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Spatial Urban Morphology and Social Capital: A Comprehensive Comparative Analysis of Neighborhood Typologies in Lahore, Pakistan

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Abstract

Across the Global South, fast urbanization is drastically transforming the urban context, often substituting organic fabrics for privatized master plans that are auto centred. The aim of this study is a detailed exploration of the intricate link between spatial morphology and the production of social capital within three highly contrasting neighbourhoods in Lahore, Pakistan: the historic Walled City, the post-independence planned grid of Allama Iqbal Town and the contemporary gated enclave of Bahria Town. This study is an effort to assess cognitive, relational, and structural components of social capital by using rigorous socio-quantitative household survey (N = 400) and GIS-based spatial morphological analytics such as space syntax integration, street network permeability and land-use entropy. The empirical results show that urban form can be a key enabler or obstacle for city communities to support cohesion. Organic high-density layouts with pedestrian focus enable regular and spontaneous human-to-human interaction, leading to considerably higher Composite Social Capital Indexes (SCIs) (0.72) and strong informal support systems. In contrast, automobile dependent gated enclaves have lower social capital scores (0.45); perimeter security and spatial insulation limit the diversity of networks and promote social isolation. Multivariate regression modeling also validates that pedestrian walkability and proximity to public open space are strong positive predictors of interpersonal trust and reciprocity, above and beyond the influence of socioeconomic status. The study highlights the need to incorporate elements of human scale design, mixed use zoning and inclusive public space distribution in the urban planning processes in order to achieve social sustainability in the fast changing South Asian metropolitan region.

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1. Introduction and Contextual Background

The spatial morphology of urban places has significant effects on the morphology of communities, their social relationships and the spontaneous creation of social capital in urban areas. Social capital – the web of trust and mutual norms and the level of civic engagement within the community – is an essential ingredient for community resilience, safety and general social sustainability (Putnam, 2000; Aldrich, 2012). Spatial changes are often about growing populations, the use of cars, and speculation in real estate in fast-growing cities in the Global South. These processes can be more dynamic than traditional urban planning, reshaping urban spatial patterns and directly influencing social cohesion (Rana & Bhatti, 2018; Aslam et al., 2022). Urban morphology is a socio-spatial artefact, as well as a dynamic spatial matrix, and

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it has the capacity to be experienced as both a physical setting and a space that shapes collective human action by providing spatial boundaries, encounter pathways, and sensory conditions.

The city of Lahore provides an important empirical setting for exploring the relationship between urban form and society. In the last few decades, there have been some major spatial changes in major cities like Lahore (Mujtaba et al., 2025). Growingly the historic ‘organic urban cores' have been surrounded by sectors planned in the post-independence era, and by newer private gated enclaves characterized by lower-density, automobile-oriented spatial configurations (Shahid et al., 2022). The spontaneous face-to-face encounters and syncretizing informal support systems are a feature of the traditional urban form while modern developments focus on vehicular mobility, single use zoning and perimeter security (Ali et al., 2026). To inform sustainable urban design and policy, it is important to understand these different types of morphological configurations and how they affect social capital. Restructuring of the cityscape of Lahore is part of a wider global transition towards privatized, segregated and auto-dependent urbanism which fundamentally changes the way people view their neighbours, engage in community life and create networks of mutual dependency.

The morphology of Lahore over time offers a very special spatial laboratory for the study of morphological evolution. The Walled City, core medieval organic, the British colonial administration, the post-colonial public sector planning and the present day private master-planned gated communities have all left their mark on the spatial fabric (Zulfiqar et al., 2025). The spatial arrangement of these spaces has an impact on informal social interaction, the visibility of residents, and the sense of security within the community. In the context of cities in emerging economies facing issues of rapid urbanization and urban fragmentation while also being highly vulnerable to the environment, it is critical to understand how spatial configuration amplifies or reduces social capital to ensure urban resilience.

