighbourhood attachment (7 items)	Loneliness	Neighbourhood attachment directly related to loneliness; Satisfaction with neighbourhood safety and amenities indirectly related to loneliness; No relationship between distance to greenspace and loneliness	Good
Kim and Clarke (2015)	USA	965	72% Female; Mean Age: NR, Range: 55+	Quantitative; Cross-sectional	Minimum Data Set for Home Care (MDS-HC) assessment tool	Neighbourhood physical disorder index created via virtual audit	Social isolation with distress; Social isolation without distress	Neighbourhood physical disorder not associated with loneliness	Good
Kowitt et al. (2020)	USA	1697	68% Female; Mean Age: 68, Range: 50-95	Quantitative; Cross-sectional	Strong Ties scale (Dean and Lin, 1977)	Social Cohesion and Trust Scale (5 items); Walking and Exercise Environment scale (11 items);	Depressive symptoms	Social cohesion, resources, walkability, and safety were associated with loneliness, which mediated relationship with depressive symptoms	Good

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Table 2 (*continued*)

Author (Date)	Study Location	Sample Size	Participant Characteristics	Study Design	Loneliness Measurement	Built Environment Measurement	Outcomes	Results	Overall Quality Rating
						Study-specific questions on perceived neighbourhood safety (3 items)			
Lai et al. (2016)	Malaysia	613	71% Female; Mean Age: NR, Range: NR	Quantitative; Cross-sectional	Social Connectedness Scale	Global age-friendly cities checklist (5 items); Internet usage scale	Social connectedness; Age-friendly environment	Age-friendliness linked to lower levels of loneliness	Fair
Lee and Tan (2019)	USA	305	47% Female; Mean Age: 76, Range: 65–85+	Quantitative; Cross-sectional	Friendship Scale (Hawthorne, 2008)	Neighbourhood Environment Walkability Scale; Study-specific questions on third places (3 items)	Social support network; Loneliness	Access to third places or local amenities not associated with loneliness	Good
Maas et al. (2009)	The Netherlands	10,089	55% Female; Mean Age: NR, Range: 12–65+	Quantitative; Cross-sectional	UCLA Loneliness Scale (6 items)	Greenspace percentage within 1–3 km of home; Urbanicity level	Loneliness; Social support; Contact with neighbours and friends	Greater greenspace associated with less loneliness	Good
Morgan et al. (2021)	New Zealand	76	82% Female; Mean Age: 78, Range: 55-92	Qualitative	Interviews	Neighbourhood accessibility	Loneliness; Social connectedness	Older adults who reported greater difficulties getting out of the house/ with public transport or limited space in residence were more likely to experience loneliness	Good
Morris and Verdasco (2020)	Australia	94	NR% Female; Mean Age: NR, Range: 75+	Qualitative	Interviews	Housing tenure	Loneliness; Depression	Living in private rentals or unaffordable housing linked to greater loneliness	Good
Neale et al. (2021)	USA	292	NR% Female; Mean Age: NR, Range: 18-73	Quantitative	UCLA Loneliness Scale (3 items)	Natural vs. urban imagery and videos	Social wellbeing; Loneliness	Viewing photographs of nature linked to less loneliness	Fair
Nzabona et al. (2016)	Uganda	605	65% Female; Mean Age: NR, Range: 60–90+	Mixed-methods Cross-sectional	Single-item loneliness measure	Dwelling quality	Loneliness	Participants who lived in residences built with sturdier materials (such as cement or bricks) reported significantly lower levels of loneliness	Fair
Odzakovic et al. (2021)	UK, Scotland, Sweden	14	79% Female; Mean Age: NR, Range: 62-88	Qualitative	Interviews	Neighbourhood experience; Dwelling quality	Social connectedness; Friendships; Neighbourhood atmosphere	Social connections forged via public spaces essential for preventing and mitigating loneliness among individuals with dementia	Good
Pearlman-Avnion et al. (2020)	Israel	120	58% Female; Mean Age: 78, Range: 65-97	Quantitative; Cross-sectional	UCLA Loneliness Scale (20 items)	Urbanicity level	Loneliness	Urban residents experienced greater loneliness than rural residents	Fair
Rantakokko et al. (2014)	Finland	847	62% Female; Mean Age: 80, Range:75-90	Quantitative; Cross-sectional	Single-item measure on loneliness	Perceived Environmental Barriers to Outdoor Mobility (PENBOM) checklist	Loneliness	Environmental barriers to outdoor mobility linked to higher loneliness; Accessibility of public spaces and to non-car-based transport and higher perceived neighbourhood walkability linked to lower loneliness	Good
Rusinovic et al. (2019)	The Netherlands	55 (plus two focus groups)	66% Female; Mean Age: 76, Range: 60-93	Qualitative	Interviews	Housing tenure; Household structure	Loneliness; Social connectedness	Co-housing communities offered social contact and emotional support linked to lower levels of loneliness	Good
Ruston (2009)	UK	88	61% Female; Mean Age: NR, Range:≤90	Quantitative; Cross-sectional	Interviews	Neighbourhood accessibility and safety	Loneliness	Participants who feared their neighbourhoods were more likely to report loneliness	Good
Sánchez-Moreno et al. (2021)	Chile	800			De Jong Gierveld Loneliness Scale			Material deprivation, lack of income, and dissatisfaction with housing	Good

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Table 2 (*continued*)

