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OBJECTIVE NEIGHBORHOOD PLANNING METRICS AND WALKABILITY PERCEPTIONS IN AMRITSAR

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Walkability is widely understood as a product of neighborhood form and residents' perceptions of how safe, convenient, and pleasant walking feels in everyday settings. This study investigates how three neighborhood-planning parameters—population density, accessibility to parks and playgrounds, and street-network connectivity—relate to residents' walkability perceptions across diverse neighborhoods in Amritsar, India. Fourteen administratively defined neighborhoods were selected to represent high-, medium-, and low-density contexts shaped by the city's historical growth and varied residential typologies. Population-density classes were derived from the city's planning framework, while accessibility and connectivity were computed objectively using Google Earth imagery supported by on-ground verification (Singhal, 2022). Accessibility was operationalized as the percentage of neighborhood area within a one-tenth-mile (approximately 160 m) proximity threshold of parks and playgrounds, and connectivity was measured using a dead-end-adjusted intersection-density index normalized to a 0–100 scale for within-city comparison. A walkability perception survey was administered to 224 adult residents by trained architecture students using structured face-to-face interviews, capturing (i) preference for walking over driving and (ii) overall rating of the neighborhood pedestrian environment on five-point Likert scales. Chi-square tests were used to assess associations between perception outcomes and the three planning variables, with Cramér's V computed to summarize association strength. The results indicate that accessibility to parks and playgrounds shows the strongest and most consistent relationship with perceived pedestrian-environment quality, while connectivity is also positively associated with pedestrian-environment ratings but exhibits a weaker link with stated walking preference. Population density demonstrates weaker, context-dependent associations with both perception measures, suggesting that compactness alone does not explain neighborhood differences without considering destination access and network conditions. The study demonstrates the practical value of simple objective neighborhood indicators for diagnosing walkability conditions and guiding local planning interventions in rapidly transforming urban contexts.

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INTRODUCTION

Walkability has become a central concern in urban planning because it links neighborhood structure with public health, social interaction, environmental performance, and urban quality. Planning literature consistently argues that walking is more likely when neighborhoods combine proximity, continuity, safety, and destination richness in ways that support routine daily movement rather than exceptional travel behavior [Ewing, 2000, Talen, 2002, Tibbalds, 2005, Lee et al., 2018]. The issue is particularly significant in rapidly transforming cities where inherited street patterns, fragmented land-use decisions, and unequal open-space provision generate sharply contrasting pedestrian environments over short distances.

A large body of scholarship has shown that walking is influenced by both objective and perceived environments. Objective measures capture observable neighborhood characteristics such as density, land-use arrangement, accessibility, block structure, and street-network form, while perceptual measures reveal how residents interpret comfort, convenience, and safety in actual use [Giles-Corti and Donovan, 2003, Leslie et al., 2005, Lee et al., 2007, Sallis, 2009]. Neither perspective is sufficient in isolation. A neighborhood may appear physically compact yet remain unattractive for walking if open spaces are poorly distributed or if the street network is fragmented. Conversely, residents may perceive a neighborhood as walkable because destinations are near and routes feel legible, even when conventional aggregate density measures are modest.

Among objective planning variables, three have recurring importance in both planning practice and academic analysis: population density, accessibility to everyday destinations, and network connectivity. Density is often treated as a precondition for pedestrian-supportive urban form because it can shorten trip distances, support local amenities, and reduce dependence on private vehicles [Ewing, 2000, Lund, 2003, Lee et al., 2018]. Yet density alone rarely explains pedestrian behavior satisfactorily, particularly where the spatial distribution of destinations and the structure of the local street network vary independently of compactness. Accessibility, especially pedestrian access to parks and neighborhood open spaces, has been repeatedly associated with physical activity and active travel [Barton et al., 2012, Talen, 2002, Zainol et al., 2017]. Connectivity, in turn, affects route choice, travel directness, and the overall permeability of a neighborhood, although the benefits of permeability may interact with safety concerns and local crime perceptions [White, 1990, Hillier and Sahbaz, 2008, Sohn et al., 2018].