Since a long time ago, sociological and morphological scholarship has pointed out that the constructed environment is no longer just a silent actor in the shaping of socio-spatial relations, but an active one (Hillier, 2007; Gehl, 2010). Street, alley, park and set-back architecture create spatial boundaries between domestic and civic space that contain and direct behavior. If urban design places more value on the movement of vehicles and on spatial separation than on the movement of pedestrians and communal belonging, the informal trust that builds between people is lost. In contrast, areas with high connectivity, human-scale characteristics, and accessible communal amenities tend to have residents who have strong feelings of place attachment, mutual aid networks, and strong collective efficacy. This paper aims to discuss these aspects in detail in the context of a particular culture and urban environment like Lahore.

In addition, the overall socio-economic context of the present-day Pakistan imparts more urgency to this investigation (Khan et al., 2026). South Asian metropolises rely on a variety of mechanisms involving the communities to build their resilience, particularly in the face of high levels of rural-urban migration, economic instability and environmental stress driven by climatic conditions. Neighbourly support and localized charity, collective security maintenance and informal child care represent informal social capital which is often the most immediate safety net for urban households in the absence of institutional arrangements. The

urban spatial design that breaks these relationships of informal supports therefore increases community susceptibility to economic and environmental impacts.

Further, Lahore's physical transformation over the last century has been a reminder of the deep influence of shifting urban paradigms on civic life (Salahuddin et al., 2024). Pockets of intimacy formed the architecture of the traditional Mohalla that emerged within the fabrics of the organic city, with private lives seamlessly blending into public space, resulting in multiple layers of over-watch and communal responsibility. In the twentieth century, however, modernist master planning principles of rigid functional segregation and broad streets that emphasized movement of vehicles over neighborhood cohesion were introduced. The growth of private enclave urbanization in the past few decades has also contributed to the privatization of public space, commercializing civic amenities and physically gating residential communities. This study analyzes the differential impacts of these different spatial typologies on the building, sustaining and dissipation of social capital in the diverse population of Lahore comprehensively.

The socio-spatial dynamics of Lahore can only be understood if the complex relationship between cultural heritage and the urban pressures that impact Lahore today are understood. Lahore represents centuries of spatial transformation, mirroring the architectural heritage of Islam, the principles of Mughal urban design, the influence of British colonialism, and modernism in the post-independence era. The human habitation and social interaction patterns are different in each historical level, as a result of the different typologies and geometries of the architecture. This research also aims to put social capital formation into context of these specific morphological conditions, in order to get a more nuanced and evidence-based perspective of the intersections of space, culture and urban planning in the Global South.

It is a significant change in the domestic-public relation, and in the transition from introverted courtyard architecture to extroverted suburban villa designs. The boundary between 'home' and 'street' in traditional urban environments was regulated to provide visual privacy, but also permit informal social surveillance. The public alleys were essentially semi-private communal areas in which neighbors carried out their daily chores, kept an eye on the neighborhood kids at play and where they participated in ongoing, informal conversation. Today, front lawns are much wider, perimeter walls are higher, and the vehicular gate more automated, creating barriers that have eliminated the visual and social links between homes and the public street space. This spatial insulation has the effect of decreasing the chances for chance meetings with neighbors, and thereby changing the socio-spatial experiences of the people residing there.

Furthermore, the motorization process has heightened spatial segregation and degraded quality of public space in today's Lahore. Street designs are more and more made for speeding up cars and providing more parking spaces, while neglecting pedestrian facilities or making them less available. The disappearance of pedestrian-friendly public space also creates disincentives to non-motorized travel, leading people to use cars instead and avoid engaging with their community at the local level. This car-driven change causes people to stay in their cars, reduces the ability to walk around the neighborhood, and affects vulnerable

demographics like children, the elderly, and low-income individuals who depend on easy access to public space for mobility and socialization.

Urban form influences social capital in the context of these intricate socio-spatial issues, and it is crucial to consider the influence when planning for the future. This study seeks to fill the gaps that have long existed between physical design fields and social science research and suggest an integrated approach for sustainable urban regeneration in the metropolises of South Asia, by creating empirical relationships between the morphological parameters and the indicators of social cohesion.