Author (Date)	Study Location	Sample Size	Participant Characteristics	Study Design	Loneliness Measurement	Built Environment Measurement	Outcomes	Results	Overall Quality Rating
			49% Female; Mean Age: NR, Range: 60+	Quantitative; Cross-sectional		Material deprivation; Time needed to access services	Depression; Loneliness; Personal wellbeing	conditions correlated with higher frequency of loneliness	
Scharf and de Jong Gierveld (2008)	England, The Netherlands	460-500: England; 3508–3182: The Netherlands	NR% Female Mean Age: NR, Range: 60+	Quantitative; Comparison-group	De Jong Gierveld Loneliness Scale	Urbanicity level; Neighbourhood socioeconomics; Perceived neighbourhood quality	Loneliness	Older people who perceived their neighbourhoods as low-quality had higher levels of loneliness	Good
Schorr and Khalaila (2018)	Europe (15 countries)	13,828	55% Female; Mean Age: 76, Range: 65-108	Quantitative; Cross-sectional	UCLA Loneliness Scale (3 items)	Study-specific questions on ease of access to services and public places	Quality of life; Loneliness	Easily accessible services and public places associated with lower levels of loneliness	Fair
Timmermans et al. (2020)	The Netherlands	1029	NR% Female; Mean Age: NR, Range: 55-85	Quantitative; Semi-experimental	de Jong Gierveld Loneliness Scale	Urban regeneration (Dutch District Approach)	Loneliness; Social engagement; Social isolation; Physical activity; Anxiety symptoms; Depressive symptoms	Dutch District Approach did not affect loneliness	Good
Timmermans et al. (2021)	The Netherlands	1959	49% Female; Mean Age: 73, Range: 63-98	Quantitative; Cross-sectional	de Jong Gierveld Loneliness Scale (6 and 11 items)	Social neighbourhood characteristics, including land-use and percentage of unoccupied dwellings	Loneliness	None of the built environment measures were significantly associated with loneliness	Good
van den Berg et al. (2010)	The Netherlands	184	51% Female; Mean Age: 60, Range: 33-87	Quantitative; Comparison-group	Frequency of loneliness; Need for social contact	Membership in allotment gardening program	General health; Life satisfaction; Loneliness; Frequency of physical activity	Allotment gardening linked to lower levels of loneliness, but only among participants aged 63+	Fair
van den Berg et al. (2019)	Europe	3748	NR% Female; Mean Age: NR, Range: 18-75	Quantitative; Cross-sectional	UCLA Loneliness Scale (6 items)	Residential distance to greenspace; Time spent in greenspace	Mental health; Vitality; Loneliness; Social cohesion	Spending time in greenspace reduced feelings of loneliness and increased social cohesion	Good
van den Berg et al. (2016)	The Netherlands	344	49% Female; Mean Age: NR, Range: NR	Quantitative; Cross-sectional	Single-item loneliness measure	Study-specific questions on residence type, area satisfaction, accessibility of shops, urbanicity, and distance to greenspaces and highways	Loneliness	Household characteristics, urbanicity, and satisfaction with neighbourhood and public facilities linked to lower levels of loneliness	Good
Van Houwelingen-Snippe et al. (2020)	Northern Europe, Canada, USA	1203	35% Female; Mean Age: NR, Range: 18-70	Quantitative; Cross-sectional	UCLA Loneliness Scale (20 items)	Natural vs. urban videos; Residential distance to nature	Social aspirations; Loneliness	Living further away from nature linked to higher loneliness	Fair
Victor and Pikhartova (2020)	United Kingdom	4663	56% Female; Mean Age: NR, Range: 50+	Quantitative	UCLA Loneliness Scale (3 items); "I often feel lonely living in this area" (Likert-scale)	Urbanicity level	Loneliness	Urbanicity level not associated with loneliness	Good
Volk (2009)	USA	15	100% Female; Mean Age: 29; Range: 22-36	Qualitative	Interviews	Dwelling size	Loneliness	Participants who lived in small apartments reported higher levels of loneliness due to inadequate room for guests and adherence to cultural hospitality/hosting rules	Good
Walker and Seasons (2002)	Canada	31	NR% Female; Mean Age: 41, Range: 22-56	Qualitative; Cross-sectional	Interviews	Housing quality; Household structure	Loneliness	Participants who lived with partners or in cooperative housing reported less loneliness;	Fair

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Table 2 (*continued*)

Author (Date)	Study Location	Sample Size	Participant Characteristics	Study Design	Loneliness Measurement	Built Environment Measurement	Outcomes	Results	Overall Quality Rating
								Loneliness can negate sense of home and belonging, even with satisfactory physical characteristics	
Walsh et al. (2020)	Ireland and Northern Ireland	106	54% Female; Mean Age: 76, Range: 59-93	Qualitative	Interviews	Access to public spaces and infrastructure	Problems with social relations; Mediators of old-age exclusion	Participants reported that a lack of infrastructure to allow spontaneous interactions with neighbours and a lack of accessible transport increased loneliness	Good
En Wee et al. (2019)	Singapore	528	58% Female; Mean Age: NR, Range: NR	Quantitative; Cross-sectional	UCLA Loneliness Scale (3 items)	Neighbourhood Environment Walkability Scale-Abbreviated (NEWS-A); Study-specific, Likert-scale questions on crime safety and land-use mix	Loneliness; Perceptions of neighbourhood physical environment; Social isolation; Mental health; Health-related quality of life	Living in public or social housing, higher-density rental accommodation, or poorly maintained neighbourhoods linked to higher levels of loneliness	Good
Wen et al. (2006)	USA	214	53% Female; Mean Age: NR, Range: 50-67	Quantitative; Cross-sectional	UCLA Loneliness Scale (R-UCLA)	Study-specific questions on perceived neighbourhood quality, physical environment, and quality of public services	Self-rated health	Access to public parks/open spaces and living in housing deemed affordable linked to lower levels of loneliness	Fair
Wen and Wang (2009)	China	905	43% Female; Mean Age: 28, Range: NR	Quantitative	Single-item loneliness measure	Presence of neighbourhood amenities	Loneliness; Satisfaction	No relationship between neighbourhood amenities and loneliness	Good
Woolrych et al. (2021)	United Kingdom	104	74% Female; Mean Age: NR, Range: 60-92	Qualitative	Interviews	Neighbourhood quality and facilities	Satisfaction with community	Presence of "third places" and improved sidewalks reported to reduce loneliness	Good
Yang and Xiang (2021)	USA	2667	46% Female; Mean Age: 36, Range: 18-89	Quantitative; Cross-sectional	UCLA Loneliness Scale (3-item)	Neighbourhood Environment Walkability Scale; Urbanicity level	Neighbourhood social cohesion; Neighbourhood conditions; Neighbourhood changes following COVID-19; Physical activity; Loneliness; Depression; Anxiety	High rates of crime and traffic issues in a neighbourhood associated with higher loneliness during COVID-19 pandemic	Good
Yu et al. (2017)	China	181	48% Female; Mean Age: 72, Range: 60-95	Quantitative Cross-sectional	de Jong Gierveld Loneliness Scale	Perceived neighbourhood walkability	Subjective wellbeing; Loneliness	Participants who perceived their neighbourhoods as walkable had lower levels of loneliness	Good
Zijlema et al. (2017)	Spain, Lithuania, United Kingdom, The Netherlands	1493–1602	54% Female; Mean Age: 48, Range: 18-75	Quantitative; Cross-sectional	UCLA Loneliness Scale	Distance to natural outdoor environments; Study-specific questions on perceived neighbourhood quality and frequency/length of greenspace visits	Loneliness; Neighbourhood social cohesion; Perceived mental health	No relationship between residential distance to nature and loneliness	Good