Planning and transport guidance has long emphasized that local walking conditions depend on a mix of street design quality, destination access, and connected routes [NZ Transport Agency, 2009, Tibbalds, 2005]. Audit-based approaches have translated these principles into measurable neighborhood indicators, including pedestrian-environment checklists, secondary-data proxies, and GIS-supported accessibility measures [Clifton et al., 2007, Parks and Schofer, 2006, Pentella, 2009]. For Indian cities, where fine-grained micro-environmental audits may be difficult to scale across multiple neighborhoods, simple and reproducible neighborhood-planning indicators can provide a practical basis for comparative diagnosis.

Amritsar offers a compelling case for such analysis. As a historic city with a dense traditional core, intermediate planned neighborhoods, and lower-density peripheral development, it exhibits substantial variation in residential form, open-space availability, and street configuration. Prior work in the city has documented neighborhood-level differences in pedestrian micro-environments and broader walkability concerns [Singhal, 2018a, Singhal, 2018b, Singhal, 2022]. However, a more explicit comparison between objectively measured neighborhood-planning parameters and resident perceptions remains necessary in order to clarify which planning variables matter most for perceived walkability in this context.

This paper addresses that gap by examining how population density, accessibility to parks and playgrounds, and street-network connectivity relate to residents' walking preference and pedestrian-environment ratings across 14 neighborhoods in Amritsar. The paper asks three questions:

RQ1: Does higher neighborhood accessibility to parks and playgrounds correspond to more positive walkability perceptions?

RQ2: Does greater street-network connectivity correspond to more positive walkability perceptions?

RQ3: Does population density, independent of accessibility and connectivity, meaningfully differentiate walkability perceptions?

Based on the literature, three working expectations guide the analysis: accessibility will show the strongest relationship with both perception outcomes; connectivity will show a positive but weaker relationship; and density will display only limited explanatory power when examined without richer information on destination access and network structure. The contribution of the paper is twofold. Substantively, it clarifies which neighborhood-planning variables are most closely aligned with perceived walkability in a rapidly changing Indian city. Methodologically, it demonstrates a parsimonious, transparent way to combine spatial indicators with resident perceptions for neighborhood diagnosis and planning prioritization.

LITERATURE REVIEW

Research on walkability has moved from broad normative claims toward more systematic efforts to measure how physical environments support pedestrian life. Early smart-growth and urban-design arguments emphasized compact form, mixed-use structure, and street continuity as the foundations of pedestrian- and transit-friendly environments [Ewing, 2000, Lund, 2003]. Later work refined the concept by distinguishing between citywide form and neighborhood-level conditions that shape routine travel, especially walking for short trips [Talen, 2002, Lee et al., 2018].

One important line of research examines how perceived and objective environments interact. Giles-Corti and Donovan [Giles-Corti and Donovan, 2003] showed that walking behavior responds to both individual and environmental factors, suggesting that neighborhood form matters not simply because it exists physically but because it is interpreted socially and behaviorally. Leslie et al. [Leslie et al., 2005] and Lee et al. [Lee et al., 2007] likewise demonstrated that residents' perceptions of walkability attributes differ across objectively distinct neighborhoods, reinforcing the idea that planning indicators must be tested against experience-based outcomes. Sallis [Sallis, 2009] further argued that physical-activity environments require multidimensional measurement strategies that combine spatial structure with perceived usability.

A second strand of work focuses on accessibility. Pedestrian access to destinations has long been used as an indicator of urban quality [Talen, 2002]. In planning terms, accessibility refers not merely to the presence of destinations somewhere in a neighborhood but to their effective reach within acceptable walking distance. Barton et al. [Barton et al., 2012] linked neighborhood accessibility with active travel, while Zainol et al. [Zainol et al., 2017] showed the practical value of GIS-aided accessibility measures for community park planning. This literature is especially relevant for neighborhood-scale studies because access to open spaces, playgrounds, and nearby recreation opportunities may influence not only walking for exercise but also overall satisfaction with the pedestrian environment.

