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Mapping desires for cities design: a conceptual framework and methodological roadmap for well-being-centred urban form in the 15-minute city

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Accessibility is a cornerstone of the '15-min city' (15 MC) concept, yet prior research has largely assessed access to services without examining its links to behaviour. As a result, accessibility-oriented interventions often prioritise basic needs, while desires and wants, frequently tied to emotions and, therefore, to wellbeing, remain insufficiently addressed. In increasingly urbanised societies, urban ecological structures provide critical services by supporting social interaction and enhancing everyday liveability. Despite a gradual shift in wellbeing assessment frameworks from predominantly macroeconomic statistics towards more balanced perspectives that account for lived experiences and conditions, the influence of urban form on residents' wellbeing remains underexplored. To address this gap, a conceptual framework and methodological roadmap are proposed based on the results of a systematic literature review using the PRISMA guidelines, including a validation component using Public Participation Geographic Information Systems (PPGIS), GIS analysis, and AI-supported evaluation. The resulting conceptual framework proposes a triple-helix roadmap in which morphological aspects, such as accessible built density, access to green and blue spaces, and patterns of pedestrian flow, are integrated with both objective and subjective wellbeing factors. Hedonic and eudaemonic dimensions are considered across city, neighbourhood, and street-block scales. By specifying corresponding indicators across these three dimensions, which can be collected and integrated using emerging methods such as PPGIS and LLMs, the framework addresses the limited literature on multiscale mixed-methods research on the 15 MC. This in return strengthens research and planning practice through improved assessment of how the spatial design of 15MCs shapes residents' wellbeing.

KEYWORDS

15-minute city, emotions, objective wellbeing, subjective wellbeing, urban form

1 Introduction

Urban design is ultimately a question of desirability: which urban forms people want, for which everyday lives, and under which trade-offs. Yet the evidence base used to define ‘good’ city form remains dominated by expert-led, performance-oriented metrics, including accessibility, density, land-use mix, walkability, and service proximity. These indicators are essential for evaluating urban performance, yet they often insufficiently capture the experiential, affective, and relational dimensions through which residents evaluate the places they inhabit. Recent research on the 15-min city (15 MC), for instance, has substantially advanced the measurement of proximity and accessibility, while also revealing inequalities in how such access is distributed across and within cities (Bruno et al., 2024; Khavarian-garmsir et al., 2023). By contrast, residents’ lived preferences, what they value, miss, tolerate, or aspire to, are still comparatively under-specified in operational planning and design workflows, beyond urban designers’ subjective interpretations. Addressing this gap requires methods that can map desires in ways that are empirically credible, spatially explicit, and actionable for design decisions. Here, “desire” is treated not as a vague affective notion, but as a structured set of expressed needs, preferences, attachments, and priorities that can be elicited, translated into indicators and spatial proxies, and tested against the city’s morphological and functional conditions. This position aligns with recent work arguing that subjective wellbeing is shaped through multiple pathways linking the built environment to travel, leisure, social relations, emotional responses, health and residential satisfaction (Mouratidis, 2021). It also resonates with emerging Public Participatory Geographic Information Systems (PPGIS) research which demonstrates the value of spatially explicit methods for capturing residents’ perceptions, preferences and health-related experiences in urban planning processes (Simon, 2024).

Treating desire as an analytical object also foregrounds the normative dimension of “wellbeing centred” urban form. Wellbeing is increasingly acknowledged as a legitimate planning outcome, yet it remains difficult to operationalise in design practice because it spans subjective and relational dimensions (e.g., perceived safety, belonging, restorative experiences, everyday autonomy) as well as material and environmental conditions (e.g., access to services, exposure to noise and heat, quality of public space). Recent reviews of the built environment, health, and wellbeing further confirm that urban form influences wellbeing through interacting physical, social, behavioural and environmental pathways, rather than through single isolated variables (Andalib et al., 2024; Salmi et al., 2024). A wellbeing centred approach therefore demands methodological pluralism: no single dataset or evaluation technique can capture the multidimensionality of lived experience, nor how it varies across social groups, neighbourhood types, and daily rhythms. Triangulated methodologies, combining qualitative articulation of values and experiences with quantitative spatial analysis and contextual validation, are thus essential for producing robust, decision-relevant knowledge without reducing wellbeing to a single proxy.

This paper proposes a literature-based conceptual framework and an illustrative methodological roadmap, grounded in a practical case study, for translating residents’ desires into a spatially grounded

understanding of urban form within the 15 MC discourse. Rather than assuming that proximity and service access automatically translate into desirability, this paper treats the 15 MC as a design and governance proposition whose success depends on whether it aligns with what residents consider a good everyday city: not only “near”, but also meaningful, supportive, and conducive to both objective and subjective wellbeing. This framing responds to a growing need to complement accessibility-led interpretations of the 15 MC with methods that can represent subjective wellbeing and sense-of-place dimensions while remaining compatible with planning instruments and urban design practice.

1.1 The 15 MC concept and emotional bonds people forge with specific locations

Carlos Moreno and Anne Hidalgo introduced a revised version of the 15-min city (15 MC) in 2015 at the Paris COP (Moreno, 2016). The concept promotes decentralisation and hyper-proximity to improve quality of life while supporting sustainability, viability, and desirability in urban environments. Through hyper-proximity, the 15 MC seeks to enable residents to revitalise local communities by ensuring access to essential functions, including housing, workplaces, commerce, healthcare services, education, and entertainment (Abbiasov et al., 2022; Moreno et al., 2021; Niu et al., 2025; Rojas-Rueda et al., 2024).

Moreno et al. (2023b), [p. 57] frame the 15 MC through three notions: chrono-urbanism, chronotopia, and topophilia. Chrono-urbanism examines the temporal dimensions of urban planning to develop a more holistic understanding of urban dynamics and to strengthen urban design and development processes. Chronotopia, in turn, provides a proactive response to spatial scarcity by enabling more flexible and adaptable strategies and supporting more efficient and sustainable use of urban space. Topophilia concerns emotional connections to places, people’s attachment to locations they value, and thus relates directly to dwellers’ subjective wellbeing (SWB) as shown by authors such as Navarrete-Hernandez and Laffan (2019), Shekhar et al. (2019), and Tuhkanen et al. (2022). It captures how such bonds shape identity, sense of belonging (Heaton, 2023; Moreno et al., 2023b), and relationships to (green) space. In environmental psychology, this ‘sense of place’ is often linked to cultural and experiential learning. Kellert and Calabrese (2015) further advanced this perspective by proposing the topophilia hypothesis, extending the emotional dimension of biophilia from individuals to communities (Lefosse et al., 2023).

To date, the growing body of 15 MC literature has primarily focused on spatial accessibility, proximity modelling, and functional urban structure as shown by Papadopoulos et al. (2023), Pozoukidou and Chatziyiannaki (2021) and Weng et al. (2019); with comparatively limited attention given to the experiential and emotional dimensions of urban life. Much of the existing research operationalises chrono-urbanism and chronotopia through accessibility metrics, walkability analyses, mobility patterns, and service distribution modelling, while topophilia and sense of belonging remain less systematically addressed. For example, Ferrer-Ortiz et al. (2022) and the Paris Urbanism Agency APUR (2021) focus primarily on access to services and activities. Ferrer-Ortiz et al. (2022) used network analysis to develop a measurement method for Barcelona, concluding that most areas

meet the 15 MC premise, with notable exceptions in peripheral zones. Similarly, much of Paris functions as a 5-min city for daily conveniences, whereas results vary in the suburbs, where access is more dependent on private cars. This dependence can intensify where municipalities struggle to justify or fund (non-car-oriented) mobility infrastructure in lower-density areas, reducing connectivity and limiting mobility options. As a result, healthcare, leisure, and workplaces may become harder to reach, with potential negative effects on residents' wellbeing. However, this paper argues that these studies do not sufficiently address the multiscale and interdependent nature of urban spatial-functional structures, which constrains robust context assessment.

1.2 Beyond needs, addressing desires: Topophilia

Because the 15 MC is frequently operationalised through hyper-proximity and accessibility metrics, research has tended to privilege chrono-urbanism and chronotopia (i.e., time-space configurations that can be modelled quantitatively) over topophilia and related constructs that foreground affect, attachment, and subjective wellbeing. This imbalance is consequential: proximity-based evaluations can demonstrate whether services are reachable, but they are less capable of explaining whether neighbourhoods are *valued*, *chosen*, and *returned to* and therefore, whether the urban form supports the affective and relational conditions under which wellbeing is produced and maintained. Recent work also cautions that proximity-centred planning risks becoming reductive if it is treated as a “solution” in itself rather than as a partial lens on urban liveability and justice (Abbiasov et al., 2024; Bonfantini et al., 2025; Caprotti et al., 2024).

A well-being-centred interpretation of the 15 MC benefits from anchoring “health” beyond biomedical absence-of-disease framings. The World Health Organization (WHO, 1946) famously defines health as: ‘a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity’ (Kamp, 1990), a formulation that continues to shape contemporary debates about how planning and design should engage with lived experience, functioning and quality of life. In parallel, sustainability scholarship has long argued for multi-pillar conceptions of value (e.g., Elkington’s “triple bottom line”), while also highlighting the limitations of narrow, accounting-style interpretations and the need to rethink how social and environmental value are integrated into decision-making.

Within this broader shift, topophilia offers a focused entry point for moving “beyond needs” toward the mapping of desires. Topophilia -closely linked to sense of place and place attachment-addresses the emotional bonds through which people evaluate environments as comforting, meaningful, restorative, or socially enabling. Lefosse et al. synthesise this dimension into four affective-emotional benefit clusters: (i) emotional recovery, comfort, safety and rejuvenation; (ii) positive mood, enjoyment and happiness; (iii) preference, aesthetic pleasure and fascination; and (iv) spiritual and ethical values (Lefosse et al., 2025). Complementary recent reviews reinforce the planning relevance of these constructs by showing how green and everyday environments can strengthen place attachment and community wellbeing, and how mobilities are intertwined with senses of

place, both directly relevant to proximity planning and neighbourhood-based life (Zeng and Wang, 2025). This matters for the 15 MC because many of city’s most socially vibrant and identity forming places are visited out of desire rather than necessity. Ratti and Florida (2021) capture this distinction by arguing that, “[...] the truly vibrant parts of the city often begin when the first 15 min end”, positioning the 15 MC less as a self-contained ideal than as a baseline that should enable broader urban encounters and specialisation.

