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How to Study Walkability: A Multiscale Analytical Framework

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Abstract

Walkability has traditionally been assessed through physical indicators and objective metrics of the built environment; however, persistent methodological fragmentation limits its interpretive capacity in complex urban contexts. This article proposes an operational analytical framework for the analysis of walkability in Latin American intermediate commercial cities, understood as a relational and multiscale urban condition. The study adopts a qualitative–analytical design based on a systematic literature review and the comparative analysis of seven international walkability assessment methodologies. Through this critical synthesis, a framework is constructed that integrates macro, meso and micro scales, differentiated analytical domains, and a sequential interpretative procedure. The main contribution lies in providing an analytical structure that enables coherent interpretation of the tensions between urban structure, socio-economic functioning and pedestrian experience, avoiding reductive or decontextualized readings of walking in intermediate commercial cities.

Keywords: walkability; built environment; multiscale analysis; urban morphology; design for walkable environments

1. Introduction

Walking in the city is not a neutral or exclusively functional act. It involves a continuous sequence of decisions, where to move, when to stop, what to avoid, which are profoundly conditioned by urban form, land uses, the presence of other people and perceptions of the safety, comfort and vitality of the environment. As Gehl [1] points out, people do not move only according to distance or time, but in relation to the quality of the space they pass through. This idea, anticipated by [2], who recognized the role of the street as the central stage of urban life, has been taken up by recent research that conceives walking as a situated and relational experience, closely linked to the built environment [3–6].

From this perspective, walkability is no longer understood as a sum of isolated physical conditions and is interpreted as an emergent quality of urban space. This implies that walkability cannot be understood through isolated physical indicators alone. It requires an analytical approach capable of capturing the interaction between urban structure, spatial configuration, and pedestrian experience.

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However, when this complex understanding of walking is transferred to the methodological level, a persistent tension emerges in the literature. On the one hand, numerous assessment instruments continue to privilege objective metrics of the built environment, such as density, connectivity or mix of uses, under the assumption that these variables sufficiently explain pedestrian behavior [7–10]. On the other hand, more recent approaches have incorporated perceptual and social dimensions, recognizing that walkability is also configured from the user's experience and everyday practices in public space [5,11–13]. The problem does not lie in the existence of different approaches, but in the difficulty of articulating them within a coherent analytical structure that allows the phenomenon of walking to be interpreted without fragmenting it.

While multiscale perspectives and integrative approaches have been addressed in urban design and walkability research, these contributions often remain implicit, fragmented across disciplines, or limited to the juxtaposition of variables rather than the explicit articulation of analytical decisions. Existing frameworks tend to combine dimensions such as urban morphology, spatial configuration, and pedestrian experience, but rarely formalize how these should be sequentially interpreted or how potential contradictions between scales should be analytically resolved. In this sense, the novelty of this study does not lie in introducing new variables or scales, but in constructing an explicit analytical architecture that structures the interpretation process, clarifies interscale relationships, and prevents common errors of extrapolation between levels of analysis.

This methodological fragmentation acquires special relevance in urban contexts where the street simultaneously fulfills functions of mobility, economic exchange and social life. In intermediary cities with a marked commercial vocation, frequent in Latin America, walking involves crossing dense, mixed and, at times, high-friction urban environments, characterized by the coexistence of formal and informal commerce, intense vehicular traffic and multiple appropriations of public space [14–16]. Research carried out in cities such as Córdoba, San Juan or intermediate urban centers in Chile and Ecuador shows that walkability in these contexts cannot be explained solely from infrastructural standards, but is mediated by socio-spatial inequalities, local economic dynamics and situated perceptions of the urban environment [17,18]. These cases do not delimit the scope of the problem, but they do illustrate its complexity.

In this scenario, the direct application of standardized methodologies can produce partial readings of urban walking. Stefánsdóttir et al. [5] note that many indices have limitations in transferring between different urban contexts, while Herreros-Irarrázabal et al. [19] underline the need to integrate scales and analytical dimensions to avoid simplified interpretations. The question is no longer to measure more variables, but to decide from what scale and under what logic to interpret the available information. Based on this methodological gap, the objective of this article is to build a multi-scale analytical framework that allows us to coherently guide the study of walkability, articulating scales, domains and interpretative decisions within an explicit structure. Rather than introducing a new measurement instrument, the proposal seeks to clarify how existing approaches should be integrated to avoid scaling errors, undue generalizations or fragmented diagnoses. Although the framework is based on problems identified in Latin American intermediary cities of high functional complexity, its analytical logic is transferable to other urban contexts where spatial structure, economic activity, and pedestrian experience converge.