The spatial evolution of the post-colonial Lahore also demonstrates the changing socio-economic stratification of the city, which can be linked to morphological changes. Colonial interventions created a dual urban structure of the dense inner city core and the sprawling low-density administrative cantonments and civil lines with deep setbacks, wide boulevards and large open spaces. Initially, post-Independence public housing schemes tried to merge the planned architecture of a grid with the fast growth in population and the provision of local market squares and communal parks. But the emergence of private corporate real estate developers changed urban development models, turning them into gated master plans for people who own cars and have homogeneous socioeconomic backgrounds. The multi-layered spatial developments explored here offer important context to the understanding of the different forms of social capital that contemporary urban fragments provide.

Moreover, physical access to public transport services and public facilities is a crucial determinant of the social characteristics of neighbourhoods. The multi-modal transport systems and pedestrian density in an organic and well-integrated grid neighborhood enable inhabitants with different economic means to move around their neighborhood without any difficulty, and thus to experience inclusive public encounters and shared use of the neighborhood (Zainab et al., 2023). In contrast, some suburban settings that are built on land near the edge of the city, often in agricultural areas, depend on private transportation for commuting, thus separating residents from the civic and economic life of the city. This spatial segregation restricts the opportunities for linking social capital between the different socio-economic groups, strengthening the social polarization in the urban region.

Another basic level that is affected by the urban morphology is the cognitive perception of boundaries of the neighbourhood. In normal neighborhood of the organic villages, the sense of belonging to the neighbourhood is closely connected with the historic gates, the mohalla affiliations (ancestral neighborhoods) and the historical communal assembly places like historic mosques or central bazaars. These spatial anchors create a very strong spatial legibility and sense of place attachment. In modern suburban developments, neighbourhoods are composed of security checkpoints, walls, and corporate branding, and the boundaries of place identity are being replaced with organic community citizenship – for socio-economic status consumption. The ability to understand these perceptual changes is essential for examining the role of spatial design in citizens' pride in their community and their stewardship of the neighborhood, as well as long-term community attachment.

2. Problem Statement and Research Questions

Although global urban studies have amply documented the essential role that social capital plays in building urban resilience, civic participation, and social sustainability, modern urban centres in Pakistan are grappling with unique challenges arising from the powerful influence of rapid, car-centred urban growth and spatial polarization. Recent research in urban neighborhoods across Karachi, Lahore and Islamabad shows that neighborhood relationships are increasingly being affected by the progressive degradation of informal support, widening of socioeconomic differences and decrease in localized neighborhood interactions. These changes are occurring at the same time as gated communities, high density speculative infill and planning for the automobile have all grown rapidly. This rapid transition towards urban enclaves has been instrumental in breaking the socio-spatial continuum of the Pakistani cities and setting up physical and social barriers between the socio-economic classes and limited opportunities for inclusive public life.

However, an important gap exists in quantitative studies of the spatial organization of social and trust relations, and civic engagement in Pakistani cities, based on the discrete typologies of urban sites. The city of Lahore, one of the fastest growing metros in South Asia, has created a multi-layered urban fabric, from medieval organic cores to post independent planned grids to contemporary private gated enclaves. Historical quarters were constructed around fine-grained street networks, favoring pedestrian traffic and allowing for casual social interaction, whereas contemporary enclaves along the periphery focus on vehicular traffic and perimeter security. This empirical vacuum is especially notable in regards to the paucity of integrated socio-spatial frameworks which systematically integrate GIS spatial analytics with standardized multi-dimensional indices of social capital in the development of regional contexts.

The above is further complicated by the current municipal regulatory frameworks and real estate incentives in Pakistan that always support low-density, car-oriented master plans over human scaled, walkable and mixed-use communities. Current planning processes ignore the social costs of spatial separation and auto-dependency, thus exacerbating social polarization, reducing informal safety nets and making localized civic institutions less viable. To respond to these spatial issues, there is a need for solid empirical evidence that clearly shows how the spatial design parameters relate directly to community trust, reciprocity and civic vitality.