These “desire-driven” destinations (e.g., cultural spaces, distinctive streets, parks, third places, or social infrastructures) are often where social ties are made and maintained, where restorative experiences occur, and where people develop attachment and belonging. Accordingly, strengthening topophilia-oriented understanding (and measurement) of the built environment is not an optional ‘soft’ complement to accessibility analysis; it is essential for explaining how urban form translates into subjective wellbeing and for designing 15 MC strategies that are not only reachable, but also meaningful, attractive, and socially generative.

1.3 Aim and research questions

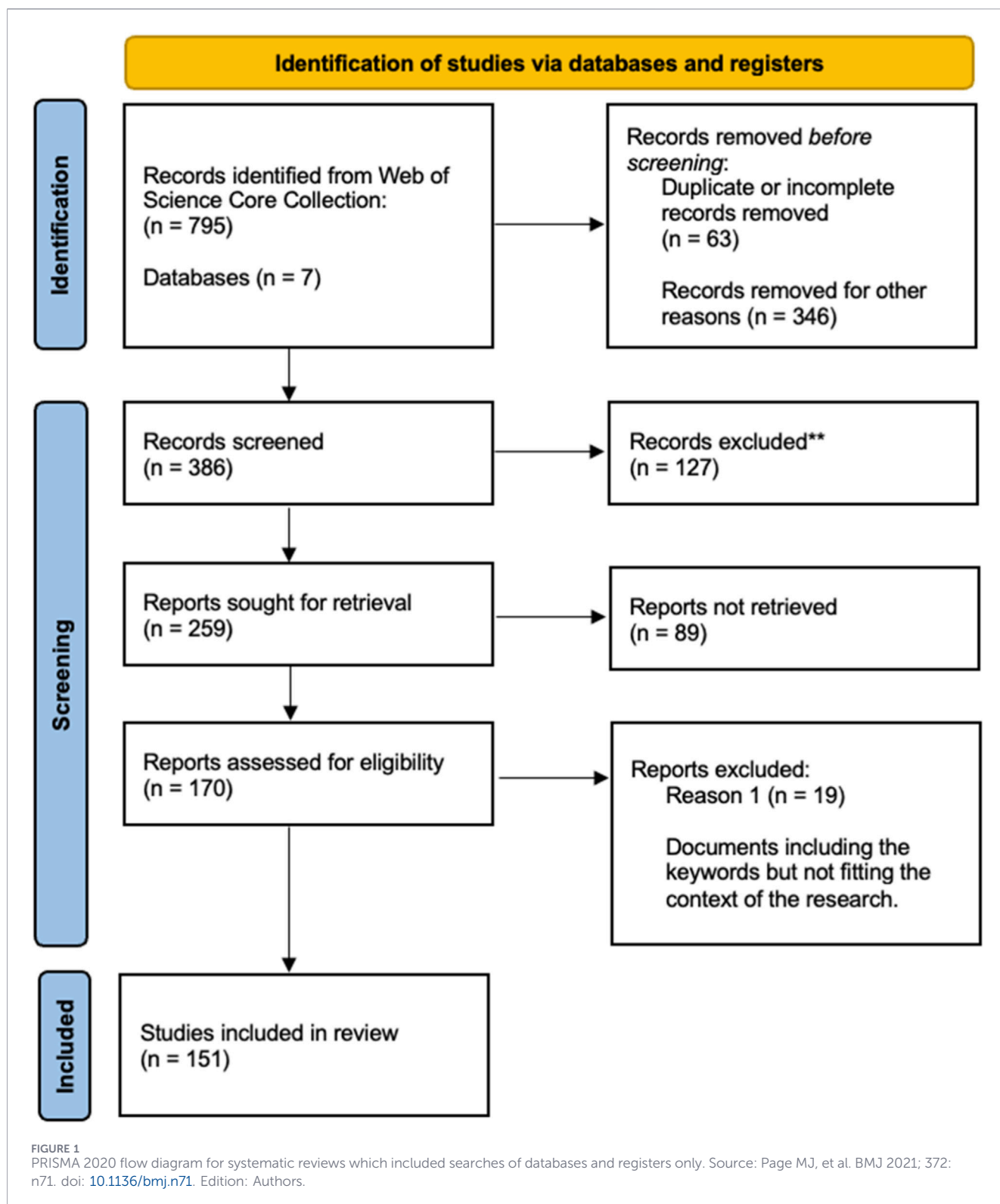
This study investigates the relationship between the built environment and wellbeing. It addresses the built environment from an urban morphological perspective, emphasising the physical form of cities, following a long line of research on the interrelations of urban planning, the environment, human wellbeing, and how urban design affects inhabitants’ health and social conditions (Geddes, 1915). Moreover, it addresses the distinction between objective and subjective wellbeing and emphasise the latter’s importance in the built environment. In line with this scope, the following research questions are formulated:

1. What characteristics of the built environment relate to wellbeing?
2. How can these characteristics be used to build a framework that informs urban and spatial planning and design processes?
3. How can the performance of the built environment in inducing subjective wellbeing be assessed?

2 Methodology

A systematic literature review was conducted to identify aspects of urban form related to the study of wellbeing within the context of the 15 MC to identify interconnected aspects that have been addressed independently across the literature. The Web of Science Core Collection along with six additional databases were used to locate publications related to urban form and wellbeing.

A total of 795 publications were identified and 386 were independently screened. Following this, duplicates and irrelevant documents, those containing some of the keywords but not fitting the context of this research, were discarded. This refinement process resulted in 151 unique studies with relevant data, which were subsequently used to develop our framework (Figure 1). The



query parameters included the following: TS=((('urban form*' OR 'urban morphology*' OR 'city form*' OR 'urban structure*' OR 'built environment*') AND ('wellbeing*' OR 'objective wellbeing*' OR 'subjective wellbeing*' OR 'subjective wellbeing*' OR 'objective wellbeing*')) and Preprint Citation Index (Exclude-Database) and Article (Document Types) and English (Languages).

The literature search did not include “15-min city” as a mandatory keyword because the review aimed to capture the broader body of evidence on urban form and wellbeing that underpins, but is not limited to, the 15 MC discourse. Many of the spatial characteristics central to the 15 MC, such as walkability, access to services, mixed use, density, and access to green space, are

TABLE 1 Urban form aspects found in the literature that relate to wellbeing.

Urban form	Description	# Publications
Green and blue access	Access or proximity to green and blue areas such as parks, forests, rivers, lakes, and seas.	91/151
Walkability	Accessibility by foot, commonly defined as places/services reachable within 15 min.	76/151
Density (DNT)	Measure of human occupation, activity, or development within a defined unit of area. In general terms, urban density describes the degree of compactness of people or development in a city. Measures include those of built form (for example, FSI, GSI) or those of people, jobs, and housing units.	73/151
Services	Feature or facility of a building or place that is intended to make life more pleasant or comfortable for the people. They are linked to the daily life needs of residents in a place. Examples of services include but not limited to grocery and convenience stores and access to public transit, schools, professional services, medical facilities, and cultural facilities.	38/151
Mixed-use (MXU)	Mixed-use refers to the mix of at least two functions at a minimum level of scale (building, plot, 15-min walkable area).	28/151
Urbanity (Vibrancy)	Urbanity generates enough diversity – the mixture of uses and activities – to be self-sustaining. This diversity must be sufficiently complex to stimulate public contact, transactions, and street life (Montgomery, 1998).	11/151

more extensively discussed in adjacent urban planning, public health, and urban morphology literatures than under the 15 MC label itself. The 15 MC therefore, serves in this paper as an interpretative planning concept.

Based on their research focus, journal outlet, and priority keywords (i.e., which keyword was central to the publication, which were complementary), the publications were clustered into seven categories. Each article was then analysed for statements on urban form and wellbeing, and the relevant information was recorded in an Excel table. The synthesis informed the key diagram and relational table presenting the overall framework.

3 Results

The review comprised 151 articles across 86 journals (see Appendix). The publications were categorised into seven clusters: Spatial and Urban Studies; Medical and Health Sciences; Environmental Sciences; Business, Economics, and Technology; Social Sciences and Public Policy; Transportation and Mobility; and Other. This classification highlights the multidisciplinary relationship between urban form and wellbeing, while also indicating a gap in transdisciplinary approaches.

Overall, the findings point to the need to integrate diverse academic perspectives to better understand the links between urban design and quality of life, particularly in the context of 15 MC. Bridging these gaps is important for developing more holistic strategies to enhance urban accessibility and wellbeing.

3.1 Urban form

The literature review showed that the most common spatial indicators addressed in connection with wellbeing are (in order of importance): accessibility to green and blue areas, walkability, density presence of certain services (e.g., cultural, sportive, and spiritual), (mixed) land use, and urbanity (vibrancy) (Table 1).

The main components used in urban morphology studies to describe urban form are buildings (and their associated open spaces), plots, and streets (Scheer, 2015). As part of street networks, streets serve as a proxy for pathway choices,

differentiating the accessibility of, and relationships between, places (Hillier and Hanson, 1984). In Space Syntax studies, street network centrality is defined as ‘how the line is positioned with respect to the system as a whole’ (Hillier, 1996), influencing movement flows and the accessibility of activities.

Plot structure represents the granularity of land ownership and can enable different strategies of owner-occupation that, according to Marcus (2005) may support higher diversity. At the scale of buildings, Berghauser Pont and Haupt (2023) introduces a multi-factor measure for built density to describe building types. The intensity of built space, measured as the Floor Space Index (FSI), is commonly used as an indicator of potential access to people and activities. Types of built environment can therefore be described through combinations of intensity and compactness.

Density, in its many variations, was the third most recurrent aspect in the sample and appeared in the earliest studies as a concept related to wellbeing. High-density environments that lack open space, light, and air have been shown to contribute to social deprivation, ill health, and crime across different contexts and historical periods (Chen et al., 2024). People and built densities also largely determine the availability of jobs, infrastructure facilities, leisure, and mobility opportunities. Mixed-use facilities, as indicated by (Gehl, 2010), can be understood as incentives for pedestrian mobility rather than car-dependent movement, which may increase time spent outdoors.