A third body of work addresses connectivity and permeability. Street-network structure affects directness, route choice, and the effort required to move between origins and destinations. Planning guidance typically treats connected networks as supportive of walking because they reduce detours and expand route options [Transport for London, 2004, NZ Transport Agency, 2009]. Yet the relationship is not entirely straightforward. White [White, 1990], Hillier and Sahbaz [Hillier and Sahbaz, 2008], and Sohn et al. [Sohn et al., 2018] suggest that permeability can interact with security concerns, implying that more connected street systems do not automatically translate into uniformly positive perceptions. This makes connectivity an important but context-sensitive variable in walkability assessment.

Finally, the literature on measurement provides important methodological precedent. Clifton et al. [Clifton et al., 2007] developed a pedestrian-environment audit that demonstrated the value of structured built-environment observation. Parks and Schofer [Parks and Schofer, 2006] and Pentella [Pentella, 2009] showed how secondary spatial data can characterize pedestrian environments at neighborhood and street scales. The Neighborhood Environment Walkability Survey (NEWS) and its abbreviated form provide influential models for capturing resident perceptions [Saelens and Sallis, 2002]. In the Indian context, Singhal's studies of Amritsar highlighted both conceptual and operational issues in neighborhood walkability assessment, including the importance of combining objective planning indicators with local field validation [Singhal, 2018a, Singhal, 2018b, Singhal, 2022].

Taken together, the literature suggests three implications for the present study. First, neighborhood walkability should be treated as a relation between measurable spatial form and resident interpretation. Second, accessibility and connectivity are likely to perform differently from density despite their frequent co-occurrence in planning discourse. Third, compact but simple indicators may be especially useful in cities where detailed pedestrian audits remain resource-intensive. These implications structure the analytical framework adopted here.

STUDY AREA AND ANALYTICAL FRAMEWORK

Amritsar as a Morphologically Diverse Urban Context

Amritsar is a major historic city in Punjab whose residential landscape reflects successive phases of growth. The traditional urban core is characterized by high density and relatively fine-grained street networks, while later planned sectors and peripheral colonies exhibit varying combinations of lower density, wider roads, discontinuous networks, and uneven provision of open spaces. The Draft Master Plan of Amritsar (2010–2031) provides a useful planning basis for distinguishing residential intensity and neighborhood types across the city [SAI Consulting Engineers, 2010]. This morphological diversity makes Amritsar suitable for studying whether density, accessibility, and connectivity influence walkability perceptions in similar ways across different residential settings.

Conceptual Model

The conceptual model used in this study assumes that residents' walkability perceptions are shaped by objective neighborhood-planning conditions through two broad pathways. First, neighborhood form can make walking functionally easier by shortening distances and improving route options. Second, it can make walking experientially better by increasing convenience, legibility, and access to pleasant destinations. Accordingly, three objective inputs are evaluated:

(i) *Population density*, representing residential intensity and a conventional proxy for compactness;

(ii) *Accessibility to parks and playgrounds*, representing convenient access to recreational destinations within comfortable walking distance;

(iii) *Street-network connectivity*, representing route continuity and permeability.

Two resident-reported outcomes are analyzed:

(i) *Preference for walking over driving*;

(ii) *Overall rating of the neighborhood pedestrian environment*.

The framework is intentionally parsimonious. It does not claim that these three planning indicators exhaust the meaning of walkability. Rather, it tests whether simple, spatially explicit measures can distinguish neighborhoods in a manner that corresponds to resident perceptions.

MATERIALS AND METHODS

Neighborhood Selection

Fourteen neighborhoods were selected to capture variation in residential intensity and urban form across Amritsar. Selection was guided by the city's planning categories and by the need to represent high-, medium-, and low-density residential contexts [SAI Consulting Engineers, 2010]. To maintain analytic clarity in the manuscript, neighborhoods are reported as coded units (N1–N14). Each neighborhood functioned as the spatial unit for objective measurement, while residents within each neighborhood served as the unit of perception analysis.

The resulting sample comprised five high-density neighborhoods, five medium-density neighborhoods, and four low-density neighborhoods. The set included neighborhoods with strong park access but moderate street structure, compact neighborhoods with weaker open-space access, and lower-density neighborhoods with varying levels of internal connectivity. This variation was essential for examining whether density alone explains perceived walkability.