In this way, the article contributes to reorienting the debate on walkability from the accumulation of indicators to methodological coherence. By making explicit a sequence of analysis and a system of interscale articulation, a conceptual architecture is proposed that allows us to understand walkability as a relational and emergent urban condition,

produced by the interaction between urban structure, functional configurations and the pedestrian's situated experience.

2. Methodology

2.1. Design and Scope of the Review

The study was structured as a focused systematic review aimed at identifying and comparatively analyzing formal instruments for the evaluation of urban walkability. Unlike extensive reviews focused on the relationship between the built environment and physical activity, the objective was not to compile all empirical studies on pedestrian behavior, but to isolate structured methodological frameworks that operationalize walkability through indexes, audits or replicable analytical systems. The review was based on the consolidated bibliographic corpus during the development of the doctoral research, which integrates more than 250 academic references related to walkability, built environment and intermediate cities. However, only a fraction of this universe corresponds to formalized methodological instruments. Consequently, the analysis was deliberately restricted to publications that propose explicit and structured systems of evaluation, whether quantitative, qualitative or hybrid. The use of a previously consolidated doctoral corpus did not replace the database search strategy but served as an exploratory and contextual basis for identifying the main theoretical and methodological traditions in walkability studies. To reduce potential selection bias, the final identification of instruments was contrasted with targeted searches in Scopus and Web of Science using explicit keywords and inclusion criteria. Therefore, the review should be understood as a focused systematic review with a qualitative-comparative purpose, rather than as an exhaustive bibliometric review. Its aim was not to represent the entire universe of publications on walkability, but to identify formalized and replicable assessment instruments capable of informing the construction of the proposed multiscale framework. This design responds to a problem identified in contemporary literature: although scientific production on walkability is abundant, the instruments used to measure it are fragmented between scales, disciplinary approaches, and divergent epistemological assumptions. For this reason, the review privileges typological diversity and analytical coherence over statistical representativeness.

The review was conducted using Scopus and Web of Science databases, covering the period 2000–2024, focusing on studies addressing walkability assessment in urban environments, with particular attention to Latin American and comparable international contexts. The search strategy combined keywords such as "walkability assessment," "built environment," "pedestrian environment," "urban audit," and "walkability index" using Boolean operators. Only peer-reviewed journal articles in English and Spanish were considered.

2.2. Instrument Identification and Selection

From the total bibliographic corpus, 38 publications were initially identified that contained explicit methodological frameworks, structured indexes or systematic walkability assessment tools.

The screening process followed a structured procedure. First, duplicate records were removed. Second, titles and abstracts were reviewed to exclude studies not related to walkability assessment or lacking a methodological framework. Third, full-text screening was conducted to ensure that selected studies included explicit and replicable methodological structures. Discrepancies in selection were resolved through iterative discussion among the authors.

These included:

It is important to clarify that the unit of analysis in this review was not the publication per se, but the methodological instrument described within it. A single publication may

present more than one instrument, while some instruments are discussed across multiple studies. Therefore, the reduction from publications to instruments involved an analytical abstraction process, in which methodological structures were identified, compared and grouped independently of their source articles. This distinction ensures conceptual clarity between the bibliographic corpus and the operational frameworks considered in the analysis.

- GIS-based composite indices.
- Microscale audits of public space.
- Structured instruments of perception.
- Multi-criteria approaches.
- Institutional frameworks for assessing the built environment.

Consequently, seven methodologies were considered sufficient to represent the main operational traditions in the assessment of walkability: macro-structural indices, configurational analyses, microscale audits, perceptual instruments, and hybrid models.

In a second phase, three exclusion criteria were applied:

1. Studies that used indices without detailing their methodological structure.
2. Empirical applications that replicated existing instruments without providing conceptual variations.
3. Research focused exclusively on health outcomes without explicit spatial operationalization of the built environment.

After this filtering, 21 instruments met the criterion of constituting formal and replicable methodological frameworks.

The final selection of seven methodologies did not respond to a criterion of quantitative exhaustiveness, but to the principle of conceptual saturation. The goal was to capture the epistemological and scalar diversity of the field. The comparative analysis showed that the incorporation of additional instruments tended to reproduce already identified combinations of variables and aggregation logics, without substantially expanding the emerging analytical typologies. Consequently, seven methodologies were considered sufficient to represent the main operational traditions in the assessment of walkability: macro-structural indices, configurational analyses, microscale audits, perceptual instruments and hybrid models.

Although a formal PRISMA diagram is not included, the selection process follows a progressive filtering logic from identification to inclusion, ensuring transparency in the construction of the analytical corpus.