Finally, the composition of built form has been linked to aspects of urban life such as vibrancy, calmness, and attractiveness (Liang et al., 2022; Trossman-Haifler and Fisher-Gewirtzman, 2022). Specific built environments afford different types of activities (Hausleitner and Berghauser Pont, 2017) and are associated with particular patterns of pedestrian movement (Berghauser Pont et al., 2019).

3.2 Wellbeing

Extensive research in psychology and neuroscience documents multiple pathways through which natural stimuli, as well as urban features, favourably affect cognitive and emotional development (H. Kahn and Kellert, 2002; Marselle, 2019) and, in turn, wellbeing. This relationship also operates in reverse: attention restoration theory

(ART) argues that urban life can cause mental fatigue due to an excess of stimuli, alongside the benefits associated with engaging with nature (Lefosse et al., 2023).

It is important to distinguish between subjective and objective wellbeing and, therefore, the methods used to assess it. Psychometric studies of psychological and emotional responses to biophilic experiences commonly use standard cognitive tests, such as the Dot Probe Task (DPT), Implicit Association Test (IAT), and Approach Avoidance Task (AAT), to demonstrate selective attention and preferences (Schiebel et al., 2022), alongside self-assessment questionnaires capturing affect-based experiential states (Hinds and Sparks, 2011). Others assess stress and related responses using indicators such as Visual Working Memory, Sympathetic Activity Index, and Parasympathetic Activity Index (Abdelaal, 2019). Complementing these approaches, Yin et al. (2018) assessed physical stress using wearable biomonitoring sensors for heart rate (HR), skin conductance level (SCL), and blood pressure (BP) against normal ranges, and then evaluated attention and memory through Stroop tests and visual backward digit span tests (Lefosse et al., 2023).

3.2.1 Objective wellbeing

Objective wellbeing (OWB) refers to those indicators reflecting people's material living conditions and the quality of their lives (Voukelatou et al., 2021). Due to its connection to materialism, economists and policymakers have conventionally regarded gross domestic product (GDP) per person—or in a certain area—as a proxy of income, employing it as a reliable indicator of OWB. Nevertheless, GDP has faced criticism as a limited measure of wellbeing, rendering it a potentially misleading tool for informing public policies (Amit and Bibek, 2019; Benjamin et al., 2014). The critique stems from the implicit assumption in using GDP as a wellbeing metric, suggesting that higher GDP automatically translates to greater overall wealth, education, environmental sustainability, health, and happiness.

3.2.2 Subjective wellbeing (SWB)

Subjective wellbeing (SWB) is a multidimensional construct encompassing an individual's self-perceived happiness, life satisfaction, and overall wellbeing. It is commonly divided into hedonic and eudaemonic types (Huta, 2016). Hedonic wellbeing is short-term, arising from the attainment of pleasure and the avoidance of pain. It depends on subjectively determined mental states and is typically assessed via frequency ratings of emotions (e.g., how often one feels happy, calm, hopeless, or sad) (Huta, 2016).

Mental health can be assessed using the Mental Health Continuum Short Form (MHC-SF), developed by Keyes (2014), which provides differentiated results on emotional, social, and psychological wellbeing. This aligns with the World Health Organization's definition of mental health as 'a state of mental wellbeing that enables people to cope with the stresses of life, realise their abilities, learn well and work well, and contribute to their community' (WHO, 2022).

Eudaemonic wellbeing relates to experiences that are naturally good for a person and satisfy internal mental needs. It is associated with longer-term effects, including flourishing, optimal functioning,

self-actualisation, self-realisation, personal meaning, and growth (Huta, 2016). Discussions of this concept trace back to Aristotle, Epicurus, and the Stoics, and are developed in modern work such as Maslow's (Huta, 2016) pyramid of needs, where eudaemonic wellbeing features among higher human necessities for self-fulfilment (Figure 2).

The literature review highlights four critical aspects closely associated with subjective wellbeing: the aesthetic value of the built environment, a sense of belonging, and interconnected concepts such as social cohesion, social interactions, community sentiment, emotional wellbeing, and safety. These can also be related to the four affective-emotional (clusters of) benefits as discerned by Lefosse et al. (2023) related to topophilia (biophilia) mentioned before (Table 2).

3.3 Urban form and subjective wellbeing

Figure 3 shows the frequency of reported interlinkages between urban form and subjective wellbeing aspects in the reviewed literature. The figure visualises cooccurrence patterns but does not imply that all relationships are equally robust, causal, or supported by comparable methodological depth across scales.

3.3.1 Aesthetics

Aesthetics is a multifaceted concept encompassing beauty, the evocation of intense emotions, and the perception of art (Nasar, 1997; Sternberg, 1931). In urban settings, it can be understood as the interplay between environments and buildings, emphasising well-formed and harmonious spatial relationships (Rezaifar, 2023). This dimension of human experience influences individuals both consciously and subconsciously, shaping preferences and behaviour, particularly regarding the places they frequent, thereby giving aesthetics a distinctly spatial character.

The review identified 32/151 publications addressing linkages between aesthetics and urban form. However, the evidence base remains methodologically and spatially skewed towards mono-scale and mono-method studies, largely quantitative approaches limited to the neighbourhood scale. While these studies illuminate specific relationships between aesthetics and urban forms, they do not yet provide a holistic view of either construct.

Appearing in more than half of the publications, walkability (WKY) emerged as the most frequently discussed urban aspect associated with aesthetics. This relationship is unsurprising: walking is closely tied to both urban form and subjective individual wellbeing. Walking patterns are shaped by built-environment characteristics, while the design of urban spaces and individual interests strongly influence where and how much people walk (Ewing and Handy, 2009). Accordingly, the perceived image of a city, i.e., its attractiveness and aesthetics, can motivate people to explore, visit, and take photographs, bringing other urban form elements into focus that support walkability and pedestrian flow (Barros et al., 2017; Sonta and Jiang, 2023; Yang et al., 2022). This aligns with work highlighting how street vibrancy, mixed-use land, service availability, aesthetic features, higher densities, and pedestrian-friendly street design increase attractiveness and desirability, best experienced through active mobility such as

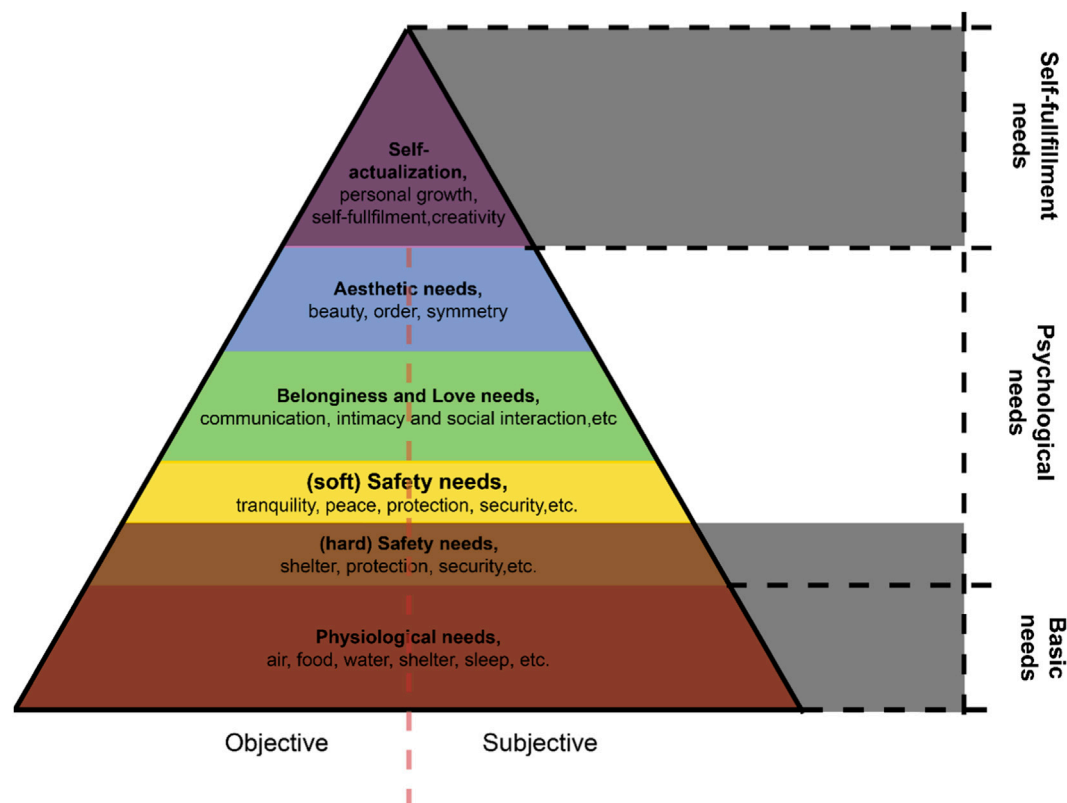


FIGURE 2

Adapted version of Maslow's pyramid reflecting two dimensions of wellbeing. Translucent shading at the top and bottom highlights the middle-section focus of the proposed framework, namely, physiological needs.

TABLE 2 Subjective well-being publications breakdown resulting from literature review.

Subjective wellbeing aspect	# Publications
Aesthetics	32/151
Belonginess	46/151
Emotions	115/151
Safety	42/151

walking (Cao et al., 2009; Ewing and Cervero, 2010; Handy et al., 2005; Heath et al., 2016; Lucchesi et al., 2021; Quinn et al., 2023).