NR = not reported.

version of the de Jong Gierveld Loneliness Scale, 16 assessed loneliness qualitatively using interviews or focus groups, and ten used single-item quantitative measures asking participants about experiences of loneliness. Five studies used other quantitative measures, examining constructs such as 'social connectedness' or 'friendship' coded in ways to infer loneliness; one study did not detail its loneliness measurement.

Studies explored diverse aspects of the built environment, with several integrating multiple measures. Twenty-five studies focused on neighbourhood characteristics such as available public space and transport infrastructure; 15 on urbanicity or city design; 14 on neighbourhood social context; 14 on housing design/conditions; ten on qualitative housing aspects, including tenure, affordability, or social experiences; and seven on natural spaces.

In relation to risk of bias, three quantitative studies were appraised as 'poor' quality (highest risk) and subsequently excluded, ten were rated 'fair' (moderate risk), and 30 were rated 'good' (some risk). Three qualitative studies were rated 'poor', and therefore excluded, four were 'fair', and 19 were 'good'. No studies were rated 'excellent' (low risk). Table S4 lists the studies excluded due to poor quality; Table S5 reports quality appraisals for quantitative designs; Table S6, qualitative.

4.2. Narrative summary of results

Built environments impact the human experience (including loneliness) in interaction with people and systems. Embedded in this understanding, our review is grouped into two themes:

1. The structured environment and loneliness; and
2. The lived environment and loneliness.

These interacting themes align with our primary research questions, *elements* of the built environment that impact loneliness (RQ1) and relationships *between* the built environment and loneliness (RQ2). Table S7 presents a summary of findings categorised by theme.

3.3. The structured environment and loneliness

The structured environment refers to the physical, material components of places where people live. Structures include the design, distribution, and density of housing; parklands and public spaces; transport networks; schools; health services; and other amenities.

3.3.1. Housing design and living quality

Fourteen studies explored housing design or conditions and loneliness. Four linked living in smaller-sized apartments to increased loneliness (En Wee et al., 2019; Kalina, 2021; Morgan et al., 2021; Volk, 2009). Such spaces leave little room to host guests (Kalina, 2021; Morgan et al., 2021; Volk, 2009), a cultural concern for some (Volk, 2009) and a challenge to maintaining relationships and engaging in hobbies for others (Kalina, 2021).

Two studies investigated housing materials and loneliness. Older Ugandans living in housing comprising stronger materials reported less loneliness than those in housing of weaker materials; the former was hypothesised as contributing to a sense of safety and encouraging visits from family members (Nzabona et al., 2016). A large study among residents of China's urbanising neighbourhoods found those in 'temporary' housing (e.g., shelters and shacks) were at greater risk of loneliness than those residing in self-built, commercial, or public housing (Chen and Gong, 2022).

Several studies explored housing density (e.g., detached, townhouse, or apartment) and loneliness. One study found no association (Bower et al., 2021). In initial analyses, two others found that apartment-dwellers were lonelier than residents of other dwelling-types, but this effect was no longer significant after adjusting for sociodemographics (Kearns et al., 2015) and age (van den Berg et al., 2016). High-rise apartment designs were linked with loneliness in one qualitative study, which found mothers who moved to high-rises had trouble remaining connected to previous friendship networks and forming new networks, an effect heightened among those dependent on welfare (Abrams et al., 2019).

Other studies revealed a mediating role played by resident socioeconomic status (SES). van den Berg et al.'s Dutch neighbourhood study (2016) found that apartment living predicted increased loneliness for those aged <65, positing that detached dwellings are often located in more-affluent areas, which are more likely to have an established community, yet may be financially inaccessible for younger people. Living in a detached dwelling is not necessarily an antidote to loneliness for lower-income people, however: Finlay and Kobayashi's (2018) mixed-methods study identified how low-income residents of the USA were at higher risk of loneliness in affordable, but isolated, suburban homes or in "marginalized areas with limited safe, public, and free spaces to gather and socialize" (p. 31).

Other features associated with greater loneliness were inadequate natural light (Bower et al., 2021; Kalina, 2021), restricted personalisation (Kalina, 2021), and a lack of common spaces (Grenier et al., 2021; Kalina, 2021; Rusinovic et al., 2019). Conversely, balconies and windows protected community-dwelling individuals with dementia against loneliness by providing insights into the world outside (Odzakovic et al., 2021).

Qualitative findings suggest co-housing models may be associated with lower loneliness amongst seniors, but this association wasn't tested directly (Rusinovic et al., 2019). In juxtaposition, interviews with older people in high-care settings connected a loss of independence and a lack of privacy in such housing to high levels of depression and loneliness (Choi et al., 2008).