2.3. Analytical Procedure and Frame Construction

Each of the seven selected methodologies was analytically decomposed to identify its internal structure and scalar positioning. The analysis was not limited to describing variables, but examined five fundamental components: (i) predominant scale of application (macro, meso or micro); (ii) type of variables used (structural, configurational, functional or perceptual); (iii) logic of aggregation of results (additive, weighted, indexed or interpretive); (iv) implicit epistemological assumptions regarding the relationship between objectivity and subjectivity; and (v) treatment—explicit or implicit—of interscale relationships.

This procedure made it possible to construct a comparative matrix aimed at making visible the differences and convergences between instruments. Table 1 summarizes this characterization, highlighting not only the methodological approach of each tool, but also its specific contribution to the proposed multiscale framework.

Table 1. Walkability assessment methodologies analyzed and contributions to the proposed methodological framework.

Methodology/Instrument	Epistemological Approach	Scale of Analysis	Type of Variables	Main Contribution to the Methodological Framework
ALPHA Questionnaire [20]	Perceptive–behavioral	Meso	Subjective—perceptual	Captures pedestrian perception of accessibility, safety, and attractiveness of the environment
National Walkability Index [21]	Technical-regulatory	Meso/Macro	Objective	Evaluates structural conditions of walkability based on density, diversity and connectivity
Neighborhood Environment Walkability Scale (NEWS) [22]	Perceptive–behavioral	Meso	Subjective—perceptual	It allows the relationship between the built environment and residents' perception of the neighborhood to be analyzed
Microscale Audit of Pedestrian Streetscapes (MAPS) [23]	Technical operative	Micro	Objective—Observational	Evaluates in detail the physical quality of the pedestrian space and the continuity of the route
Place Standard Tool [24]	Participatory-social	Micro/Meso	Social—perceptual	It incorporates the collective valuation of urban space and the social dimension of walking
Space Syntax [25]	Morphological-spatial	Micro/Meso	Objective—Configurational	Analyzes spatial configuration and its influence on pedestrian movement potential
Pedestrian Environment Data Scan (PEDS) [26]	Technical-observational	Micro	Objective	Audit physical conditions of the pedestrian environment from an empirical and replicable logic

The comparative analysis showed recurrent patterns of interscale fragmentation. Macrostructural indices tend to privilege quantifiable variables such as density, diversity, and connectivity, but reduce or abstract experiential dimensions. In contrast, micro-scalar audits offer high spatial resolution in the physical assessment of the pedestrian environment, although they often operate disconnected from the broader territorial structure. On the other hand, perceptual-behavioral instruments incorporate relevant subjective dimensions, but they usually lack explicit structural anchorage.

These tensions reveal that fragmentation is not only thematic, but scalable. Most of the instruments analyzed privilege a specific dimension of the phenomenon, generating partial readings that can induce undue extrapolations between levels of analysis. This finding was the starting point for the construction of an integrating framework.

Based on the comparative synthesis, a multi-scale analytical scheme was designed that articulates three interdependent levels: (i) the urban and territorial structure (macro); (ii) the spatial and functional configuration of the tissue (meso); and (iii) the situated pedestrian experience (micro). These levels do not operate in a hierarchical way, but in a relational way, allowing the identification of coherences and tensions between structural, configurational and perceptual dimensions.

The relational nature of these scales can be understood through different types of interscale interaction. In some cases, structural conditions at the macro level are consistently translated into meso- and micro-scale configurations, producing aligned or coherent walkability conditions. In other situations, macro-level structures may appear favorable while meso-scale configurations or micro-level experiences reveal fragmentation or conflict, generating interscale tensions. Finally, mismatches may occur when functional dynamics or localized practices disrupt both structural and configurational conditions, resulting in fragmented or unstable walkability patterns. These relational configurations are not fixed

typologies but analytical interpretations that depend on the specific urban context and the focus of the analysis.

As a result of this articulation, a composite analytical code was developed, conceived as a heuristic device to guide interscale interpretation. This code does not seek to generate a new quantitative index or classify cities in terms of performance, but to avoid extrapolation errors and to structure analytical coherence in complex urban contexts.

3. Results

The main result of this research is the construction of an operational analytical framework that allows urban walkability to be addressed as a relational, multi-scalar and situated phenomenon, specifically in the context of Latin American commercial intermediary cities. The framework is not limited to ordering variables or describing components of the built environment but establishes an analytical architecture from which it is possible to interpret how the structural conditions of the urban system, spatial configurations, socioeconomic practices and the pedestrian experience interact and are stressed in the act of walking. From this perspective, walkability is understood as an emergent urban condition, produced by the articulation, and in many cases by the mismatch, between scales, analytical domains and interpretative decisions.