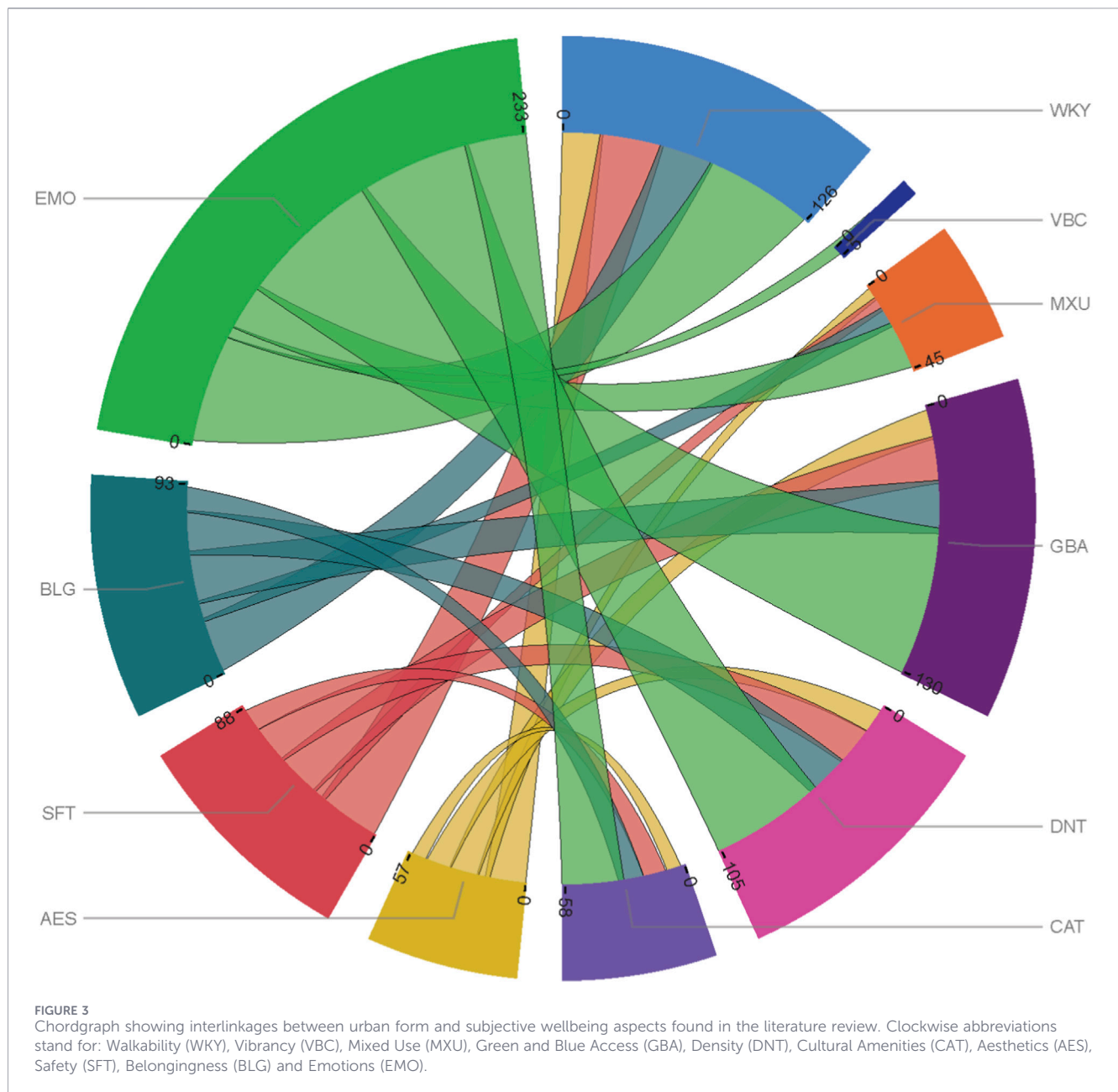
Beyond attractiveness, there is substantial evidence that walking supports health outcomes: it reduces stress and benefits cardiovascular, metabolic, and emotional health (Lai et al., 2022; Roe et al., 2020). Walkable streets can also encourage social co-presence, inclusion, and neighbourhood cohesion (Legeby et al., 2015), reinforcing perceived liveability (Stavroulaki and Pont, 2020). Streets that facilitate informal encounters foster social networks and attachment (Stavroulaki and Pont, 2020) counteracting loneliness, which is linked to higher mortality (Harris, 2023), cardiovascular disease (Paul et al., 2021), metabolic disorders, mental health issues, and cognitive decline (Browning et al., 2022).

Green and blue spaces (GBA) were the second most prominent urban form aspect linked to aesthetics. For instance, Liang et al.

(2022) show how interventions targeting green and blue spaces in key locations in Milan increased pedestrian flow and the volume of social media posts and photographs, thereby attracting attention and eliciting positive feelings among potential users. At a broader urban-economic level, Carlinio and Saiz (2019) report a positive association between city beauty and the ability to attract jobs and new residents, particularly highly educated and affluent groups. Their approach combined indicators such as parks, historic spaces, proximity to coastlines, bodies of water, or mountains, and the size of the tourism industry, alongside a 'beauty indicator' derived from geotagged photographs from platforms such as Panoramio and Google Maps. Complementing this, Luttik (2000) finds a significant correlation between aesthetics and property values: people are willing to pay more for homes in attractive places with abundant green and blue spaces than for comparable locations lacking such features.

3.3.2 Belonginess

A sense of belonging (BLG) is an important determinant of objective and subjective wellbeing (Sherrieb et al., 2010). In psychology, belonging is 'a subjective feeling that one is an integral part of their surrounding systems, including family, friends, school, work environments, communities, cultural groups, and physical places' (Hagerty et al., 1992). Our review indicates that urban form characteristics, walkability, density,



green and blue spaces, and mixed uses, are consistently associated with belongingness.

Mixed-use (MXU) development can support belonging by enabling everyday encounters and lowering the effort required to participate in local life. Mixed-use areas reduce travel distances and increase accessibility, thereby strengthening opportunities for social interaction and community engagement (Hoppenbrouwer and Louw, 2005). Howden-Chapman et al. (2021) notes that mixed-use urban environments are 'linked to higher levels of social engagement', which may reinforce community bonds. Context-specific factors also matter: satisfaction with shops, leisure facilities, and public transport (Fleury-Bahi et al., 2013) can influence social cohesion and mental health (Cardinali et al., 2023).

Walkability similarly shapes belongingness by increasing incidental contact in daily routines. Walkable neighbourhoods

and streets (Martire et al., 2023) encourage informal interactions because people are more likely to meet, observe, and engage with others while moving through shared spaces. Building upon Leyden (2003), Rashidfarokhi and Danivska (2023), [p. 754] state that 'walkable, mixed-use neighbourhoods can encourage the development of social capital and place attachment through an increase in interactions.

Accessible green open spaces (GOS), such as urban parks, further support belonging by facilitating interaction and place attachment. Evidence exists for partial effects from GOS to social cohesion (Giles-Corti et al., 2016; Wan et al., 2021) and from social cohesion to mental health (Santini et al., 2020), yet the full impact pathway remains inconclusive (Cardinali et al., 2024). Although less studied, blue spaces (e.g., lakes, beaches, rivers) may provide restorative settings that also enable social connection. In a

Spanish case, [Subiza-Pérez et al. \(2020\)](#), [p. 5] found ‘that beaches, in comparison with parks, triggered greater levels of attachment and identification’.

Density and centrality can contribute to belonging, but their effects appear contingent on perceived cohesion and the quality of shared space. [Tao et al. \(2020\)](#) show that higher population density may correlate with more social interactions, while belongingness depends on neighbourhood attachment and perceived social cohesion. Built density also affects the availability and quality of public (green) space, which can either support or strain social cohesion. Reviewing links between densification and greenspace accessibility, [Madureira and Monteiro \(2021\)](#) note that cohesion is often challenged in high-density areas but can be supported through well-planned public green spaces ([Raman, 2010](#)). Centrality may amplify interaction by increasing visibility and access to key places, yet reviewed studies provide limited clarity on where centrality becomes overcrowding and informal networks weaken ([Piasek and Garcia-Almirall, 2024](#)). This threshold is likely culturally dependent.

Taken together, mixed-use, walkability, access to green or blue spaces, and appropriately managed density and centrality can strengthen belonging when they enable contact, trust, and attachment. Social cohesion refers to engagement and social trust among community members ([Speer et al., 2001](#)), and is unlikely to emerge where the physical environment inhibits interaction. Spatial and psychological barriers, such as fear of crime, can reduce opportunities for contact and support, undermining cohesion and ultimately belonging.

Belonging also develops across the life course and scales, expanding from immediate settings (home, street, neighbourhood) to wider territories as people age and move. This multi-scalar character connects belonging to urban form through both objective and subjective conditions, including the adequacy of housing and public space, safety and fear of crime, personal physical and psychological state, and the quality of social relations ([Macintyre et al., 2002](#); [Schwirian and Schwirian, 1993](#)).

3.3.3 Emotions

Emotions are closely linked to mental health, although evidence suggests that stress and affect may vary across societies ([Gallup, 2019](#)). Urban form is therefore a critical determinant of quality of life through its influence on emotional wellbeing. In our literature review, this subjective wellbeing dimension appears in most publications (76%) addressing urban form.

Urban density shows a nuanced relationship with emotional wellbeing. Higher-density settings can support social interaction and service access yet may also increase stress and perceived crowding where infrastructure is insufficient. [Mouratidis \(2019a\)](#) finds that compact urban forms with higher densities and mixed-use functions are associated with higher life satisfaction, partly due to shorter distances to services and stronger access to social networks. At the same time, excessively high densities can reduce wellbeing through noise, pollution, and diminished privacy.

Green space access is consistently associated with improved emotional wellbeing, with studies repeatedly reporting stress reduction and mental health benefits. [Wu et al. \(2022\)](#) find a positive association between urban greenness and life satisfaction, particularly in residential locations, and suggest that greenness

combined with mixed land use further strengthens these effects. [Su et al. \(2022\)](#) similarly report that immediate exposure to nearby green space increases momentary happiness, especially in urban contexts. Earlier work supports these findings: [Marselle et al. \(2015\)](#) indicate that green environments can enhance emotional wellbeing, particularly following physical activity.

Blue spaces are discussed less directly in the reviewed papers, but available evidence points in a similar direction. [Samuelsson \(2021\)](#) highlights environmental diversity, including green and water features, as relevant for restorative experiences and emotional wellbeing. Other research likewise links proximity to water with improved mood and lower stress ([Huynh et al., 2013](#)).

Walkability also contributes to emotional wellbeing by enabling physical activity, everyday social contact, and convenient access to services ([Frank and Engelke, 2001](#)). [Gjerde and Vale \(2022\)](#) show that aesthetically pleasing streetscapes encourage walking, which is associated with improved mental health and social engagement. Complementing this, [Ma et al. \(2024\)](#) find that higher-quality street spaces, especially those perceived as safer and more interactive, are strongly linked to subjective wellbeing. These findings align with earlier evidence that walkable environments support active transport and are associated with lower levels of depression and anxiety ([Frank and Engelke, 2001](#)).