A qualitative study by Cotter et al. (2012) found older people who reported their housing was cold were more likely to report loneliness, an effect compounded by financial deprivation. In a study conducted during COVID-induced lockdowns in Australia, being bothered by outside noise was associated with loneliness even after adjusting for sociodemographics (Bower et al., 2021).

That study was among three that explored associations between housing disrepair and loneliness, finding the number of structural issues or physical concerns (e.g., plumbing issues, mould) had a cumulative impact on loneliness (Bower et al., 2021). Similarly, severe material deprivation and dissatisfaction with housing conditions were associated with high loneliness amongst rural Chilean older adults (Sánchez-Moreno et al., 2021). Finally, a study of older adults in the USA linked disrepair to loneliness (Finlay et al., 2020).

At the broader scale, a study by Timmermans et al. (2020) evaluated the Dutch District Approach, a program designed to enhance deprived areas through improvements to housing conditions, physical neighbourhood environments, and safety. Using a difference-in-difference analysis of longitudinal cohort data on people aged 50+ they found no effect on loneliness or social interaction.

3.3.2. Urban scale and infrastructure mix

Macro-level urban characteristics such as neighbourhood density, city size, and urbanicity (urban, suburban, or rural) had mixed effects on loneliness. Some studies found neighbourhood density did not directly impact loneliness (Finlay and Kobayashi, 2018; van den Berg et al., 2016); others found residents of higher-density neighbourhoods reported increased loneliness. Dutch adults aged 60+ residing in medium- and high-urbanised neighbourhoods reported higher loneliness than residents of less-urbanised areas (Scharf and de Jong Gierveld, 2008). A qualitative study of refugees settling in Canada reported that although smaller towns created an initial alienating sense of "urban shock" and "homesickness, isolation, and doubt" (El-Bialy and Mulay, 2015, p. 54), such towns later encouraged familiarity and safety.

Similarly, most studies showed little direct impact of urbanicity on loneliness after appropriate adjustment. Abshire et al.'s (2022) survey of USA residents found no difference by urbanicity after adjusting for

individual demographics. Likewise, Victor and Pikhartova's (2020) study of UK residents aged 50+ found no links between loneliness and urbanicity or geographical region. An exception is a mixed-methods study of elderly Ugandans, which found that urban dwellers were more likely to be lonely than those in rural communities (Nzabona et al., 2016).

As a whole, it appears the direct effect of density and urbanicity on loneliness is questionable. However, evidence exists of indirect effects, in which factors such as resourcing, access, and SES mediate these relationships. Finlay and Kobayashi's (2018) interviews with USA residents aged 55+ show that residents of under-resourced, low-density areas who also had poor physical and mental health experienced greater social isolation than individuals with similar health issues residing in other areas.

Multiple studies identified the importance of public, and semi-public, infrastructure. High-rises containing common areas and surrounding public space were linked to less loneliness (Finlay and Kobayashi, 2018). Using Internet communication technology (ICT) was associated with greater loneliness amongst rural elderly Israelis, but urban residents who used ICT reported less loneliness (Pearlman-Avnion et al., 2020), implying that digital communication may help overcome disconnection in urban areas, while undermining solidarity in rural communities. Grenier et al.'s (2021) interviews and focus groups with persons aged 60+ and their service providers in Canada reveal both rural and urban areas lack social interaction, but for different reasons: fewer services and mobility issues in rural areas, and greater burdens of poverty, mental health, housing, and food insecurity in urban areas.

One aspect of urban form that appears to impact opportunities for interaction consistently is proximity to a centre. One study found those living on a city's fringe showed significantly greater odds of social isolation compared to those in closer proximity (Finlay and Kobayashi 2018). Interestingly, this effect was reduced among individuals residing within city centres, particularly on main roads or high streets.

Mixed effects were reported regarding citywide infrastructure and public amenities and loneliness. El-Bialy and Mulay (2015) reported that poor citywide public servicing (such as snow removal) harmed cross-city travel, basic service access, and social contact. Cimino et al. (2020) described the negative impact of lack of access to medical and other support services in rural areas, while Hagan (2020) reported rural older adults were increasingly isolated by removal of essential services. Finlay and Kobayashi's (2018) interviews reveal the importance of living close to amenities such as parks and senior centres, which "were hubs of planned and spontaneous social interactions" (p. 30). Grenier et al.'s (2021) qualitative study among elderly Canadians highlighted the importance of access to meaningful activities, supports, and common spaces. In contrast, van den Berg et al. (2016) found distance to shops did not impact loneliness or social isolation and Wen and Wang (2009) reported no direct relationship between proximity to neighbourhood amenities and loneliness.

Finally, there were similarly mixed findings regarding the impact of area-level diversity. A Dutch study found no significant impact of land-use mix on loneliness among older residents (Timmermans et al., 's 2021). Conversely, interviews revealed that multi-racial and multi-generational urban areas reduced loneliness among ethnic-minority residents (Finlay and Kobayashi, 2018) and newly arrived refugees (El-Bialy and Mulay, 2015).

3.3.3. *Public spaces and mobility*

Twenty-five studies investigated resident loneliness and neighbourhood characteristics such as transport infrastructure and public spaces. Quantitative modelling generally linked access to public spaces and amenities to decreased loneliness (Gibney et al., 2019, 2020; Kearns et al., 2015; Lai et al., 2016). Two studies also connected access to commercial services to decreased loneliness (Kearns et al., 2015; Schorr and Khalaila, 2018). One exception was Lee and Tan (2019), who found access to spaces to meet others was not associated with loneliness; however, this study had a relatively small sample size (n = 303) and used an ambiguous definition of 'spaces'.