The framework arises as a synthesis of the comparative analysis of existing methodologies and responds to a structural limitation identified in the specialized literature: the fragmentation of walkability analysis derived from the isolated application of scales, approaches or types of variables. This fragmentation has made it difficult to understand the links between urban planning, daily functioning and pedestrian experience, particularly in urban contexts where socio-spatial complexity is high. In view of this, the proposed framework does not seek to integrate metrics or produce aggregate readings of urban space, but to construct a form of analysis that makes explicit the relationships, tensions and contradictions that configure walkability in intermediary cities with a strong commercial vocation.

3.1. Rationale Andmultiscale Logic of the Analytical Framework

The framework is structured around three scales of analysis, macro, meso and micro, understood not as independent hierarchical levels, but as interrelated analytical instances. Each scale activates specific questions about walkability and produces a different type of reading, the interpretation of which in isolation is insufficient to understand the phenomenon.

On the macro scale, walkability is approached as a potential structural condition, determined by the general organization of the urban system, the location of centralities, the hierarchy of the road network, and the regulatory frameworks that regulate the use of space. In Latin American commercial intermediary cities, this scale allows us to identify territorial discontinuities, articulation deficits and tensions derived from non-homogeneous urban growth models, which condition walking even before its daily manifestation.

The meso scale constitutes the operational core of the framework, as it is the level where structural conditions are translated—partially, ambivalently, or failed—into observable walkability. The analysis focuses on corridors, neighborhoods and commercial centralities, spaces where urban form, the mix of uses, the intensity of economic activity and social practices interact directly. It is on this scale that the contradictions between apparently favorable macro readings and fragmented pedestrian experiences become visible, revealing walkability as a situated, contingent urban condition strongly influenced by functional and socio-spatial dynamics.

The micro scale allows walkability to be approached as a lived experience of walking, incorporating perceptions of comfort, safety, legibility and modal conflict. This scale

is critical to understanding how pedestrians negotiate space in high-friction commercial environments; however, their readings cannot be extrapolated to the urban complex without an interpretation that links them to the structural and functional conditions identified at higher scales.

3.2. Domain Articulation and Analytical Decisions

The operational contribution of the framework lies in the explicit articulation between analytical domains, types of data, and interpretative decisions differentiated by scale. The framework distinguishes between structural-normative, configurational, socio-spatial and perceptual-behavioral domains, understood as analytical categories that allow organizing heterogeneous variables and diverse empirical results without imposing closed typological schemes.

This articulation makes it possible to interpret walkability as a condition produced by the interaction between urban planning, daily functioning and pedestrian experience, making visible the imbalances that are usually hidden in approaches focused exclusively on indicators or specific measurements. This logic acquires relevance in Latin American commercial intermediate cities, where the coexistence of formality and informality, the overlapping of pedestrian and vehicular flows, and the weak hierarchization of public space stress conventional approaches to the analysis of the built environment.

To synthesize the analytical logic underlying the proposed framework, Table 2 presents an integrated view of its multiscale structure. Rather than introducing new variables or measurement criteria, this synthesis articulates the relationships between scales, analytical domains, types of data, and interpretative roles. In this way, it provides a conceptual overview that clarifies how the different components of the framework operate together, reinforcing the relational and non-hierarchical nature of walkability as an emergent urban condition.

Table 2. Multiscalar analytical structure of the proposed framework: relationships between scales, domains, data types and interpretative roles.

Analytical Dimension	Macro Scale (Structural–Normative)	Meso Scale (Configurational–Functional)	Micro Scale (Experiential–Perceptual)	Interscale Integration
Analytical focus	Urban system structure and regulatory conditions	Spatial configuration and functional dynamics of commercial environments	Situated pedestrian experience	Coherence or tension between scales
Key question	Does the urban structure enable pedestrian movement?	Do spatial and functional conditions translate into observable walkability?	How is walking experienced in specific environments?	Do the different readings converge or contradict each other?
Type of variables	Structural, territorial, regulatory	Configurational, morphological, socio-spatial	Perceptual, behavioral, experiential	Relational (cross-scale interpretation)
Type of data	Urban planning data, territorial datasets, cartography	Urban observation, land-use mapping, spatial analysis	Experiential records, perception-based data	Integrated interpretation of all data sources
Analytical role	Defines the structural field of possibility for walking	Acts as the operational core where walkability becomes observable	Provides lived evidence of pedestrian conditions	Articulates coherence or identifies mismatches
Main contribution to analysis	Identifies structural constraints and opportunities	Reveals translations or failures between planning and practice	Captures the subjective dimension of walkability	Prevents fragmentation and scaling errors
Risk if analyzed in isolation	Overestimating structural continuity	Confusing functional intensity with walkability	Generalizing localized experiences	Ignoring interdependencies between scales
Output	Structural condition (S1–S3)	Configurational/functional condition (C/F codes)	Experiential condition (E1–E3)	Composite analytical code (e.g., F2–T)

Table 2 provides a synthetic overview of the proposed framework, highlighting the relationships between scales, domains, and analytical roles. Building on this integrative

logic, Table 3 develops the framework in greater detail by specifying the analytical questions, variables, data requirements, and interpretative risks associated with each scale.