Beyond density, greenery, and walkability, vibrancy can shape emotions by creating opportunities for social and cultural participation. [Barrie et al. \(2023\)](#) emphasise the role of vibrant public spaces in building community in mixed-use high-rise areas; in Adelaide, public spaces attracting diverse users supported interaction and were positively associated with emotional wellbeing. Similarly, [Zhao et al. \(2025\)](#) reported that vibrant, well-designed public spaces characterised by the presence of other people, trees, and grass can reduce loneliness while fostering positive emotions.

Evidence on how emotional outcomes vary across spatial scales remains limited and case specific. In a Dutch case, [Ettema and Schekkerman, \(2016\)](#) suggest that neighbourhood characteristics may influence wellbeing more strongly than accessibility to urban facilities. In the Vancouver metropolitan region, [Martino et al. \(2021\)](#) find that the intensity of the built environment mattered more for emotional wellbeing than centrality and diversity.

3.3.4 Safety

Safety is a multi-dimensional concept shaped by urban, architectural, and ecological conditions that together create a supportive living environment within a territory. A place can be considered safe when residents feel safe and when environmental exposure does not threaten essential facilities and inhabited areas ([Rastyapina and Korosteleva, 2016](#)).

The density–crime relationship has long been examined and remains context-dependent. Early work by [Watts \(1931\)](#) identified population density as a factor affecting crime rates in Canadian cities. More recently, [Browning et al. \(2010\)](#) report that higher commercial and residential density is associated with increased homicide and aggravated assault in Columbus, Ohio. [Amirusholihin et al. \(2024\)](#) similarly suggests that population density, alongside per capita income, contributes to variation in crime rates in East Java.

Beyond density, perceived safety is strongly influenced by spatial configuration and enclosure. Baran et al. (2018) suggests that highly enclosed spaces are typically perceived as less safe than those with moderate or low enclosure, and that the presence of unfamiliar individuals and pathway configuration shape these perceptions. This aligns with Jacobs (1961) and Gehl (2010) who argue that streets and pathways that support lingering, sitting, and walking can strengthen feelings of security. Dumbaugh (2008) finds that increasing access points in residential street networks, reducing disconnected street patterns, shortening walking distances, and aiming for travel distances of a quarter mile or less can improve perceived neighbourhood safety. Van Nes and Lopez (2010) further emphasise intervisibility, including entrances and windows on both sides of streets, as a key urban design factor for safety.

Ecological structure, particularly greenery, can also affect perceived safety, though impacts vary by context. Mouratidis (2019b) uses a combined GIS approach in Oslo and reports that increased urban tree cover is strongly associated with higher perceived safety. However, the effects of green open spaces depend on land use, density, and openness. Maas et al. (2009), drawing on a survey of 80,000 Dutch residents, show that although more green space generally correlates with greater social safety, enclosed green spaces in highly urbanised areas may reduce perceived social safety.

Service provision and activity patterns can influence safety outcomes in different directions. Cultural services (CAT), such as libraries, museums, and theatres, may support neighbourhood development and thereby contribute to crime reduction, while other services can increase exposure to crime opportunities. Oyaizu (2006), using spatial econometric models, reports that parking facilities and hospitals are associated with higher crime, whereas retail stores, restaurants, bars, and schools show no significant correlation with neighbourhood crime rates.

Findings on urban vibrancy and crime are similarly mixed. Villar and Thesis, (2020), using business licences as a proxy for urban vibrancy, finds a negative association between vibrancy and higher crime rates. Sinchaisri and Jensen, (2021) operationalise vibrancy in Philadelphia through regular and spontaneous block parties, showing that neighbourhoods with more regular block parties tend to have higher crime rates, while those with a greater share of spontaneous events experience lower crime rates; increases in spontaneous block parties are also linked to declining crime over time. Conversely, Bernasco and Luykx, (2003) finds in The Hague that vibrant and attractive neighbourhoods can become more susceptible to crime and burglary when combined with accessibility and opportunity.

3.4 Findings from a methodological and scalar perspective

The literature also indicates that, given the predominantly quantitative operationalisation of urban form, 70% of the papers focused on this methodological dimension. Only 12% offered qualitative assessment and 8% adopted mixed methods, an important limitation when examining linkages between urban form and wellbeing. Quantitative studies, for instance, may capture the extent of green space, yet overlook whether its quality aligns with residents' values. In such cases, spaces can

remain unused and become "coldspots" within the green network, as Aranda et al. (2023), [p. 1641] reports, thereby failing to deliver wellbeing benefits (Flowers et al., 2016; Kajosaari et al., 2024; Nguyen et al., 2021). These value-laden dimensions, emotion, meaning, and attachment, are difficult to represent through narrow quantitative proxies alone, underscoring the need for integrated quantitative and qualitative approaches.

This methodological bias also shapes how wellbeing is treated. Because more than half of the publications are quantitative, subjective wellbeing, when included, is frequently reduced to numerical measures. Method choice also varies by disciplinary cluster: publications in the social sciences and medical and health fields were more likely to employ qualitative approaches than those in business, economics, and spatial and urban studies, where quantitative proxies are more common. This pattern highlights an imbalance in how subjective well-being is addressed and strengthens the case for methodological pluralism that combines quantitative measurement with robust qualitative evidence.

The imbalance is particularly striking given the prominence of emotions in the literature: emotional aspects were mentioned in 76% of publications, yet only a small subset explored emotions qualitatively. This suggests a gap, as the complex and multifaceted nature of subjective well-being, especially emotional experience, may not be adequately captured by quantitative indicators alone. Mixed approaches can offer deeper interpretive insight, aligning with social-ecological urbanism and with accessibility-driven planning logics in so called X-minute cities, where X stands for diverse time frames.

A similar mono-functional tendency appears in the choice of analytical scale. City-scale analysis dominated (40%), followed by neighbourhood (33%), other (21%), district (5%), and multiscale approaches (2%). Within this review, no study was identified that examines the relationship between urban form and subjective well-being through a multiscale lens while also combining quantitative and qualitative methods. To address this gap, a conceptual framework is proposed that integrates multiscale reasoning with an explicitly mixed-methods methodology.

Conceptually, pairing subjective dimensions with objective counterparts provides a useful entry point. Subjective parameters such as beauty and urban aesthetics can be approximated through objective indicators using proxies such as increased visitation, tourism, economic activity, and social media content. As people gravitate towards places perceived as beautiful, these dynamics were historically observable through footfall and local income; today, geotagged social media data can provide near real-time signals of perceived attractiveness at multiple locations.

The same logic applies to safety. Its objective dimension concerns measurable aspects of security, including crime rates, accident records, emergency response times, surveillance systems, infrastructure quality, and the implementation of safety measures and policies. Perceived safety, by contrast, reflects individuals' and communities' subjective assessments of risk and security in a given environment. A comprehensive approach should consider both dimensions, and their relationship to urban form, to better understand impacts on residents' well-being.

Finally, this need for counterbalance extends to geographical scale. Mono-scale analyses can generate useful insights, but they also risk oversimplification and unintended externalities when broader

interactions are ignored. In this regard, [Curtis et al. \(2020\)](#) warn that city-level indicators used to operationalise policy and resource allocation may not translate into greater equality and well-being at the community/neighbourhood scale. Similarly, [Giannico et al. \(2021\)](#) note that their study does not account for wider geographical scales and their effects on neighbourhood outcomes, calling for policymakers to recognise multiscale limitations in large-scale plans that will require fine-tuning when scaling up or down.

3.5 Synthesis: proposed framework and assessment strategy

Based on the literature review, three methodological challenges are identified: (1) the complexity of measuring environmental and psychologic drivers underpinning perceived qualities ([Zhang et al., 2019](#)); (2) the appropriate unit (scale) of analysis ([Ettema and Schekkerman, 2016](#); [Giannico et al., 2021](#); [Kubiszewski et al., 2019](#); [Wang and Wang, 2016](#)); and (3) the potential mismatch between objective and subjective measures of wellbeing ([Binder, 2014](#); [Cummins, 2018](#); [Fabian, 2016](#); [Voukelatou et al., 2021](#)).

The first challenge reflects the transdisciplinary nature of wellbeing research, spanning psychology, environmental studies, the built environment, and the social sciences. Objective wellbeing is typically assessed through measurable characteristics of living conditions and the lived environment, whereas subjective wellbeing requires methods capable of capturing self-reported feelings, perceptions, meanings, and experiences, as well as estimating how these relate to spatial conditions and everyday practices ([Andalib et al., 2024](#)). The second challenge concerns scale. Current evidence still lacks a robust multi-scalar understanding of how urban form relates to wellbeing, across levels ranging from individual buildings and street segments to neighbourhoods, districts, cities, and regions. Yet the key challenge is often not identifying which factor matters at which level but understanding how multiple spatial conditions co-occur within places and how they are shaped by related places and how they are shaped by broader urban processes and interconnected spatial systems. Recent work on relational urbanism and place-based wellbeing similarly suggests that urban experiences emerge through interactions between morphology, mobility, social infrastructure, environmental exposure and temporal rhythms, rather than through isolated variables ([Mouratidis, 2021](#); [Salmi et al., 2024](#)). To address these challenges, a conceptual framework and methodological roadmap are proposed to link urban form and subjective wellbeing with measurable, objective proxies through a multiscale logic. The framework is organised around subjective wellbeing domains, since these form the principal interface through which residents experience urban environments. For each domain, it identifies the urban form conditions most consistently associated with it in the literature, together with measurable objective counterparts where these are reasonably established, or operational proxies where direct measurable counterparts are absent or difficult to operationalise.

This distinction is important: safety has the clearest objective counterpart in crime, nuisance, and hazard-related indicators, while aesthetics can be approximated through proxies such as visitation, land value, economic attractiveness, and social media traces.

By contrast, belongingness, vibrance, and emotional experience remain more context-sensitive and difficult to operationalise, requiring mixed methods and interpretive approaches capable of

capturing relational and experimental dimensions of urban life ([Hill et al., 2024](#); [Simon, 2024](#)). The framework should therefore not be read as a set of one-to-one equivalences, but as a relational synthesis that connects subjective experience to urban form and measurable evidence across building, street, neighbourhood, and city scales.