More broadly, the *kinds* of public spaces seen to support interactions varied widely. Quantitative studies often integrated vague definitions such as "public buildings" (Cao et al., 2020) and "basic services" (Domènech-Abella et al., 2021). A few studies used more detailed descriptors to explore how interactions can occur in indoor spaces such as Men's Sheds (Woolrych et al., 2021) or outdoor sites like community gardens and parks (Lai et al., 2016); intentionally (e.g., a regular coffee meeting in a café; Fagan and Trudeau, 2014) or spontaneously (e.g., lunch in a pub; Woolrych et al., 2021); fixed in use (e.g., a shopping mall; Morgan et al., 2021) or flexible (e.g., a community centre; Morgan et al., 2021); and either at a permanent location or within a mobile space (e.g., on a community bus; Hagan, 2020). In a comprehensive qualitative study reporting on 104 interviews conducted with elderly UK residents, Woolrych et al. (2021) highlighted community centres as a central meeting space and physical backdrop for routine interactions. This study also found that participants did not want to reserve these spaces for the exclusive use of older people; they preferred them to be multi-purpose hubs for all ages to avoid the stigma of meeting in "places that signify old age" (p. 1409).

This sentiment reveals a conundrum when attempting to craft a palette of spaces for neighbourhood interaction: public spaces are rarely spatially or temporally static, a dynamism that can positively and negatively impact interaction. First, public spaces must cater to the physical and emotional needs of diverse residents without stigmatising, isolating, or exacerbating exclusion. For example, an ethnographic study of 14 people living with dementia highlighted their need for neighbourhoods to be flexible in terms of noise and stimulation (Odzakovic et al., 2021). At the same time, other community members need public spaces that can support the noise and activity of a vibrant civic society, along with comfortable and quiet public spaces for retreat.

Transport infrastructure plays a critical role in allowing residents to access these public spaces. For example, a quantitative study of 848 Finnish older adults found that accessible transit facilitates access to spaces (Rantakokko et al., 2014), a finding confirmed by Bergefurt et al.'s (2019) survey among 200 elderly residents of Dutch cities. Other studies revealed that subgroups with restricted access to private cars—due to financial, regulatory, or physical constraints—were particularly vulnerable to isolation and loneliness. Lai et al. (2016) and Walsh et al. (2020) examined elderly residents of Malaysia and Ireland, respectively, whilst Cimino et al. (2020) interviewed people living with spinal-cord injury. Each demonstrated that the availability and useability of transport modes such as walking, cycling, and public transport were integral to equitable access to opportunities for public interactions (Gibney et al., 2019; Hagan, 2020; Lai et al., 2016).

Several studies demonstrated that challenges associated with non-car-based mobility varied by population. Numerous studies among older adults confirmed that individuals tend to live more locally as they age (Cao et al., 2020; Domènech-Abella et al., 2020; Gibney et al., 2020; Lee and Tan, 2019; Rantakokko et al., 2014; Schorr and Khalaila, 2018; Timmermans et al., 2021; Walsh et al., 2020; Yu et al., 2017) and they are less physically mobile when accessing their local neighbourhoods (Finlay et al., 2020; Hagan, 2020; Kalina, 2021; Kowitt et al., 2020; Morgan et al., 2021; Odzakovic et al., 2021; Woolrych et al., 2021). Walkability and public-transport accessibility are also key for adolescents (Matthews et al., 2019).

Transit safety similarly facilitated access to positive interactions that reduced loneliness (Domènech-Abella et al., 2021). In addition, public-transport reliability and comfort were identified as important (Lai et al., 2016; Morgan et al., 2021), particularly in locations vulnerable to extreme weather (Cimino et al., 2020; Rantakokko et al., 2014). Some qualitative studies demonstrated that perceived or real stigma associated with public transport is a barrier to its use by older adults (Morgan et al., 2021), particularly those in rural areas (Hagan, 2020). This finding was confirmed by Walsh et al. (2020) through over 100

in-depth interviews with older adults in Ireland.

Accessible public transit may also provide a sense of independence and perceived control over interactions. Through interviews with older-adult New Zealanders, Morgan et al. (2021) concluded that "underpinning discussions of what helped and hindered participants to connect was an emphatically expressed desire not to burden others" (p. 1136). Similarly, Kowitt et al. (2020) concluded perceived individual control mediated the effect of built-environment perceptions on depressive symptoms, including elements of loneliness (Kowitt et al., 2020).

3.3.4. Natural spaces

Multiple studies looked at residential access or proximity to 'natural' spaces (Maas et al., 2009), generally including greenspaces (e.g., parks, forests) (van den Berg et al., 2019; Zijlema et al., 2017); sometimes bluespaces (e.g., oceans, lakes) (Zijlema et al., 2017); and often excluding private spaces (e.g., gardens, farmland) (Astell-Burt et al., 2022b). Generally, individuals with greater exposure to natural spaces reported less loneliness. In the largest study (n = 10,089), residents of The Netherlands with greater greenspace within 1 and 3 km of home reported slightly less loneliness (Maas et al., 2009). In another Dutch study, individuals who belonged to allotment gardens were less lonely than their non-gardening neighbours, despite only 17% describing social contact as an important reason for going to the garden (van den Berg et al., 2010). In a multi-city European cross-sectional study, each additional hour of time spent visiting natural space was associated with decreased loneliness and loneliness accounted for 23% of the relationship between time in natural space and better mental health (van den Berg et al., 2019). Interestingly, this study found no association between distance to public greenspaces and either loneliness or social isolation (van den Berg et al., 2016).

Other studies similarly reported mixed results: participants living further from nature reported higher loneliness, but the number of weekly visits to nature had no impact (Van Houwelingen-Snippe et al., 2020). An Australian longitudinal study examining the impact of residential greenspace at 400, 800, and 1600 m found no differences in loneliness over a four-year period (Astell-Burt et al., 2022b). Closer proximity to natural environments was not associated with loneliness among residents of four European cities, but marginally related to higher neighbourhood social cohesion (Zijlema et al., 2017).