Table 3. Operational analytical framework for the multi-scale analysis of walkability in Latin American commercial intermediary cities.

Scale of Analysis	Central Analytical Question	Type of Analytical Variables Involved	Type of Data Required for Analysis	Analytical Decision Criterion	Analytical Risk if Addressed in Isolation	Function within the Analytical Sequence
Macro	Does the urban structure of the intermediate city enable pedestrian movement within a context of regional commercial centrality?	Structural and regulatory variables (urban hierarchy, location of centralities, potential accessibility)	Aggregated territorial data, urban cartography, planning instruments	Identify structural constraints or opportunities that condition walking before its everyday materialization	Assuming urban continuity where functional discontinuities typical of intermediate cities exist	Defines the structural field of possibility for walking
Meso	Does the spatial configuration favor pedestrian continuity between commercial and residential areas?	Configurational variables (connectivity, centrality, spatial integration)	Network analysis, morphological data, road structure	Detect spatial patterns that facilitate or inhibit pedestrian movement	Confusing commercial centrality with effective pedestrian accessibility	Complements and challenges the normative reading
Meso	Do commercial centralities and corridors translate structural conditions into observable walkability?	Morphological and functional variables (land-use mix, continuity of urban frontage, commercial intensity)	Systematic urban observation, land-use mapping, functional data	Verify continuity or fragmentation of the pedestrian system in high-intensity environments	Overinterpreting local failures without considering structural and economic pressures	Acts as a key mediating scale within the framework
Meso	Does formal and informal commercial activity sustain or weaken everyday walking?	Sociospatial variables (social use of space, informality, commercial appropriation)	Social observation, situated qualitative records, contextual information	Identify tensions between commercial use, mobility, and public space	Attributing walkability problems to "disorder" without relational urban analysis	Explains mismatches between planning and urban practice
Micro	How is walking experienced in high-friction commercial environments?	Perceptual–behavioral variables (comfort, perceived safety, legibility, pedestrian–vehicle conflict)	Experiential records, situated perceptual data	Recognize recurring patterns of pedestrian experience	Generalizing extreme experiences to the entire urban system	Provides lived evidence for the analysis
Micro	What immediate conditions of the commercial environment affect pedestrian movement?	Local physical variables (obstacles, space occupation, point accessibility)	Direct observation, visual documentation	Detect specific critical factors of the commercial environment	Converting micro-level issues into erroneous structural diagnoses	Informs fine adjustments and validates higher-level interpretations

The contextual orientation of the framework does not respond to an arbitrary geographical delimitation, but to the recurrent identification in the literature of these conditions as structuring factors of walkability in this type of cities. The framework is designed to

address these tensions while maintaining its potential to adapt to other urban environments with similar functional configurations.

Table 3 further develops this analytical structure, organizing the readings by scale and explaining the interpretative risks associated with their isolated approach. These partial readings do not constitute autonomous results but represent the analytical input from which the sequential procedure of the framework is activated.

3.3. Operational Synthesis and Construction of the Analytical Code

The operational synthesis constitutes the functional core of the framework and allows the articulation of the multi-scalar reading of urban walking with an explicit sequence of analytical decisions. The framework does not aim to produce integrated diagnoses or classifications of urban performance, but to delimit differentiated analytical fields that allow characterizing, in a situated way, the structural, functional and experiential conditions of walkability.

In addition, Table 4 translates the analytical framework into a sequential procedure of interpretative decisions. Unlike Table 1, whose reading is structural and not linear, this table is read progressively, allowing the partial readings obtained by scale to be integrated and the coherence or interscale tension of the case analyzed to be evaluated.

To illustrate the operational application of the framework, a simplified example is presented. Consider a commercial corridor in an intermediate city. At the macro level, planning documents and urban cartography are analyzed to determine whether the structural configuration facilitates pedestrian movement, identifying a conditioned structure (S2). At the meso level, spatial configuration and land-use data are examined, revealing fragmented continuity due to discontinuous frontages and high vehicular pressure (C3), alongside ambivalent functional conditions driven by mixed formal and informal commercial activity (F2; SS2). At the micro level, field observation and rapid audits identify recurring obstacles, pedestrian–vehicle conflicts, and moderate perceived safety (M2; E2).