Objective Neighborhood Measures

Population Density

Population density was used as an indicator of residential compactness and was expressed as persons per hectare (pph). Density classes were aligned with the city's planning framework [SAI Consulting Engineers, 2010]. For interpretive analysis, neighborhoods were grouped as follows:

- *Low density:* $<$ 450 pph
- *Medium density:* 450–700 pph
- *High density:* $>$ 700 pph

Accessibility to Parks and Playgrounds

Accessibility was operationalized as the percentage of neighborhood area located within a one-tenth-mile (approximately 160 m) walking-proximity threshold of parks and playgrounds. This threshold was chosen to represent a highly local neighborhood-access condition relevant to routine walking and nearby recreation, consistent with the pedestrian-access orientation of planning guidance and related accessibility research [Talen, 2002, Barton et al., 2012, NZ Transport Agency, 2009, Zainol et al., 2017]. The indicator for neighborhood i was computed as:

$$A_i = \frac{\text{Area}\big(N_i \cap B_i(160\text{ m})\big)}{\text{Area}(N_i)} \times 100 \tag{1}$$

where N_i is the neighborhood boundary and $B_i(160\text{ m})$ is the union of 160 m buffers around all parks and playgrounds associated with the neighborhood.

Accessibility values were then categorized for comparative analysis as low ($< 20\%$), medium (20–50%), and high ($> 50\%$).

Street-Network Connectivity

Connectivity was measured using a dead-end-adjusted intersection-density index based on the internal street network visible in Google Earth imagery and verified in the field. The measure sought to distinguish between networks that provide multiple route choices and those constrained by cul-de-sacs or dead ends. Let J_i denote the number of usable three-way-or-higher intersections, D_i the number of dead ends, and $\text{Area}(N_i)$ the neighborhood area in hectares. The raw connectivity score was calculated as:

$$K_i = \frac{J_i - 0.5D_i}{\text{Area}(N_i)} \tag{2}$$

To facilitate within-city comparison, the raw scores were normalized to a 0–100 scale:

$$C_i = 100 \times \frac{K_i - \min(K)}{\max(K) - \min(K)} \tag{3}$$

where $\min(K)$ and $\max(K)$ are the minimum and maximum observed raw connectivity values across the 14 neighborhoods. Normalized connectivity values were classified as low (< 50), medium (50–69), and high (≥ 70).

The use of image-based mapping, secondary spatial information, and on-ground verification follows the broader logic of audit and secondary-data approaches used in pedestrian-environment studies [Clifton et al., 2007, Parks and Schofer, 2006, Pentella, 2009, Singhal, 2018b, Singhal, 2022].

Resident Perception Survey

Perceived walkability was measured through a structured face-to-face survey administered to 224 adult residents, with 16 respondents drawn from each neighborhood. Interviews were conducted by trained architecture students after a common briefing on question delivery, respondent eligibility, and non-leading interaction. Participation was voluntary and anonymous. Only adults who reported living in the neighborhood were included.

The survey instrument was informed by the logic of neighborhood walkability perception research and by the use of structured environmental-perception items in walkability studies [Saelens and Sallis, 2002, Leslie et al., 2005, Lee et al., 2007, Sallis, 2009]. Two items were selected as the focal outcome variables for this paper:

P1: "In this neighborhood, I prefer walking to short local trips rather than driving."

P2: "Overall, the pedestrian environment in this neighborhood is good."

Responses were recorded on five-point Likert scales. For descriptive analysis, the original five categories were retained. For inferential analysis, responses were collapsed to improve cell stability in cross-tabulation:

- *Walking preference:* prefer driving (1–2), neutral (3), prefer walking (4–5)
- *Pedestrian-environment rating:* poor (1–2), fair (3), good (4–5)

Statistical Analysis

The association between each objective neighborhood variable and each perception outcome was evaluated using Pearson's chi-square test of independence:

$$\chi^2 = \sum_{r=1}^{R}\sum_{c=1}^{C}\frac{(O_{rc}-E_{rc})^2}{E_{rc}} \tag{4}$$

where O_{rc} is the observed frequency in cell (r,c) and E_{rc} is the corresponding expected frequency under independence. To summarize association strength in tables larger than 2×2, Cramér's V was computed as:

$$V = \sqrt{\frac{\chi^2}{n\times \min(R-1, C-1)}} \tag{5}$$

where n is the total sample size. Following common practice, the analysis emphasizes both statistical significance and effect size. The purpose was not to infer causal effects but to test whether simple planning indicators differentiate resident perceptions in a meaningful way.