Moreover, current literature on urban planning in Pakistan has paid more attention to the inadequacies of infrastructure, transportation bottlenecks and housing shortage, typically writing social capital as an exogenous sociological variable divorced from the physical layout of space. Such an isolationist approach presents a major gap between spatial design of the city and socio-community outcomes. Street layouts, block dimensions, and public space distributions are often poorly understood factors in the design of housing schemes by urban planners and real estate developers, impacting community bonding or social isolation.

In order to directly tackle these conceptual and empirical issues, four main research questions are posed for systematic investigation:

1. What are the differences in physical spatial parameters (permeability of the street network, building density, walkability and open space provision) among Lahore's historical, grid and gated residential typologies?

2. What are the measurable differences in composite social capital index (SCI) scores (cognitive, relational, and structural) between people living in these different urban forms?

3. How strongly are interpersonal trust, interpersonal reciprocity and informal networks of support related to spatial layout and urban design features, after controlling for socioeconomic status?

4. What are the ways of reorienting spatial planning policies and urban design frameworks to improve social sustainability, community cohesion and civic life in cities in Pakistan.

This study seeks to provide theoretical perspective as well as practical guidance to urban planners, policy makers, architects and municipal managers in all cities of Pakistan and similar urban areas in South Asia by answering basic research questions. The general goal is to create an empirical benchmark showing the non-neutrality of urban space as a form of shaping collective human behavior and community well-being.

This empirical baseline is needed to change the planning paradigm from a technorational perspective with emphasis on monetization of land and road capacity to a human perspective with emphasis on social sustainability. The study aims to determine if certain morphological characteristics (such as fine-grained street networks, building facades that are active and public parks) can actively reduce the social isolation that is widely recognized as a problem of modern suburbanization.

Speculative real estate practices have been allowed to go on without any critical analysis as there was no empirical study on social consequences of urban morphology in Pakistan. Mega housing is often pitched as self-contained utopia with a high level of security and infrastructure, but the long-term social impacts, including social fragmentation, lack of civic engagement and social alienation, are not measured. This research is systematic in measuring social capital for various residential typologies, with the aim of overturning the prevailing real estate paradigms and supporting the adoption of social inclusion as an urban design standard.

The study also explores the effect of spatial segregation on strengthening socio-economic differences in Lahore. Gated developments effectively isolate the wealthy from the urban landscape by separating them from people of other social classes, which diminishes bridging social capital. On the other hand, traditional mixed use neighborhoods encourage frequent interactions among different social classes and create a sense of understanding and empathy. The socio-spatial dynamics is crucial to investigate for designing urban policies that foster social inclusion, spatial justice and fair access to urban resources.

One fundamental aspect of this research problem is the decline of public space government and democratic engagement in quick privatization of cities. Private real estate corporations are increasingly given control over residential development while public streets, parks and civic squares become controlled and commodified spaces. Gated communities have a board of management that dictates behavior, barring spontaneous public meetings, street vendors, and community organizing outside of the community. This institutional transition is replacing

civic involvement with shopping and ending the era of neighborhood-based democratic governance.

Furthermore, the temporal and financial costs that suburban designs place on households due to spatial mismatch between their dwellings and employment opportunities and social services are considerable. The longer commutes take, the less time is available for family bonding, neighborhood socializing, and civic engagement, driving social fragmentation. This study quantifies the socio-spatial tradeoffs, thereby underscoring the critical need for the integrated approach to land-use and transport planning that would greatly improve opportunities for community involvement within its own area while reducing commute time.

3. Theoretical Framework and Hypotheses

This research's analytical framework combines existing theories found in the field of urban morphology, space syntax and sociology to investigate how physical space influences the creation of social capital. The space syntax theory by Hillier (2007) suggests that the configuration of the street network determines the pattern of movement and how much spatial co-presence in the street network, which is the baseline for informal social encounters. Within the framework of space syntax theory, the street integration values determine the distribution of 'natural movement' in an urban grid. Highly integrated streets will see a high volume of pedestrians, which will create opportunities for non-compulsory social interactions that can form the basis of larger social networks. On the other hand, a segregated spatial layout curtails the freedom of movement and leads to abandoned public space and limited opportunities for spontaneous community bonding.