By applying the interscale contrast, the readings show tension between relatively stable structural conditions and fragmented or ambivalent meso- and micro-scale conditions, resulting in a tensioned interscale condition (T). The final composite code is therefore constructed as F2–T, indicating ambivalent walkability shaped by functional contradictions and interscale tensions. This example illustrates how heterogeneous data sources are sequentially interpreted through the framework to produce an integrated analytical outcome.

Resulting from the integration of the dominant domain, the dominant condition, and interscale coherence. The composite analytical code fulfills two complementary functions within the framework. First, it operates as a synthetic interpretative output that summarizes the dominant condition of walkability in relation to a specific analytical domain. Second, it acts as a heuristic device that guides subsequent analysis by indicating where interscale tensions or consistencies emerge. These functions are sequential rather than interchangeable: the code is first constructed through the integration of partial readings and is then used to orient further analytical or research decisions.

Regarding reliability, the framework does not aim to eliminate qualitative judgment but to structure it through explicit criteria and stepwise evaluation. Consistency can be strengthened in future applications using shared coding protocols, comparative case analysis, and, where possible, inter-researcher validation processes. In this sense, reliability is approached as analytical consistency rather than statistical reproducibility.

[*Dominant Domain + Dominant Condition*] — [*Interscale Coherence*]

The dominant domain is defined from the initial analytical focus and establishes from which dimension—structural, functional-socio-spatial or experiential—the analysis has

been addressed as a priority. The dominant condition is taken exclusively from the code associated with that domain, expressing the main state of walking within that dimension. Interscale coherence is determined by qualitative evaluation of the relationship between structural, configurational, functional, and experiential readings, distinguishing between integrated, stressed, or fragmented situations.

Table 4. Sequential analytical procedure for the integrated interpretation of urban walkability.

Step	Analytical Decision	Guiding Question	Guiding Factors	Domains	Assignable Partial Code	Implications for the Analysis
1	Definition of the analytical focus (single)	What do I primarily want to understand about walking in this urban context?	Study objective, type of area (center, corridor, specific segment)	—	S/F/E	Defines the entry point of the analysis and avoids diffuse interpretations
2	Urban structural reading	Does the urban and regulatory structure facilitate or restrict walking?	Road hierarchy, centralities, planning, urban continuity	Favorable/ conditioned/ restrictive	S1/S2/S3	Delimits the structural field of possibility for walking
3	Spatial configuration analysis	Is there real continuity in the pedestrian system or systematic disruptions?	Connectivity, crossings, sidewalk continuity, route legibility	Coherent/ tensioned/ fragmented	C1/C2/C3	Distinguishes potential accessibility from effective accessibility
4	Evaluation of urban translation	Are structural conditions translated into observable walkability?	Land-use mix, commercial intensity, active frontages	Continuous translation/ ambivalent/ failed	F1/F2/F3	Identifies mismatches between planning and actual use
5	Sociospatial interpretation	Do commercial activities and social practices support or constrain walking?	Formal/informal commerce, spatial appropriation, pedestrian–vehicle conflicts	Support/ ambivalence/ conflict	SS1/SS2/SS3	Explains walkability as a situated social practice
6	Evaluation of pedestrian experience	How is walking experienced in this specific environment?	Comfort, perceived safety, legibility, stress	Positive/ mixed/ negative	E1/E2/E3	Provides lived evidence without automatically generalizing it
7	Specific physical verification	Are there local factors that alter pedestrian movement?	Obstacles, point accessibility, micro-conflicts	Compatible/ tensioned/ critical	M1/M2/M3	Refines the diagnosis by avoiding overemphasis on micro-level issues
8	Interscale contrast	Do structural, functional, and experiential readings converge?	Results from previous steps	Integrated/ tensioned/ fragmented	I/T/F	Identifies coherence or contradictions across scales
9	Construction of the final code	What type of walkability emerges from the set of decisions?	Integration of all partial codes	Composite code (e.g., F2–T)	Final code	Synthesizes the emergent state of walkability
10	Orientation of subsequent analysis	From which dimension should further analysis or intervention be developed?	Final code obtained	Structural/meso/ micro approach	—	Indicates how to continue the study of walkability

To reduce subjectivity and improve analytical consistency, each category is assigned based on observable conditions derived from the data sources used at each step. Although the framework relies on informed qualitative judgments, subjectivity is managed with explicit analytical criteria, structured sequencing of decisions, and the triangulation of multiple data sources across scales. By requiring that each interpretative step be supported by observable conditions, the framework reduces arbitrary assessment and promotes analytical transparency.