RESULTS

Objective Neighborhood Variation

Table 1 summarizes the objective indicators for the 14 neighborhoods. The sample captures substantial variation in all three planning measures. Density ranges from 260 to 910 pph, accessibility from 6% to 72%, and normalized connectivity from 29 to 81. Importantly, the indicators do not move together mechanically. Some high-density neighborhoods also display high accessibility and connectivity (for example, N1–N3), while others combine compactness with weaker access to parks and fragmented networks (for example, N5). Likewise, some lower-density neighborhoods exhibit moderate park access and serviceable connectivity (for example, N11–N12). This heterogeneity supports the analytical premise that density alone may be insufficient for explaining walkability perceptions.

Table 1: Objective characteristics of the sampled neighborhoods

Neighborhood	Density (pph)	Density class	Accessibility (% area)	Access class	Connectivity (0–100)	Connectivity class
N1	910	High	72	High	81	High
N2	860	High	68	High	76	High
N3	820	High	61	High	74	High
N4	780	High	34	Medium	70	High
N5	740	High	18	Low	41	Low
N6	650	Medium	57	High	71	High
N7	610	Medium	43	Medium	63	Medium
N8	560	Medium	25	Medium	59	Medium
N9	520	Medium	14	Low	43	Low
N10	470	Medium	9	Low	39	Low
N11	390	Low	48	Medium	55	Medium
N12	340	Low	31	Medium	52	Medium
N13	300	Low	12	Low	37	Low
N14	260	Low	6	Low	29	Low

Density class thresholds: low $<$ 450 pph, medium 450–700 pph, high $>$ 700 pph.
Accessibility class thresholds: low $<$ 20%, medium 20–50%, high $>$ 50%.
Connectivity class thresholds: low $<$ 50, medium 50–69, high $\geq$ 70.

Distribution of Survey Responses

Table 2 presents the overall distribution of the two perception outcomes on the original five-point scales. For walking preference, 40.2% of respondents selected positive categories (4 or 5), 28.1% were neutral, and 31.7% selected negative categories (1 or 2). The distribution of pedestrian-environment ratings is similar: 40.2% reported good or very good conditions, 29.5% selected the midpoint, and 30.4% rated their neighborhood poorly.

These aggregate distributions indicate a mixed pedestrian experience across the city as a whole. Walkability is neither uniformly poor nor uniformly favorable; instead, substantial variation appears likely across neighborhoods with different planning characteristics.

Table 2: Overall distribution of perception responses on the original five-point scales ($n = 224$)

Response category	Walking preference	Pedestrian-environment rating
1 (most negative)	24 (10.7%)	25 (11.2%)
2	47 (21.0%)	43 (19.2%)
3	63 (28.1%)	66 (29.5%)
4	53 (23.7%)	54 (24.1%)
5 (most positive)	37 (16.5%)	36 (16.1%)
Total	224 (100%)	224 (100%)

Accessibility and Walkability Perceptions

Accessibility to parks and playgrounds shows the strongest relationship with both perception outcomes. As shown in Table 3, the share of respondents who prefer walking rises from 23.8% in low-accessibility neighborhoods to 64.1% in high-accessibility neighborhoods. The chi-square test is significant ($\chi^2 = 32.19$, $p < 0.001$), and Cramér's $V = 0.268$ indicates a moderate association.

A similarly strong pattern is evident for pedestrian-environment ratings (Table 4). In low-accessibility neighborhoods, 15.0% of respondents report a good pedestrian environment, compared with 62.5% in high-accessibility neighborhoods. The association is statistically significant ($\chi^2 = 39.04$, $p < 0.001$) and stronger than for walking preference ($V = 0.295$). These findings indicate that proximity to parks and playgrounds does not simply support recreational activity; it is also associated with a broader positive evaluation of neighborhood walkability.