[Table 3](#) synthesises the relationships discussed in [Sections 3.1–3.4](#) and shows how subjective wellbeing domains are connected both to measurable counterparts or operational proxies and to specific urban-form characteristics. It distinguishes between more consistently supported links and those that remain more proxy-based, tentative, or context-dependent. It does not represent a formal quantification of relationship strength, but rather a structured interpretation of the evidence reviewed in this paper.

[Table 4](#) translates this relational framework into an operational structure by specifying, for each component, the relevant indicators, their potential spatial aggregation units, main data requirements, calculation methods, and key limitations. In doing so, the table does not suggest that all indicators are equally robust, universally available, or directly comparable. Rather, it provides a modular menu of measures that can be adapted to different case-study contexts and data environments. Urban form indicators are generally the most standardised and transferable, while objective wellbeing indicators depend on local administrative data availability, and subjective wellbeing dimensions often require context-sensitive collection through surveys, PPGIS, interviews, digital traces, or other participatory and computational methods. The table should therefore be understood as an operational guide for assembling a case-specific assessment strategy, rather than as a fixed universal template. Its purpose is to support coherent cross-scalar analysis while making explicit where proxy measures, data substitutions, or methodological triangulation are required.

Within the framework, the urban form component comprises eight characteristics intended to support analysis within and across scales. These include accessible density measures, mixed use, pedestrian flow and walkability, centrality, and accessibility to green, blue, and cultural amenities. Their relevance lies not only in their individual effects, but in how they combine to shape the spatial conditions under which different dimensions of wellbeing are experienced.

[Figure 4](#) illustrates how [Tables 3, 4](#) can be operationalised through a case study in Utrecht, the Netherlands. Rather than presenting an inventory of indicators, it synthesises the reviewed literature as a relational framework: subjective wellbeing dimensions are positioned centrally as the lived interface between urban form and wellbeing, with the most frequently associated urban form conditions shown on the right and corresponding objectives or measurable proxies (where available) shown on the left. In doing so, [Figure 4](#) makes explicit not only which indicators are relevant, but also how they interrelate and where evidence remains partial or uneven.

In the Utrecht example, the blue block (objective wellbeing) integrates data across three administrative scales—neighbourhood, district and municipality (buurt, wijk and gemeente in Dutch), drawing primarily on the Leefbaarometer and the Buurtatlas, complemented by space syntax-based spatial analysis for the urbanity section. The green block (subjective wellbeing) is derived from a Public Participatory GIS tool from ESRI, Survey

TABLE 3 Relationships between components of the proposed conceptual framework.

Subjective wellbeing domain	Measurable indicators and proxies	Associated urban form conditions	Sources
Safety	Crime *; nuisance *; hazard exposure *; accident exposure (?)	Walkability/pedestrian flow *; street visibility/intervisibility *; enclosure (?); centrality (?); density (?); green-space accessibility (?)	Andalib et al. (2024), Mouratidis (2021), S. Zhang (2019)
Belongingness	Residential stability (p); permanence/length of stay (p); local participation proxies (p); social cohesion proxies (?)	Mixed use *; walkability *; green-space accessibility *; blue-space accessibility (?); density (?); centrality (?)	Hill et al. (2024), Moreno et al. (2023a), Simon (2024), Tuhkanen et al. (2022)
Aesthetics	Attractiveness (p); visitation (p); land value (p); economic attractiveness (?); social media/image traces (p)	Walkability *; green-space accessibility *; blue-space accessibility *; density (?); mixed use (?); urbanity/vibrancy (?)	Giannico et al. (2021), Jia et al. (2023), Navarrete-Hernandez and Laffan (2019)
Vibrancy	Footfall (p); activity intensity (p); business activity (?); temporal activity patterns (?); urbanity proxies (p)	Mixed use *; centrality *; cultural services *; walkability/pedestrian flow *; density (?)	Ferrer-ortiz et al. (2022), Khavarian-garmsir et al. (2023), Moreno et al. (2023a)
Emotions	Sentiment analysis (p); digital perception traces (p); behavioural traces (?); image/text-derived emotion proxies (p)	Green-space accessibility *; blue-space accessibility *; walkability *; density (?); urbanity/vibrancy (?); street-space quality *	Andalib et al. (2024), Mouratidis (2021), Shekhar et al. (2019), Simon (2024)

where (*) denotes a relatively stronger relationship in the reviewed literature (p) denotes a proxy-based, measurable relationship; and (?) denotes a more tentative or context-dependent relationship.

123. The orange block is generated through spatial analysis using morphological datasets at different administrative levels from the Centraal Bureau voor de Statistiek (CBS), Geo-Point Utrecht and the Publieke Dienstverlening Op de Kaart (PDOK). Pedestrian flow and foot-traffic intensity can, where relevant, be sourced via the API service Besttime app.

When operationalising the framework, Figure 4 also highlights a persistent challenge: collecting subjective wellbeing data with comparable breadth and depth. While urban form and objective wellbeing are often available through quantitative databases, subjective wellbeing typically requires more heterogeneous methods. Voukelatou et al. (2021), [p. 295] discuss these trade-offs and compare common options. To mitigate these limitations, multiple data sources are triangulated. For hedonic wellbeing, this includes combining ‘active’ and ‘passive’ approaches, such as proxy measures derived from social media or other websites.

For example, Ordoñez and Berg (2014) used street-view photos and the Place Pulse crowdsourced perception dataset to predict perceived safety, uniqueness, and wealth at city scale; Wei et al. (2022) used street-view images and deep learning to map parcel-level perceptions of security, depression, vitality, and aesthetic quality in Shanghai; and Liu et al. (2023) extracted six perception dimensions from street-view panoramas (wealth, boredom, depression, beauty, safety, and liveliness) using a machine learning framework. Complementing image-based proxies, Snaphaan et al. (2024) analysed Google Places ratings for non-residential facilities in sampled neighbourhoods in Ghent and London as a proxy for place management quality and linked these ratings to crime occurrence at the street-segment level. APIs can further support rapid collection at scale, including emotion analysis using geotagged media and text (Siriraya et al., 2023).

Social media APIs provide access to large volumes of qualitative, often geo-referenced data, while more affordable and accessible tools such as Public Participatory GIS (PPGIS) (Sieber, 2006), language models, and artificial intelligence can increasingly support assessment of subjective concepts at scale. Although related work can be traced back to at least 2011 (Goebel et al., 2011), the literature has expanded rapidly since 2021 (Figure 5).

As a complement to APIs, digital PPGIS tools can be deployed through hybrid engagement strategies spanning active to passive modes (Ramirez Aranda and Vezzoni, 2021), in combination with Large Language Models.

Sacco et al. (2026) provides a practical implementation of this approach. Instead of relying on a pretrained model to classify subjective wellbeing variables, Sacco et al. (2026) trains a model using a bespoke vocabulary co-developed through stakeholder workshops in the Utrecht case study area. This vocabulary explicitly covers each variable within the subjective wellbeing concept and is then applied to analyse the PPGIS survey. The bottom-up construction process used is FREDoC (Fuzzy Relevance Emotions Document Classification) (Cardone et al., 2022; 2024), which is well suited to contexts where perceptions are ambiguous and non-binary. The resulting fuzzy sets were projected into a GIS environment to be later combined with the other components of the framework.

Unlike machine learning approaches that require large, labelled training datasets, FREDoC uses TF-IDF (Term Frequency–Inverse Document Frequency) weighting to quantify how strongly a term recurs across documents relative to the corpus as a whole, and then converts these relevance scores into fuzzy linguistic labels (very low, low, medium, high, very high) using a predefined fuzzy partition. Although it does not offer the breadth of APIs and big-data

TABLE 4 Compilation of framework indicators, their description, and implementation considerations.

Type	Indicator	Description	Scalability	Spatial aggregation units	Data needed	Data limitations	Tool/source
Urban form	Accessible FSI	Floor area within a building in relation to the surface of a specified area, calculated as a cumulative measure for the area that can be reached within a specified distance	Can be calculated for metric, angular, topological, and time distances	- Plot - Street - Block - Neighbourhood	- Street network - Building footprint - Aggregation unit - Number of floors	The information on accessibility, for whom and at what time may not be available	- Place syntax (Stähle et al., 2005) - Measure (Berghauser Pont et al., 2019)
Urban form	Accessible GSI	The proportion of built-up land within a defined area, calculated as a cumulative measure for the area that can be reached within a specified distance	Can be calculated for metric, angular, topological, and time distances	- Plot - Street - Block - Neighbourhood	- Street network - Building footprint - Aggregation unit	The information on accessibility, for whom and at what time may not be available	- Place syntax (Stähle et al., 2005) - Measure: (Berghauser Pont et al., 2019)
Urban form	Mixed-use index (MXI)	Ranges from 1 to 100 depending on the percentage of total floor area devoted to residential use in comparison to floor area dedicated to types of work or services	Through scales	Any spatial aggregation unit	Shape of relevant spatial aggregation unit; surface areas of different uses within spatial aggregation unit;	Higher-resolution information on uses within spatial aggregation units may not be available	van den Hoek J. (2008); van den Hoek J. W. (2008)
Urban form	Pedestrian flow/ walkability	A combination of different measures of urban form known to relate to pedestrian movement	Through scales	Any spatial aggregation unit	- Pedestrian flow - Businesses licenses - Sidewalk width - Building height # of people - Traffic volumes	Most pedestrian and walkability data requires tracking, thus generating privacy issues	- Besttime app - Aino ai **Berghauser Pont et al., 2019
Urban form	Centrality/ Betweenness	Angular Betweenness calculates how often a line falls on the shortest path between all pairs of street segments in a network or how many shortest paths pass through it	Can be calculated for angular distances with different metric radii	Street segment	Street network		Place syntax (Stähle et al., 2005)

(Continued)