Two studies examining digital representations of nature found benefits (Neale et al., 2021; Van Houwelingen-Snippe et al., 2020). Neale et al. found greater reductions in loneliness after viewing "fixed-image" natural versus urban scenes in a laboratory environment, reporting no impact of the presence of people in natural scenes.

3.4. The lived environment and loneliness

The second theme focuses on non-structural elements that mediate experiences of the built environment and loneliness.

3.4.1. Perceptions of neighbourhood social context

Neighbourhood social context refers to the subjective social/cultural interactions of individuals who dwell in, and regularly pass through, the same local spaces. Several studies linked a sense of neighbourhood belonging with reduced loneliness, even after adjusting for housing characteristics (Bower et al., 2021; van den Berg et al., 2016). Knowing more people in one's neighbourhood was also associated with reduced loneliness (Kearns et al., 2015). However, the context of 'neighbourhood belonging' is not straightforward, being contingent on an individual's unique housing, social, and socio-economic situation. Multiple qualitative analyses found the need to belong is magnified among people experiencing structural housing issues. A lack of local social connections limited Australians' opportunities to seek solace from poor housing, leaving people feeling trapped and isolated (Bower et al., 2021). A South African study found belonging could only be realised when it was possible to be out and about in the neighbourhood, particularly among older people (Kalina, 2021). Other studies highlighted the importance of 'fitting in': identifying with and relating to those living close by. One study found Canadian residents of supportive housing with severe mental illness living alongside people with differing levels of social-welfare support were more likely to be lonely (Walker and Seasons, 2002). Broader social changes in the profile of a neighbourhood could also compromise neighbourhood belonging. A qualitative study of older New Zealand adults found trends of increasing rents and job-market precariousness made neighbourhoods feel more transitory, constraining residents' connections (Morgan et al., 2021).

Two studies showed that residents who perceived their neighbourhoods as lower in collective efficacy felt lonelier than those in areas with greater efficacy, even after adjusting for familial context or neighbourhood structural features (Kearns et al., 2015; Matthews et al., 2019).

3.4.2. Perceptions of neighbourhood structural context

Studies in multiple regions linked positive neighbourhood perceptions to reduced loneliness (En Wee et al., 2019; Kearns et al., 2015; Matthews et al., 2019; Scharf and de Jong Gierveld, 2008; Wen et al., 2006). A Singaporean study of older adults found that poorer perceptions of neighbourhood physical environment and upkeep (e.g., "too much" litter, poor street lighting, perceived absence of people on the streets) were associated with higher odds of loneliness (En Wee et al., 2019). A quantitative study in deprived neighbourhoods across Scotland connected higher perceived neighbourhood quietness and physical quality (perceived attractiveness and well-maintained parks, walkways, and street lighting) to reduced loneliness (Kearns et al., 2015). In a study of adults aged 50+ in the USA, perceived positive neighbourhood environment (comprising social cohesion, resources for physical activity/walking, and safety) was significantly associated with lower loneliness (Kowitt et al., 2020). van den Berg et al.'s Dutch neighbourhood study (2016) also found that satisfaction with one's neighbourhood and its facilities predicted reduced loneliness, with indications that residents' socio-economic status may mediate this association. Conversely, Kowitt et al. (2020) reported that poverty indirectly worsened loneliness via a negative impact on perceptions of the neighbourhood.

3.4.3. Housing affordability

Housing costs and affordability also mediated socio-economic status and loneliness. Among six studies examining housing affordability, living costs, and loneliness, several connected living in housing deemed affordable to reduced loneliness (Bower et al., 2021; Grenier et al., 2021; Morris and Verdasco, 2020; Wen et al., 2006). Among the underlying causes, the high cost of occupying and maintaining a home allowed less money for social activities that prevent or lessen loneliness or social isolation (Morris and Verdasco, 2020). For example, older Irish residents often reported going without goods and experiences to pay for home heating, a practice associated with feeling lonely "almost all of the time" (Cotter et al., 2012, p. 43). Conversely, affordable urban housing provided a safety net offering residents immunity from forced relocation due to variations in income or expenditures (Grenier et al., 2021). When housing was unaffordable across an urban area, deciding where to live is less likely to be based on feelings of safety, comfort, and connection than on costs, potentially leading to displacement from family and friends and increased loneliness (Morgan et al., 2021; Morris and Verdasco, 2020).

3.4.4. Housing tenure

Three studies examined housing tenure. One study found older adults living in private rentals tended to be lonelier than residents of public/social housing (Morris and Verdasco, 2020). Another found that individuals renting public/social housing were lonelier than homeowners (En Wee et al., 2019). The final study found that residents of "other tenures" (staying with friends or family members, being currently homeless, and other arrangements) were lonelier than homeowners, but reported no differences between public or private renters and

homeowners (Bower et al., 2021).

Overall, these associations appeared inseparable from, and often explained by, socio-economic and cultural contexts. For example, the finding that those living in "other" tenure arrangements were lonelier than homeowners was not significant after accounting for income and employment (Bower et al., 2021). Similarly, the finding that private renters were lonelier than their counterparts in public/social housing was attributed to the financial burden posed by private rents and to increased tenure insecurity, while social housing residents had more money to participate socially and were less anxious about their accommodation's longevity (Morris and Verdasco, 2020).

3.4.5. Safety

Several studies connected perceived threats from crime and antisocial behaviour to loneliness, and this link persisted regardless of objective threats as determined by crime data (Kearns et al., 2015; Matthews et al., 2019; Yang and Xiang, 2021). An exception to this was when crime rates change: for example, increasing crime rates were associated with greater loneliness (Yang and Xiang, 2021). A quantitative study of older adults in assisted living found those residing on a block with at least one "neighbourhood crime watch" sign felt more isolated because the signs created the anticipation of crime (Kim and Clarke, 2015). Feeling unsafe walking alone at night was associated with greater loneliness (Finlay and Kobayashi, 2018), while perceived personal risk from ambient pollution was tied to increased isolation (Ruston, 2009). A qualitative study of Canadian seniors found those with fears around safety at home tended to feel more socially isolated, but also revealed the importance of a safety net of affordable rent and protection from housing displacement (Grenier et al., 2021).