Connectivity and Walkability Perceptions

Connectivity also differentiates walkability perceptions, but less strongly than accessibility. In low-connectivity neighborhoods, only 28.8% of respondents prefer walking, compared with 52.5% in high-connectivity neighborhoods (Table 3). The association is statistically significant but weaker than for accessibility ($\chi^2 = 13.08$, $p = 0.011$, $V = 0.171$). This suggests that route continuity and permeability matter for travel preference, but their influence may be mediated by other qualities of the walking environment.

Table 3: Walking preference by neighborhood-planning variable (collapsed categories)

Variable	Category	Prefer driving	Neutral	Prefer walking	Total	χ^2 $(df = 4)$	Cramér's V
Accessibility	Low	39	22	19	80	32.19^{***}	0.268
	Medium	26	24	30	80		
	High	6	17	41	64		
Connectivity	Low	32	25	23	80	13.08^{*}	0.171
	Medium	24	14	26	64		
	High	15	24	42	80		
Population density	Low	18	23	23	64	5.87	0.114
	Medium	25	25	30	80		
	High	28	15	37	80		

Walking preference categories are derived from the original five-point scale: prefer driving = responses 1–2; neutral = response 3; prefer walking = responses 4–5.
$^{*}p < 0.05$, $^{***}p < 0.001$.

For pedestrian-environment ratings, connectivity performs somewhat better. Good ratings rise from 25.0% in low-connectivity neighborhoods to 53.8% in high-connectivity neighborhoods (Table 4). The relationship is significant ($\chi^2 = 14.78$, $p = 0.005$, $V = 0.182$). Although still weaker than accessibility, the effect is more pronounced for global environmental evaluation than for stated walking preference.

Population Density and Walkability Perceptions

Population density exhibits only weak, context-dependent associations with the two outcomes. For walking preference, the proportion of respondents who prefer walking increases from 35.9% in low-density neighborhoods to 46.3% in high-density neighborhoods, but the overall association is not statistically significant ($\chi^2 = 5.87$, $p = 0.209$, $V = 0.114$). For pedestrian-environment ratings, low-density neighborhoods actually record the largest share of good ratings (46.9%), followed by medium-density (38.8%) and high-density neighborhoods (36.3%), again without a significant association ($\chi^2 = 6.41$, $p = 0.170$, $V = 0.120$).

Table 4: Pedestrian-environment rating by neighborhood-planning variable (collapsed categories)

Variable	Category	Poor	Fair	Good	Total	χ^2 $(df = 4)$	Cramér's V
Accessibility	Low	38	30	12	80	39.04^{***}	0.295
	Medium	22	20	38	80		
	High	8	16	40	64		
Connectivity	Low	33	27	20	80	14.78^{**}	0.182
	Medium	18	19	27	64		
	High	17	20	43	80		
Population density	Low	19	15	30	64	6.41	0.120
	Medium	29	20	31	80		
	High	20	31	29	80		

Pedestrian-environment categories are derived from the original five-point scale: poor = responses 1–2; fair = response 3; good = responses 4–5.
$^{**}p < 0.01$, $^{***}p < 0.001$.

These results reinforce the interpretation that compactness, by itself, does not reliably predict how residents assess walkability. In Amritsar, density appears to matter only insofar as it coexists with accessible destinations and usable street structure. Comparative strength of associations between objective planning variables and perception outcomes is given in Figure 1.