TABLE 4 Continued

Type	Indicator	Description	Scalability	Spatial aggregation units	Data needed	Data limitations	Tool/source
Urban form	Accessibility to green spaces	Attraction Reach calculates, for each object (for example, a building) in a set of origin objects, the sum of all attractions (green spaces) from a set of attraction objects that can be reached via the network within a user-defined radius. It typically considers factors such as metric distance to the nearest green space, travel time, as well as the quality, services, and size of the green space itself	Can be calculated for metric distances with different metric radii	• Street segment • Building • Street Block • Green Spaces	Street network, green spaces (parks, gardens, forests, or other natural environments), including information on size, services and quality and entrances to green spaces	Information on the quality of green space may not be available and is very different for specific user groups	Place syntax (Stähle et al., 2005)
Urban form	Accessibility to blue spaces	Attraction Reach calculates, for each object (for example, a building) in a set of origin objects, the sum of all attractions (water bodies) from a set of attraction objects that can be reached via the network within a user-defined radius. It considers factors such as proximity, travel time, physical accessibility, and the quality or usability of the blue space	Can be calculated for metric distances with different metric radii	• Street segment • Building • Street Block • Blue Spaces	Street network, green spaces (such as rivers, lakes, seas, or canals within an urban or rural environment), including the size and quality of the entrances to blue spaces	Information on the quality of blue spaces may not be available and is very different for specific user groups	Place syntax (Stähle et al., 2005)

(Continued)

TABLE 4 Continued

Type	Indicator	Description	Scalability	Spatial aggregation units	Data needed	Data limitations	Tool/source
Urban form	Cultural services	Attraction Reach calculates, for each object (for example, a building) in a set of origin objects, the sum of all attractions (cultural services) from a set of attraction objects that can be reached via the network within a user-defined radius. It considers factors such as proximity, travel time, physical accessibility, and the quality or usability of the cultural services	Can be calculated for metric distances with different metric radii	• Street segment • Building • Street Block • POI for cultural services	Street network, services, including the size and quality of the entrances to blue spaces	Information about the locations and quality of services may not be available and is very different for specific user groups	Place syntax (Stähle et al., 2005)
Objective wellbeing	Crime (safety)	Any act contrary to the legal code or laws	Occurrence per inhabitant in a given time frame and or geographical area	• Administrative units • Neighbourhood • District • City • Zip code	Registered crimes and nuisances, e.g.: • Burglaries • Thefts • Violent crimes • Vandalism • Disturbances	Depending on the region of analysis, data availability and quality might be limited	Leefbaarometer ¹ 2021
Objective wellbeing	Permanence (belongingness)	Measures the length of stay in a single place	• Age group • Nationality • Income	• Administrative units • Neighbourhood • District • City • Zip code	Census data tracking mobility rates within a city	Highly sensitive data which could be hard to reach due to privacy limitations	Census data
Objective wellbeing	Attractiveness (aesthetics)	Refers to the quality of a city or urban area that makes it appealing for residents, visitors, businesses, and investors	N/A	• Administrative units • Neighbourhood • District • City • Zip code	• Steady increase in visitors • GDP • Tourism • Economic activity • Social media content	In certain places, such data is either inexistent, private, or behind paywalls	• Census data • City monitors • Social media • Governmental channels e.g., Leefbaarometer 2021

(Continued)

TABLE 4 Continued

Type	Indicator	Description	Scalability	Spatial aggregation units	Data needed	Data limitations	Tool/source
Objective wellbeing	Urbanity (vibrancy)	The vibrant, mixed-use character of urban environments, where diverse functions (e.g., residential, commercial, and recreational) overlap, leading to dynamic social interactions	Can be calculated for metric distances with different metric radii	• Administrative units • Neighbourhood • District • City • Zip code	• Density and MXU • Social interactions • Accessibility and connectivity • Services • Cultural and economic dynamism	Highly dependent on context, making cross-case comparative analyses difficult	• open street maps • overpassturbo Jacobs, 1961
Subjective wellbeing	Safety	Subjective perceptions of safety felt by residents, visitors, and other city users might not always align with the current crime statistics of a place	• Individual • Collective • Demographic groups	• Administrative units • Neighbourhood • District • City • Zip code	Qualitative data that reflects people's perception of the subject. Ideally, it should have a spatial component in order to identify areas of interest within the territory • Interviews • Surveys • Social media • Social monitors	Aside from data accessibility/quality limitations due to privacy regulations, in some cases, providing feedback regarding safety issues could potentially represent a life threat in people's lives, thus discouraging them from speaking out	• PPGIS • Apps • APIs • Crowdsourcing
Subjective wellbeing	Belongingness	Subjective feeling that one is an integral part of one's surrounding systems, including family, friends, school, work environments, communities, cultural groups, and physical places (Hagerty et al., 1992)	• Individual • Collective • Demographic groups	• Administrative units • Neighbourhood • District • City • Zip code	Qualitative data that reflects people's perception of the subject. Ideally, it should have a spatial component in order to identify areas of interest within the territory • Interviews • Surveys • social media • Social monitors	Often, people who face issues with belongingness are ex-pats. This often means that there is a language barrier to be able to communicate with locals, and thus, any formal consultation methods which do not offer a variety of languages will not capture this indicator	• PPGIS • Apps • APIs • Crowdsourcing

(Continued)

TABLE 4 Continued

Type	Indicator	Description	Scalability	Spatial aggregation units	Data needed	Data limitations	Tool/source
Subjective wellbeing	Aesthetics	The specific interplay between urban environments and buildings, emphasising well-formed and harmonious spatial relationships (Rezafar, 2023)	• Individual • Collective • Demographic groups	• Administrative units • Neighbourhood • District • City • Zip code	Qualitative data that reflects people's perception of the subject. Ideally, it should have a spatial component in order to identify areas of interest within the territory • Interviews • Surveys • Social media • Social monitors		• PPGIS • Apps • APIs • Crowdsourcing
Subjective wellbeing	Vibrance	Measures the level of activity among both commercial and residential citizens in a given urban area	• Individual • Collective • Demographic groups	• Administrative units • Neighbourhood • District • City • Zip code	Qualitative data that reflects people's perception of the subject. Ideally, it should have a spatial component in order to identify areas of interest within the territory. • Interviews • Surveys • Social media • Social monitors		• PPGIS • Apps • APIs • Crowdsourcing
Subjective wellbeing	Emotions	Complex psychological states that involve subjective experiences, physiological responses, and behavioural expressions. They influence how we perceive, interpret, and interact with the world around us	• Individual • Collective • Demographic groups	• Administrative units • Neighbourhood • District • City • Zip code	Qualitative data that reflects people's perception of the subject. Ideally, it should have a spatial component in order to identify areas of interest within the territory. • Interviews • Surveys • Social media • Social monitors	Given that emotions are a very personal and individual subject, some people might not feel comfortable disclosing such information through an active collection system such as interviews	• PPGIS • Apps • APIs • Crowdsourcing

¹The Leefbaarometer is an official, place-dependent database maintained by the Dutch government, providing comparable inputs to a city monitor across multiple degrees of granularity within the Netherlands. Other countries may have tools similar to the leefbaarometer, although these are not always available across scales within the same platform; in such cases, multiple platforms may be needed to achieve a full equivalent.

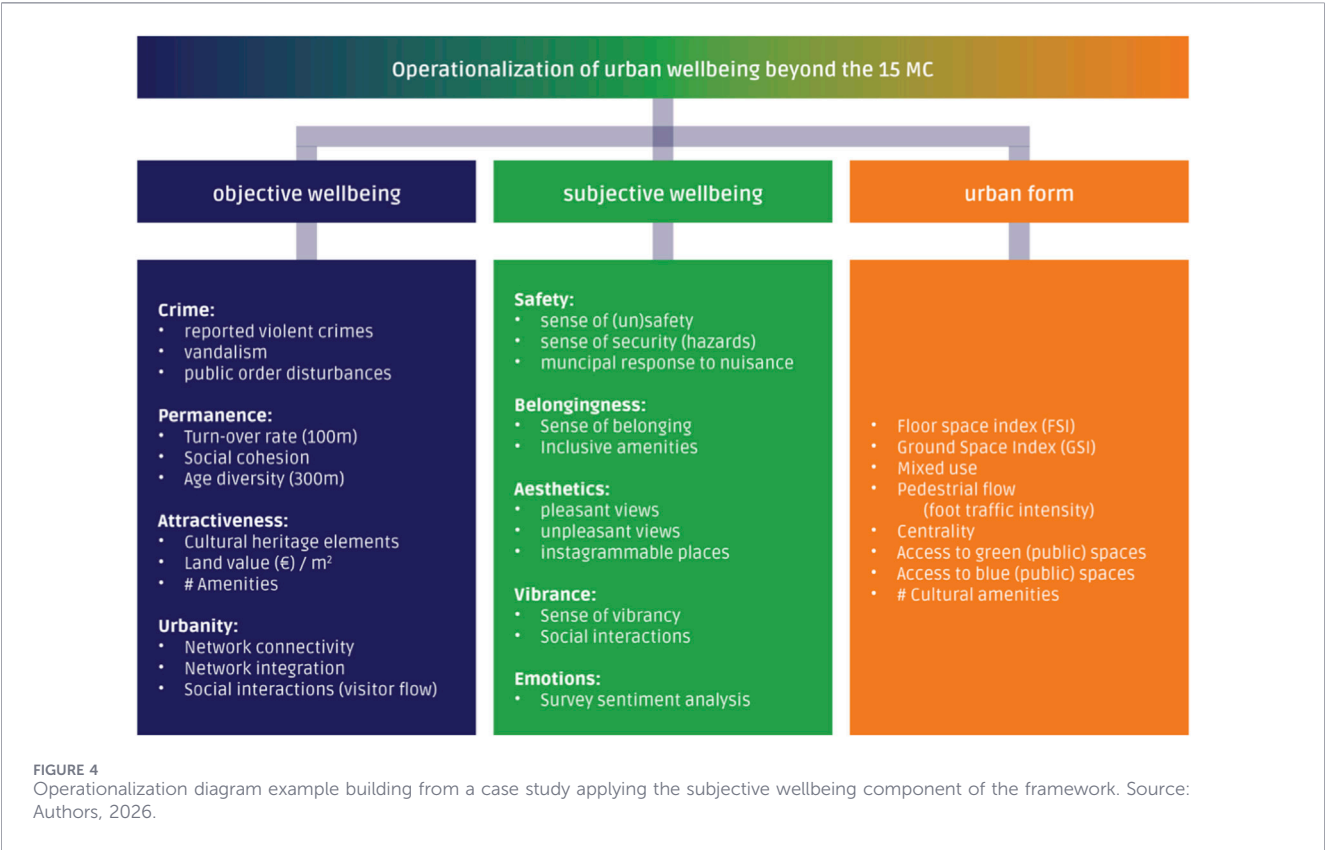


FIGURE 4
Operationalization diagram example building from a case study applying the subjective wellbeing component of the framework. Source: Authors, 2026.