Space syntax is complemented by Jacobs (1961) and Gehl (2010) who highlight how human scale urban design (walkable, mixed use and visually permeable) creates 'eyes on the street', which helps to promote natural surveillance and safety and therefore promotes mutual trust between people. Jacobs claimed that well-designed urban neighborhoods require a fine grain of primary use variety, short blocks, mixed building ages and adequate human density. These morphological features generate a continuous fabric of public use and ensure that street spaces are active and naturally monitored all day long. Gehl extended this paradigm and identified the three types of outdoor activities, necessary, optional and social activities. He showed that good physical environments convert trips that are essential for function into leisurely time and place for spontaneous social interaction, affecting the amount and duration of time spent in spontaneous social interaction.

At the same time, sociological theories categorize social capital into three main types: cognitive social capital (shared norms, mutual trust, and values); relational social capital (interpersonal networks, obligations, and reciprocity); and structural social capital (formal civic engagement, institutional connections, and membership in groups) (Bourdieu, 1986; Coleman, 1990; Putnam, 2000; Aldrich, 2012). Cognitive social capital is a psychological and affective aspect of social capital that is manifested in trust and shared values among people, which facilitates collective action without formal enforcement. Relational social capital can be defined as the networks of mutual aid, friendships, and reciprocal obligation that people can mobilize in their everyday lives or in times of crisis. Structural social capital refers to the

extent of organized civic associations, neighborhood block committees, and formal institutional connections that are conducive to structured governance and resource sharing.