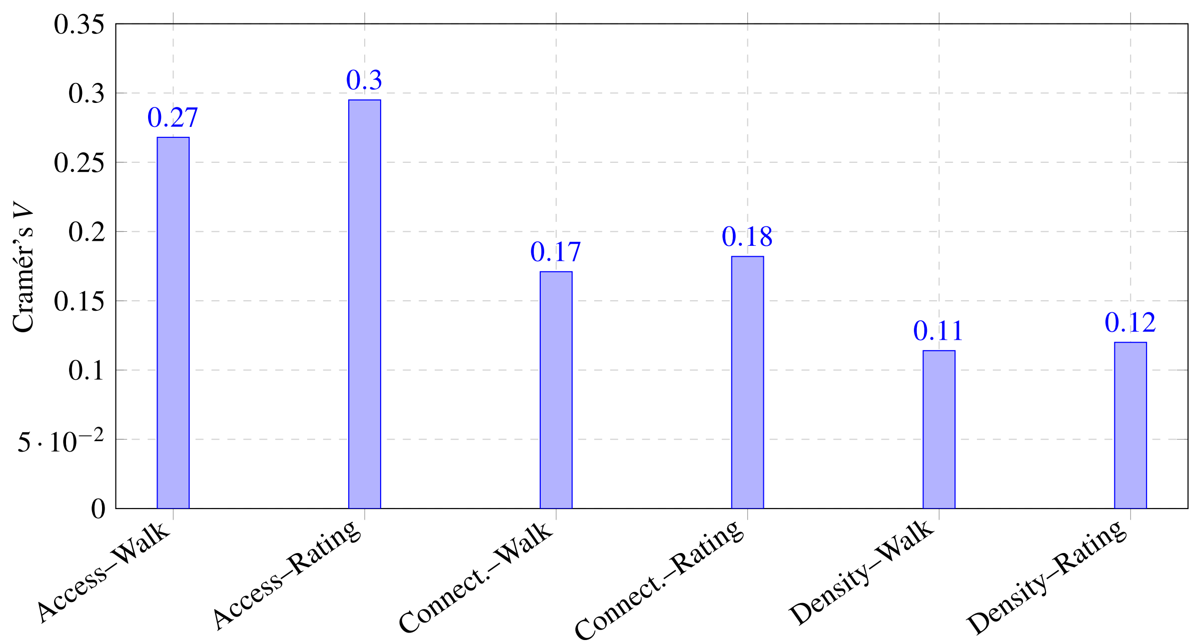

Figure 1: Comparative strength of associations between objective planning variables and perception outcomes

DISCUSSION

The findings demonstrate that the three neighborhood-planning variables examined here do not contribute equally to perceived walkability. Accessibility to parks and playgrounds has the strongest and most consistent relationship with both stated walking preference and overall pedestrian-environment rating. This result is conceptually coherent with research emphasizing pedestrian access as a core dimension of neighborhood quality [Talen, 2002, Barton et al., 2012]. It also aligns with the view that nearby, usable destinations help make walking meaningful in everyday life rather than merely physically possible. In the present case, access to neighborhood open spaces appears to function as both a utilitarian and experiential asset: it provides a reason to walk and reinforces residents' broader sense that the neighborhood supports pedestrian activity.

Connectivity also matters, but its role is more conditional. The positive association between connectivity and pedestrian-environment ratings suggests that residents recognize the value of route continuity, legibility, and reduced detour in everyday movement. This is consistent with planning guidance that treats connected networks as favorable to walking [Transport for London, 2004, NZ Transport Agency, 2009]. However, the weaker association with stated walking preference indicates that connected routes alone may not be sufficient to shift mode preference where other conditions remain unfavorable. This finding resonates with the more nuanced literature on permeability, which warns that route openness may interact with concerns about security, exposure, or local traffic conditions [White, 1990, Hillier and Sahbaz, 2008, Sohn et al., 2018]. In other words, connectivity is beneficial, but it is not socially or behaviorally self-executing.

The most important substantive conclusion concerns density. Although high-density neighborhoods show somewhat higher walking preference than low-density neighborhoods, the association is weak and statistically insignificant. Moreover, low-density neighborhoods in this sample do not perform uniformly poorly; some record favorable pedestrian-environment ratings because they combine moderate accessibility with acceptable street structure. This pattern complicates planning narratives that treat compactness as a sufficient proxy for walkability. The result is consistent with the broader argument that density becomes meaningful for pedestrian life only when translated into reachable destinations and usable networks [Ewing, 2000, Lund, 2003, Lee et al., 2018]. It also supports earlier concerns in local walkability research that aggregate neighborhood form should not be interpreted without attention to the actual pedestrian environment [Singhal, 2018a, Singhal, 2018b, Singhal, 2022].

From a methodological standpoint, the study shows the value of using simple objective indicators that can be measured with widely available imagery and field verification. This approach does not replace detailed pedestrian audits [Clifton et al., 2007], nor does it capture the full richness of environmental quality emphasized in broader physical-activity measurement literature [Sallis, 2009]. Nonetheless, it offers a practical, scalable method for comparative neighborhood assessment in cities where data and technical resources are constrained. Such parsimony is valuable for planning diagnosis, especially when the immediate goal is to identify where interventions are most urgently needed and which type of deficiency is most consequential.