4. Discussion

4.1. How does the built environment impact loneliness?

Our systematic review identified 57 studies that explored wide-ranging aspects of the built environment, including housing design and conditions, neighbourhood structural characteristics, public space, transport infrastructure, natural spaces, urbanicity, and city design. Many studies analysed social and cultural environments as well as built, with several describing how neighbourhood characteristics mediate relationships between socio-economic status and loneliness. Our results reveal specific aspects of the built environment that can reduce loneliness, as summarised in Table S8. However, the evidence does not suggest a deterministic, one-to-one, relationship between built-environment characteristics and loneliness. Instead, the relationship is complex, contextual, and multidirectional, emerging from interrelationships among the built environment and the broader socio-cultural and economic milieu, which intersect with individual experiences, needs, values, and practices.

To elucidate this complexity, we examined two distinct built-environment domains: the 'structured' environment and the 'lived' environment. We conclude that impacts on loneliness occur via interactions between them, contingent on multiple contextual aspects. This makes intuitive sense: loneliness is subjective, occurring when someone feels their current social context differs from their ideal (Peplau and Perlman, 1982). If the built environment is understood as the container for social relationships, it follows that loneliness will depend on how this container facilitates or impedes each person's ability to enact and realise this ideal. While acknowledging that specific pathways link the built environment to loneliness (Astell-Burt et al., 2022a), we propose that the interplay among structure, process, and agency makes it difficult to provide a single, static model. Instead, we offer some theoretical concepts to frame thinking about this relationship, while emphasising the complexity and dynamism our review reveals.

Our distinction between structured and lived environments was inspired by the recognition that both form and function shape human experience, as embedded in several theories. The sociological 'structurationist school' (Thrift, 1996) encompasses a group of such theories, bound together by the commonality that the dialectical relationship between form and function offers an ideal position to observe the way social existence is shaped and lived.

Psychological traditions have also acknowledged the space between structure and lived experience. The theory of 'affordance' draws out the contingent nature of the relationship between the built environment and loneliness. In his original description, Gibson (1979) writes:

> "The verb to afford … refers to both the environment and the animal in a way that no existing term does. It implies the complementarity of the animal and the environment" (Gibson, 1979, p. 127).

Originally a term from the psychology of perception, affordance has been adopted by theorists of the lived environment to speak about the possibilities offered by an environment's makeup to its inhabitants, or the multi-faceted contexts, opportunities, and barriers that the built environment sets for socialising and perceiving a sense of community (Brown and Reavey, 2015; Ingold, 2009). Affordance is what emerges from the relationship between person and environment; both what the person is enabled to do by the makeup of the space, and what use they can and choose to make of it. However, what the environment 'affords' is not inherent to either the person or the environment, but emerges in the relationship between the two.

Both theoretical frameworks—one emanating from sociology and the other from psychology—reference a complementarity between people and the environment, allowing us to elucidate the ways in which built environments afford conditions protective against loneliness. Taking this understanding forward, we found little convincing evidence of impacts of broader-scale aspects of the structured built environment (such as rurality, city size, and overall density) on loneliness, suggesting there are mediating factors at play. The 'structured' environments that provide protection against loneliness tend to be at the scale of the home and neighbourhood. Studies on apartment size, for instance, show a key impact of a small apartment is a reduced ability to host and socialize, preventing a strong sense of belonging at home. Housing disrepair had a similar impact. Likewise, physical access to community spaces and natural spaces facilitates social connection by providing venues for interactions.

Environments that enable realisation of a valued social identity were also protective against loneliness. The ability to personalise and 'make-home', for example, supports identity formation. Structural aspects of access are also key, particularly where the act of access also enables connection (e.g., walking or using public transport). Similarly, environments structured to be safe—from crime, traffic, and pollution—also enable people to explore their neighbourhoods, attenuating loneliness.

It is clear that these provisions are interpreted through a complex series of interpersonal filters that escape useful generalisation. A consistent theme is the crucial impact of socio-economic status, age, and physical ability on the way people make use of their surrounding environments. If the full range of people's needs and differing capacities are not catered for, then these built environments are not truly affording connection, privacy, or safety. Adding to this complexity is that although some of these filters are individual, a subset is characteristic of the structured environment. Housing tenure, for example, mediates the ability to personalise space. Housing affordability is shaped by macro-economic factors of housing supply, impacting the freedom to live near established connections.

In summary, the literature reviewed reflects the notion that the built environment 'affords' opportunities that are then filtered through multiple scales and influences, as well as interpreted through lived experience, to protect against loneliness. The built environment's ability to shape loneliness is riven with subjectivity, defined by both collective and individual histories, resources, relationships, obligations, and preferences.

4.2. Implications for policy and practice

Given our review reveals the lack of a single built environment universally 'good' or 'bad' for loneliness, we urge researchers and practitioners to think more relationally about which aspects of the built environment afford those activities, relationships, and feelings known to mitigate loneliness. The challenge remains providing spaces and infrastructures that foster opportunities for interaction, connection, self-actualisation, and belonging, while accounting for a diversity of abilities, desires, and needs.

Our review also calls for a deeper consideration of the ways the interplay between the built environment and wider systems can deny the right to live a connected life. SES was shown to be a key determinant of loneliness, supporting existing calls for more equitable models of welfare, housing, and community programming. Inequality can lead to physical and emotional isolation through the unjust distribution of access, opportunity, and well-designed and maintained space. A less socio-economically stratified society is connected by shared experiences and opportunity, as well as by the removal of physical barriers of privation. Ageing, disability, and mental and physical health are also factors that can reduce individual capacity to access aspects of built environments that facilitate social connection. The needs of marginalized groups must be considered explicitly in built-environment design, prioritising equitable outcomes.