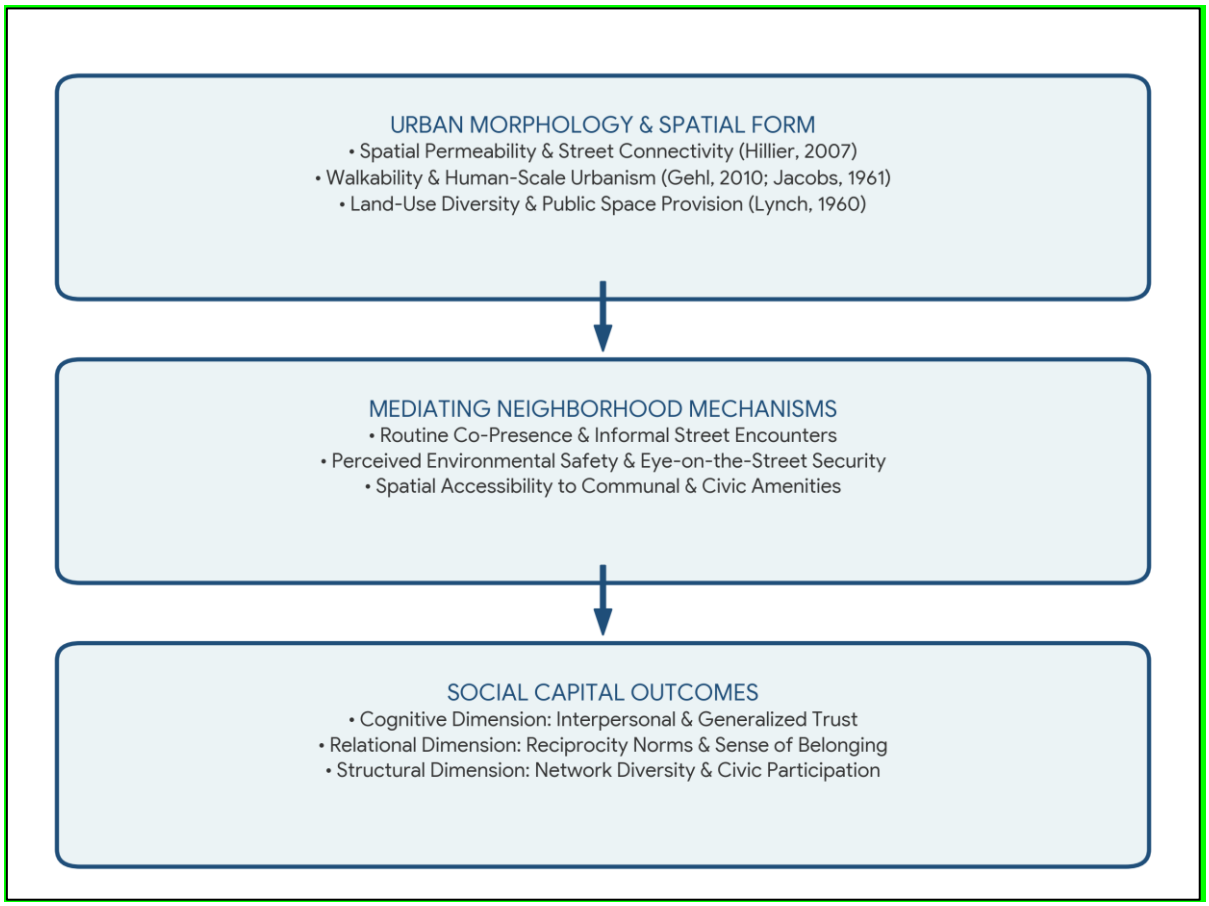


Figure 1: Conceptual Framework Mapping Urban Morphology to Social Capital Outcomes

The theoretical framework connects these areas by neighborhood-level mechanisms. Physical urban form (permeability, connectivity, walkability, density, and open space provision) is shown to directly shape the spatial behaviour of everyday life, with varying levels of routine co-presence, informal street encounters, perceived environmental safety, and spatial accessibility towards communal amenities. The environmental experiences in between then, in turn, support or constrain residents' cognitive, social, and structural social capital.

This framework relies on the conceptualization of routine co-presence as a space catalyst. Urban spatial designs that facilitate frequent, non-threatening encounters between neighbours can help to decrease social distance and create a sense of familiar strangers. These passive visual connections gradually start to become active, and acquaintances begin to talk to each other, while developing a greater sense of familiarity and understanding, which pave the way for increased interpersonal trust. Conversely, a variety of spatial configurations that physically separate dwellings from the public by walls and gates that restrict vehicle access and by expansive paved parking aprons diminish these casual forms of contact, increasing social anxiety and distrust of strangers.

From this theoretical synthesis three main hypotheses are developed for empirical testing:

Hypothesis 1 (H1): People who live in high-density and strongly connected organic street networks (like the Walled City) have higher levels of informal social support, mutual reciprocity, and localized trust than people living in automobile oriented, gated developments.

Hypothesis 2 (H2): Structural social capital (network size and diversity) is predicted positively by open space accessibility and pedestrian walkability for all residential typologies.

Hypothesis 3 (H3): An increase in residential building density, at a fixed ratio of public space, is negatively associated with generalized trust, suggesting over-crowding and social friction in unmanaged cores.

These hypotheses enable testing to isolate the specific contribution of the spatial configuration, as compared to the contribution of underlying socioeconomic factors. The framework operationalizes the urban design features as independent variables which can explain variation in social cohesion within a community by combining spatial morphology and sociology.

Furthermore, it is theoretically possible to integrate both place attachment and spatial legibility (Lynch, 1960) for further analysis. The spatial legibility of a neighborhood (how easy it is for people to understand and navigate the space) increases feelings of security and spatial belonging. Identifiable public nodes, well defined public edges, and clear landmarks provide and reinforce a feeling of belonging and psychological ownership of public space and I sense civic pride and social participation.

There is further nuanced theoretical perspective in the "bonding, bridging, and linking" social capital (Putnam, 2000; Aldrich, 2012). Bonding capital is a dense, inward-looking network of homogenous individuals (extended family, neighbours) that offers emotional and material support. Bridging capital links different social classes, ethnic, religious groups… fosters social integration and more general civic trust. Linking capital is an important avenue that enables the connection of citizens to formal state institutions and political governance systems. This research examines the impact of different neighborhood configurations, and their function in cultivating or inhibiting these particular types of social capital. Organic cores can build strong bonding capital by fostering physical closeness, and designed mixed-use cores could be better at building bridging capital by providing a shared public space.