PLANNING IMPLICATIONS

The results carry three practical implications for neighborhood planning in Amritsar and similar cities.

First, *distributed local open-space access should be treated as a walkability priority*. The strongest associations in the study involve accessibility to parks and playgrounds, which suggests that neighborhood walkability is influenced not only by street form but by whether residents can easily reach attractive nearby destinations. Planning policy should therefore prioritize a finer-grained distribution of neighborhood parks, playgrounds, and usable open spaces rather than relying solely on larger but more distant facilities. This conclusion is consistent with both pedestrian-access theory and recent park-accessibility planning research [Talen, 2002, Zainol et al., 2017].

Second, *street-network improvements should focus on usable permeability rather than abstract connectivity*. Creating or restoring short pedestrian links, reducing dead-end barriers, and improving route continuity can enhance perceived walkability. However, these interventions should be designed with attention to safety, surveillance, and active frontage in order to avoid the potential drawbacks associated with poorly managed permeability [Hillier and Sahbaz, 2008, Sohn et al., 2018]. Design-sensitive permeability is preferable to purely numerical connectivity maximization.

Third, *density policy should be paired with destination and network strategies*. Compact development alone is unlikely to generate walkable neighborhoods if it is not accompanied by open-space access and coherent pedestrian circulation. Planning tools for walkable neighborhoods should therefore integrate density controls with zoning, public-space provision, and street design measures [Lee et al., 2018]. In practical terms, the city should not assume that denser neighborhoods are automatically pedestrian-friendly, nor that lower-density neighborhoods are beyond improvement. What matters is the configuration of neighborhood opportunities and routes.

These implications align with people-centered urban design principles that emphasize convenient local movement, usable public environments, and everyday pedestrian comfort [Tibbalds, 2005, Transport for London, 2004, NZ Transport Agency, 2009].

LIMITATIONS

Several limitations should be acknowledged. First, the analysis is cross-sectional and based on a fixed set of 14 neighborhoods; it therefore identifies association rather than causation. Second, the perception survey intentionally focuses on two global walkability outcomes and does not include the full range of attitudinal, safety, or micro-environmental variables often measured in larger walkability instruments [Saelens and Sallis, 2002]. Third, the objective indicators are deliberately parsimonious. They do not capture sidewalk condition, shading, traffic speed, enclosure, frontage activity, or land-use mix, all of which can shape pedestrian experience [Clifton et al., 2007, Pentella, 2009]. Fourth, the accessibility measure focuses specifically on parks and playgrounds. While this is appropriate for neighborhood recreation and local walking, other destinations such as shops, schools, and transit stops may affect mode choice differently.

These limitations do not diminish the core value of the findings. Rather, they clarify the scope of inference and indicate directions for future work. Subsequent research could combine the present indicators with more detailed audits, GIS-based route analysis, or multivariate models that incorporate sociodemographic and micro-environmental variables.

CONCLUSION

This paper examined whether three objective neighborhood-planning measures—population density, accessibility to parks and playgrounds, and street-network connectivity—are associated with residents' walkability perceptions across 14 neighborhoods in Amritsar. The results show a clear hierarchy of explanatory relevance. Accessibility to parks and playgrounds has the strongest and most consistent association with both walking preference and perceived pedestrian-environment quality. Connectivity also matters, particularly for overall environmental evaluation, but its influence is weaker. Population density shows only limited and context-dependent association with perceived walkability.

The broader implication is that walkability should not be inferred from compactness alone. Neighborhoods become walkable when residents can reach meaningful destinations through coherent and usable street networks. For cities such as Amritsar, this means that planning for walkability should prioritize local destination access and pedestrian-supportive network structure alongside, rather than beneath, discussions of density. Methodologically, the paper demonstrates that relatively simple, reproducible spatial indicators can generate analytically useful distinctions between neighborhoods and can provide a practical basis for planning diagnosis in resource-constrained urban contexts.

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