4.3. Recommendations for future research

There were several issues with definitions, measurements, and models across the included studies that reduce the robustness of the surveyed literature. For example, almost all quantitative studies measured loneliness as a unidimensional construct via the UCLA or de Jong Gierveld loneliness measures. We recommend integrating multidimensional conceptualisations of loneliness that incorporate greater subjectivity, such as social loneliness and emotional/intimate loneliness.

Some studies relied on a direct question about 'loneliness', which is generally not considered to be best practice (although see Shaver and Brennan, 1991). Consensus is that omitting the term 'loneliness' is effective to avoid eliciting social stigma around admitting to experiences of loneliness and consequent under-reporting, particularly among men (Peplau and Perlman, 1982). Although the standard instruments provide greater sensitivity, their unidimensionality limits the ability to explore how the built environment shapes different kinds of loneliness.

Although outcomes were generally examined as homogenous, there was considerable heterogeneity in exposure measures. Concepts such as public space, walkability, greenspace, and accessibility were defined and measured in different ways. In addition, many quantitative studies failed to adequately describe or conflated built-environment measures, preventing the assessment of individual elements. Moreover, built-environment variables were often self-reported, without any attempt made to 'ground-truth' these assessments. This can be particularly problematic when outcomes were similarly assessed via self-report (such as loneliness), leading to heightened covariance. An additional element of heterogeneity relates to the geographical scales conceptualised as related to loneliness. Studies rarely acknowledged the situatedness of their examinations as related to one specific scale (for example, neighbourhood) which sits in a context of other scales (for example, region). Similarly, both qualitative and quantitative studies failed to acknowledge that experiences of loneliness can be influenced by built environments other than the residential environment, nor did they take into account elements of temporality, such as whether an area is accessed daily, weekly, or monthly. Some of these issues could be explored in this literature through acknowledgement of the 'uncertain geographic context problem' (Kwan 2012), which seeks to account for the impact of spatial and temporal scales of exposure on outcomes. Although problematic from a research perspective, this heterogeneity does not necessarily reflect weaknesses in research design, nor is it a problem that can or should be resolved. As outlined above, the interplay between built environments and the people in them is complex and contextual, and sometimes it cannot be reduced accurately to standardised measurements (Kent et al., 2022). This suggests that it may be better to explore the relationship between built environments and loneliness through well-executed qualitative studies, with the overarching findings more clearly articulated by delving more deeply into individual experiences, practices, places, and sentiments. However, such studies must be conducted and reported in a way that adheres to accepted standards and triangulated through ongoing quantitative survey and observational studies carried out on a broader scale.

Among our studies, both qualitative and quantitative designs often lacked adequate control for confounding (or assessment of context in the case of qualitative inquiries). Constructs such as socio-economic status are associated with both our predictor (built environment) and outcome (loneliness), so failing to account for such factors may severely bias findings. For example, greenspace proximity is associated with reduced loneliness, but it was unclear whether many related studies controlled for both personal and neighbourhood SES, which might independently predict capacities to live near greenspace as well as better social connections and reduced loneliness, a limitation echoed in a 2022 review on greenspace and loneliness (Astell-Burt et al., 2022a).

4.4. Strengths and limitations

This is the first paper to review the vast, interdisciplinary body of research examining links between built environments and loneliness. Our systematic review includes both quantitative and qualitative studies, delivering new empirical insights grounded in a novel fusion of theoretical concepts from psychology and sociology. Using a predefined PECO framework to guide our identification and selection of studies increased specificity; cross-checking reference lists and searching the grey literature reduced the risk of missing potentially relevant studies. In addition, due to the novelty of our approach, multiple elements of our analysis relied on customised methods that advanced upon standard best practices, including the development of bespoke data extraction and quality appraisal tools.

Although rigorous, our review has limitations. The research in this space traverses both geographical distance and disciplinary territories and our review is subsequently limited by the need to define variables of interest in relatively narrow ways. In addition, we did not include research published before 2000, which may have missed earlier insights relevant to our theoretical conclusions. Other limitations are related most directly to the nature of the body of research under review, as detailed in section 4.3. Our findings are not generalisable—to geographic, demographic, social, political, or economic contexts. We posit that this lack of generalisability is inherent to the nature of the link between built environments and health more generally. Finally, although we explored the impact of spatial scales in great detail, we have not thoroughly examined the impact of heterogeneity with respect to temporal and spatial scales. These are extremely important influences that undoubtedly influence the relationships under investigation; however, the degree to which they remain unspecified in the underlying literature precludes us from analysing these issues in depth.

5. Conclusion

This paper investigates relationships between built environments and loneliness using a rigorous systematic-review methodology. For the purposes of analysis, we divided our findings into the structured and lived environments, allowing us to develop a theoretical statement: *the built environment affords practices that prevent loneliness, but no single built-environment aspect is capable of fully preventing loneliness.* We used theories of structuration from sociology, as well as affordance from psychology, to explore this proposition.

This key conclusion supports existing calls for researchers to develop

more detailed understandings of the ways in which specific built environments support or inhibit loneliness among specific populations and at specific times. Such specificity would represent an important advancement upon current research designs that broadly examine the impact of built environments on experiences of loneliness. At the same time, these studies are likely to be more difficult to conduct *en masse* than population surveys or broad-based geographical analyses, requiring additional resources and reaching less-definitive conclusions. However, only research that is conducted with respect for context, sensitivity to nuance, and an appreciation of the power of individual agency will be able to inform the development and implementation of policies and designs that make an appreciable impact on public health. Understanding and addressing the increasingly destructive pandemic of loneliness is an endeavour clearly worthy of investment.

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Systematic review registration

PROSPERO, the International Prospective Register of Systematic Reviews ID: CRD42021212047.

Declaration of competing interest

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

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.healthplace.2022.102962.

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