Indeed, the idea of ‘Third Places' by Oldenburg (1999), which is the third public space apart from home (first place) and work (second place) is applicable for understanding neighborhood social life. Community squares, local parks, corner shops, and dhabas (tea shops) are all examples of third places that provide important social hubs for community interaction, informal discussion, and social bonding. These third places in a neighborhood are physically shaped and distributed, which directly impacts the number and variety of social experiences. Third places are often lost to modern suburban developments, which are replaced by private, commercial settings and changing the way people interact in communities.

The Attention Restoration Theory (ART) proposed by Kaplan and Kaplan (1989) and the stress recovery model proposed by Ulrich (1984) also bring to this framework an environmental psychology emphasis, and a connection between green urban design and social psychological outcomes. Neighbourhood green spaces that are accessible contribute to

cognitive restoration, stress reduction, decrease interpersonal irritability and promote pro-social behaviour. The more residents can easily access a high quality parks and tree-lined walking corridors, the more psychologically open they are to friendly social interaction, assistance to others, and community involvement. Combining these theories for environmental restoration and the two models, space syntax and social capital, with the theories provides a comprehensive theoretical framework for the assessment of the spatial performance of neighborhoods.

Moreover, Lefebvre's (1991) theory of the 'Production of Space' gives a critical theoretical dimension to the study of power relations and real estate capital in determining urban morphology. Lefebvre sees a distinction between a space of spatial practice (space experienced in everyday life), a space of representations (space conceived by urban planners and developers) and a representational space (space lived in by art and everyday people). For example, in today's cities in Pakistan, lived space is often superseded by conceived space, controlled by speculative corporate master plans, which often introduce rigid and commodified layouts to the city's organic community life. In this critical socio-spatial analysis of spatial morphology, the constant conflict between financialized urban development and community social needs become evident.

4. Research Methodology and Spatial Framework

The design of this study is an empirical approach with mixed methods using GIS-based spatial morphological analytics and socio-quantitative household surveys (N = 400) and qualitative field interviews in three contrasting urban typologies in Lahore – Walled City of Lahore (historic organic core), Allama Iqbal Town (post-independence medium-density grid), and Bahria Town Lahore (contemporary planned gated enclave). Spatial analytics were combined with socio-quantitative empirical data, providing a strong triangulation between physical space and human behavior.