Structural conditions (S1–S3) are defined according to the presence or absence of continuity in the urban system and planning coherence. Configurational conditions (C1–C3) are determined by the degree of spatial continuity and network integration. Functional

and socio-spatial conditions (F1–F3; SS1–SS3) are evaluated based on the consistency between land use, commercial activity, and pedestrian flow. Experiential conditions (E1–E3) are assigned according to recurring patterns in perceived safety, comfort, and legibility, while micro-physical conditions (M1–M3) are based on direct observation of obstacles, accessibility, and conflict points. Interscale coherence (I/T/F) is established by comparing the alignment or mismatch between results across scales.

3.4. Guiding Function of the Analytical Code in the Approach to Walkability

The construction of the composite analytical code constitutes an interpretative result that does not describe urban performance, but rather guides the methodological approach to walkability, indicating from what scale and analytical domain it is pertinent to deepen the analysis. In this way, the code operates as a guidance device that avoids decontextualized readings or poorly scaled analytical decisions. Table 5 systematizes this guiding function, explaining how the most representative combinations of the code indicate the level from which the walkability analysis should be continued, without prescribing solutions or establishing normative hierarchies between scales.

Table 5. Guiding function of the composite analytical code in the multiscale approach to walkability.

Sample Analytical Code	Synthetic Reading of the State of Walkability	Priority Approach Scale/Domain	Sense of the Analytical Approach
C1–I	Consistent and stable walkability	Meso (configurational)	To delve into spatial factors that sustain pedestrian continuity
F1–I	Functionally integrated walkability	Meso–micro (functional–social)	Analyze dynamics of use and practices that consolidate walking
C1–T	Potential walkability with interscale stresses	Micro (experiential)	Identify local frictions that prevent the translation of a good configuration
F2–T	Ambivalent walkability	Meso (functional-socio-spatial)	Examine contradictions between planning, commercial use and mobility
E1–T	Positive pedestrian experience in a conditioned context	Macro–meso	Analyze structural constraints that could compromise the sustainability of walking
C3–F	Structurally fragmented walkability	Macro (structural-normative)	Addressing systemic barriers that impede pedestrian continuity
E3–F	Critically impaired walkability	Macro–meso	Review deep misalignments between urban structure, use, and experience

In this sense, the analytical code reinforces the interpretative nature of the framework and allows establishing a clear bridge between the multiscale analysis and the subsequent phases of discussion or formulation of research strategies.

The figure shows the sequential activation ofmultiscale analysis (macro, meso, and micro), the construction of the analytical code composed of the dominant domain, the dominant condition, and interscale coherence, and its guiding function to identify the priority scale from which to further develop the analysis, as shown in Figure 1.

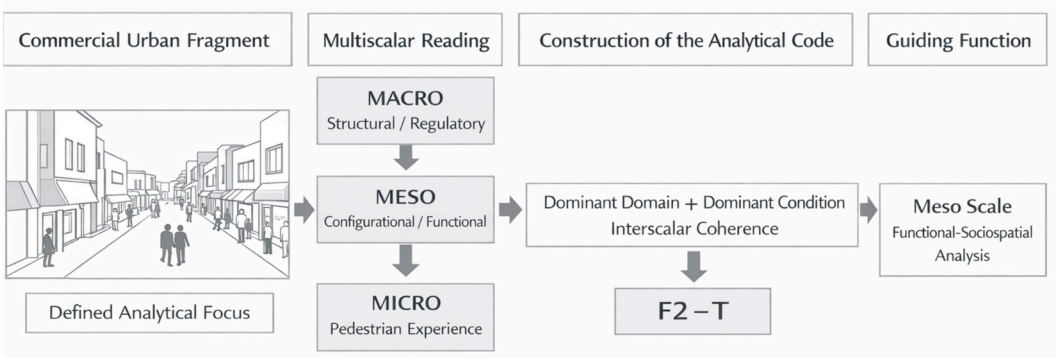

Figure 1. Illustrative application of the multiscale analytical framework.

4. Discussion

The proposed framework helps clarify how walkability should be analyzed across scales by providing an explicit methodological structure. While much of the literature has advanced in the sophistication of indicators—incorporating configurational metrics, perceptual variables, or integrated accessibility models there is still a structural difficulty in articulating these dimensions within a coherent interpretative system [5,8,11,12]. In this sense, the main contribution of the study does not lie in the incorporation of new variables, but in the explicitness of how they should be read together.