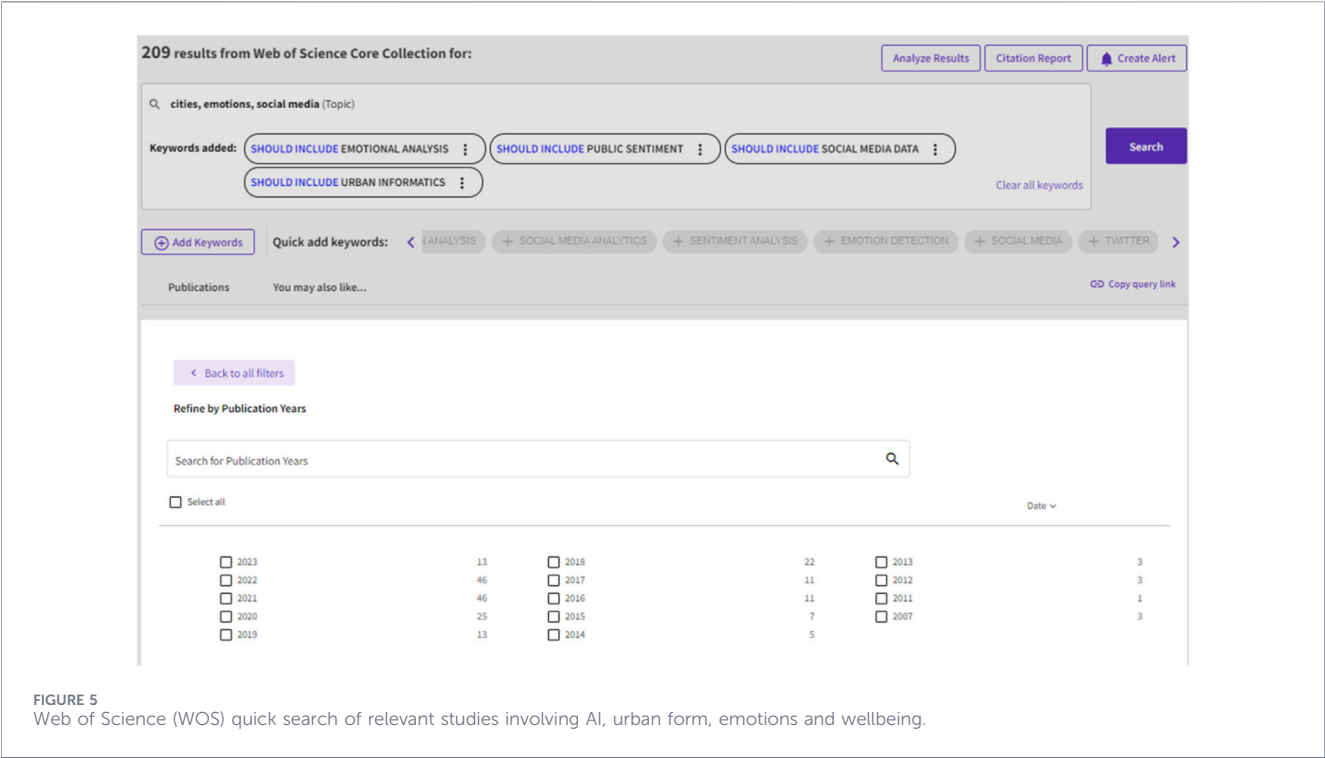


FIGURE 5
Web of Science (WOS) quick search of relevant studies involving AI, urban form, emotions and wellbeing.

resources typical of large-scale platforms, it can generate more context-sensitive insights for specific case study areas.

Given the spatial character of both hedonic and eudaimonic wellbeing, the analytical pipeline should also retain and process location information linked to the extracted attributes. When applying this framework beyond Netherlands, a risk of geographical dependency is recognised, given that Netherlands belongs to a limited and comparatively privileged group of

countries with access to high-quality, publicly available data. Nonetheless, crowdsourcing websites such as Geofabrik, Overpass Turbo and Open Street Maps are daily updated by millions worldwide narrowing the gap of available data. Overall, this combined data-collection and analysis strategy helps address the limitations of individual data sources when assessing wellbeing.

4 Conclusion

Evidence indicates that subjective wellbeing is influenced by urban form characteristics such as green and blue spaces, walkability, and vibrancy. Yet most studies do not examine the scales at which these effects are strongest, nor how these elements interact across scales (e.g., neighbourhood and city). Results indicated that only 2% of the reviewed studies adopt a multiscale approach; highlighting that the literature is otherwise strongly skewed towards single-scale analyses, typically at either the city or neighbourhood level.

To address this gap, our framework adopts a multiscale perspective, using indicators applicable at building, street, neighbourhood, and city levels to support cumulative, cross-scale analysis.

Belonging is also associated with population, built density, and mixed-use areas, which can foster social interaction and community engagement. However, the literature provides limited insight into how different intensities of these characteristics (e.g., excessive density) may support or undermine belonging, particularly across cultural and environmental contexts. This limits the ability to identify thresholds for density and centrality that promote belonging without overcrowding. By combining density and centrality measures with both subjective and objective wellbeing indicators, the framework offers a basis to help fill this gap when applied to multiple cities in future research.

A further gap concerns the dominance of quantitative approaches, especially accessibility metrics, which are central to the 15 MC concept. As a result, design elements such as architectural character, street aesthetics, and the layout and visual appeal of specific urban features remain comparatively underexplored. By using advanced tools such as AI (artificial intelligence) to analyse emotions (e.g., advanced sentiment analysis from text and photo sources), the proposed approach can produce more detailed, spatially explicit insights into wellbeing. This strengthens validation of subjective measures and helps connect environmental and psychological factors. In turn, it enables the 15 MC concept to be interpreted more through urban design and lived experience, and less exclusively through land use and the spatial distribution of facilities.

Overall, the framework addresses the methodological challenges identified earlier by integrating urban form characteristics with both objective and subjective wellbeing measures, and by structuring indicators for use across multiple spatial scales. It also supports more holistic evidence base by combining data sources, for example, quantitative databases for objective wellbeing and PPGIS and social media scraping for hedonic wellbeing. This extends the 15 MC concept beyond needs to include citizens' desires, shifting from a narrow focus on quantifying accessibility towards generating evidence that can inform the design and planning of the 15 MC region as beautiful, sustainable, and inclusive.

Methodologically, many assessments of subjective domains still rely on 'manual' approaches such as face-to-face surveys or *in situ* workshops. While these can yield rich insights, they are time-intensive and often not cost-effective for research across larger or multiple geographies (cities, regions, countries). Post-collection processing can also become resource-intensive, particularly under constrained budgets.

As with any publication, limitations and potential biases are always present and should be disclosed openly for consideration of those seeking to apply it. Two limitations are highlighted in particular: methodological bias and geographical bias.

The outputs of this study comprise a conceptual framework and methodological roadmap derived from a systematic literature review; as such, the results are necessarily constrained by the scope and maturity of the literature analysed. The query described in Section 2 entails two key limitations. First, the "Preprint Citation Index" was excluded because preprints have not undergone peer review and therefore do not provide the same level of quality assurance as published academic literature. Given that the aim of this paper is to develop a robust, literature-based conceptual framework, studies that had completed formal peer-review and publication procedures were prioritised. Second, the review was restricted to English-language publications for practical and methodological reasons. Including multiple languages would have required substantial additional time and resources for translation, even at the screening stage, potentially reducing consistency in study selection. A broader and more systematic screening of peer-reviewed studies in English was therefore prioritised, while acknowledging that relevant insights published in other languages may have been missed.

A risk of place dependency is also recognised, particularly because Dutch-specific sources (e.g., the Leefbaarometer or Buurtatlas) are used in this manuscript. These tools are intended as placeholders that can be swapped according to project needs, rather than fixed requirements. The framework is designed as a modular indicator set with clearly specified data needs, enabling equivalent proxies to be substituted in other contexts. To support transferability and global scalability, an explicit transfer protocol is proposed: (a) translate each indicator into a minimum viable data specification, (b) replace Dutch sources with locally available administrative datasets, globally consistent open datasets (e.g., Geofabrik, Open Street Maps via Overpass Turbo), or functionally model equivalent alternatives based on what is available, and (c) recalibrate indicators and report sensitivity/uncertainty to reflect variation in data quality and coverage.

Despite these limitations and in light of these technological advances, further research should explore the adoption of these emerging tools to enable deeper investigation of how people relate to place across scales. With that in mind, it is important to highlight the privacy and ethical risks associated with emerging tools such as AI-enabled tracking and passive data collection (e.g., pedestrian-flow monitoring). For such methods to be considered fit for public-sector planning, they should operate within clear boundaries: a lawful basis and explicit public-interest purpose; strict data minimisation and proportionality; avoidance of identifiable or re-identifiable individual trajectories; and reliance on aggregated, privacy-preserving outputs that cannot be used to monitor, profile, or target individuals or small groups. Use should be transparent and

subject to robust governance (ethics review and DPIA, secure storage, limited retention, and restrictions on secondary use and sharing). Finally, planners should explicitly address bias and equity risks, since passive datasets may systematically under-represent certain groups and lead to discriminatory inferences if used uncritically.

With appropriate ethical and privacy safeguards, the risks of these technologies can be mitigated, enabling them to strengthen the evidence base for tophophilia in the 15 MC in relation to the other two components. This, in turn, can help clarify relationships between subjective wellbeing (SWB) and urban form across both smaller and larger scales.

Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repository and accession number(s) can be found in the article/supplementary material.

Author contributions

NR: Writing – review and editing, Methodology, Formal Analysis, Investigation, Writing – original draft, Validation, Visualization, Conceptualization. Av: Supervision, Writing – review and editing, Funding acquisition, Writing – original draft, Resources. BH: Writing – original draft, Writing – review and editing. AW: Funding acquisition, Resources, Writing – review and editing.

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