The comparative review showed that existing methodologies tend to privilege specific scales: technical indices are in the meso-macro, urban audits in the micro and questionnaires in the perceptual dimension. However, the literature rarely problematizes the risks of extrapolation between levels. The multi-scalar framework developed addresses this omission by formalizing a sequential procedure that forces analytical decisions to be declared, preventing micro results from being generalized as structural diagnoses or macro configurations from being assumed as a guarantee of a positive pedestrian experience.

This contribution is particularly relevant in Latin American commercial intermediary cities, where the overlapping of urban functions, economic informality, and vehicular pressures intensifies the tensions between planning, use, and experience. In these contexts, walkability cannot be understood only as physical continuity or as an isolated subjective perception, but as an emergent condition produced by the friction between structural, configurational and socio-spatial domains.

The composite analytical code can be understood as a methodological contribution that complements existing approaches to walkability assessment. While previous frameworks have focused on the development of indicators, indices, or perceptual instruments, the proposed code introduces a structured way to interpret relationships between scales and domains. In this sense, rather than replacing existing methodologies, it provides an interpretative layer that allows their results to be read in an integrated and coherent manner, particularly in complex urban contexts.

However, the framework retains a conceptual character and requires empirical validation in specific case studies. Its applicability in other urban contexts - particularly in metropolitan cities or in rural environments - should be evaluated considering differences in territorial structure and functional complexity.

From a practical perspective, the framework can be used by urban planners, policymakers, and researchers as a diagnostic and interpretative tool. It allows the identification of mismatches between planning intentions, spatial configurations, and lived pedestrian experience, which can inform targeted interventions at different scales. For example, structural constraints identified at the macro level may guide strategic planning decisions, while meso- and micro-scale findings can support the design of specific urban interventions such

as street redesign, pedestrian prioritization, or the regulation of commercial activities. In this sense, the framework does not replace existing technical tools but complements them by providing an integrated reading that can support more context-sensitive decision-making.

The relationship between contextual specificity and broader applicability is addressed as a distinction between empirical grounding and analytical structure. The framework is empirically informed by the conditions of Latin American intermediate commercial cities, where functional complexity, informal dynamics, and intense pedestrian–vehicular interactions are particularly evident. However, its analytical logic is not restricted to this context. It operates as a transferable interpretative structure that can be adapted to other urban environments, provided that similar conditions of multiscale interaction and functional complexity are present. Therefore, transferability is conditional rather than universal and depends on the availability of comparable data and the relevance of the analytical domains across contexts.

The applicability of the proposed framework is particularly suitable in urban contexts characterized by functional complexity, overlapping land uses, and significant pedestrian–vehicular interaction, such as intermediate or dense commercial cities. Its use in metropolitan or rural environments may require adaptation, especially in cases where urban structure is highly centralized or where pedestrian activity is limited. In addition, the framework assumes the availability of minimum data at each analytical scale, including territorial information, spatial configuration data, and localized observations of pedestrian experience.

Likewise, the construction of the code depends on informed qualitative judgments, which require transparency in its application.

In summary, the study contributes to overcoming the methodological fragmentation identified in the literature by proposing an integrated reading structure that articulates scales, domains and interpretative decisions. This approach does not replace existing instruments but rather reorganizes them within a relational logic capable of capturing the emergent and situated nature of urban walkability.

5. Conclusions

This study was based on a critical observation: the proliferation of walkability assessment instruments has not been accompanied by an analytical architecture capable of integrating them coherently. The methodological fragmentation identified in the literature does not respond to the insufficiency of indicators, but to the absence of an explicit logic that articulates scales, domains and interpretative decisions.

Based on the comparative review of seven international methodologies, a multi-scale analytical framework was constructed that reorders the study of walkability into three interrelated levels macro, meso and micro and links them through a sequential procedure that culminates in the formulation of a composite interpretative code. This code does not intend to measure or classify cities, but to orient the analysis towards the dimensions where interscale tensions or coherences emerge.

The main contribution of the article is methodological–epistemological: it shifts the emphasis from the accumulation of variables to the coherence of analysis. In this sense, walkability is redefined as an emerging urban condition produced by the interaction between territorial structure, spatial configuration, socioeconomic dynamics and pedestrian experience.

Although the framework is based on problems observed in Latin American commercial intermediary cities, its analytical logic is transferable to other contexts where multiple scales and urban functions converge. However, its implementation requires empirical validation in case studies and refinement from comparative applications.

In a field where the discussion tends to focus on metrics, the present study proposes that the fundamental problem is not what to measure, but from where and how to interpret. Under this premise, the multi-scale framework developed constitutes a conceptual tool aimed at strengthening the methodological coherence of the study of walkability and avoiding reductionist readings of the urban phenomenon.

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