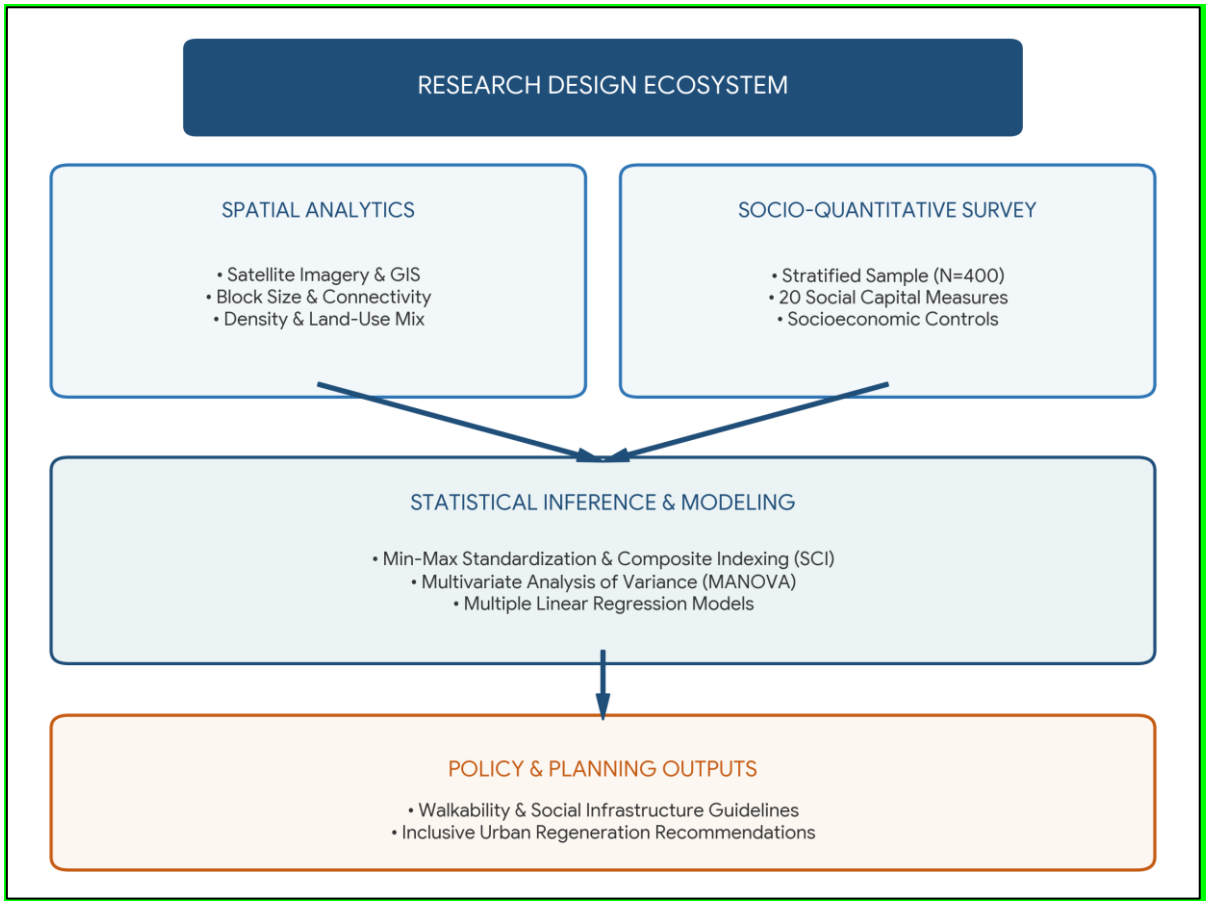


Figure 2: Research Design Ecosystem and Methodological Workflow

The methodological steps are organized as in the chart of Figure 2, from data collection and spatial parameterization on to household surveys, statistical standardization, multivariate modelling and policy synthesis. High resolution satellite imagery and cadastral vector maps were used in ArcGIS to derive spatial parameters such as street intersection density, node-to-link connectivity ratios, land-use entropy and public space walksheds. At the same time, the social capital was measured from three perspectives, namely cognitive, relational and structural, through twenty indicators on a 5-point Likert scale through household survey data.

A stratified random sampling approach was used, within the three study typologies, to account for the socio-economic diversity and for achieving statistical representativeness. A total of 400 completed household questionnaires were obtained, 140 from the Walled City, 130 from Allama Iqbal town and 130 from Bahria Town. Survey instruments were pre-tested to identify linguistic and contextual clarity, and measured various aspects including interpersonal trust, neighborly reciprocity, how often informal assistance is provided, civic association membership, localized safety perception, and place attachment.

Spatial morphology extraction consisted of the accurate digital mapping of road centrelines, building footprints, land-use allocations and public open space boundaries. Intersection density was computed as the number of street nodes that are connected to three or more street nodes per square kilometer using spatial network tools. Land-use diversity entropy (H) was done based on Shannon's Entropy index with four major land-use categories (residential, commercial, institutional, open space):

$$H = - \Sigma [p_i * ln(p_i)] / ln(k)$$

where p_i is the proportion of total floor area devoted to land use category i, and k is the total number of distinct land-use categories present. Higher entropy values (ranging from 0 to 1) indicate greater land-use mix and functional integration.

To construct a standardized comparative baseline across disparate survey measures, raw survey responses were normalized using min-max scaling transformations:

$$Standardized\ X_i = (X_i - X_{min}) / (X_{max} - X_{min})$$

Equal weightings (w_i = 1/20) were applied across all normalized indicators to generate an overall Composite Social Capital Index (SCI) for each individual respondent:

$$SCI = (1 / 20) * \Sigma (X_i')\ \ [for\ i = 1\ to\ 20]$$

To determine the independent contribution of urban morphology, after controlling for socioeconomic covariates, such as household income, education, occupation, age, and length of residency, statistical validation was carried out using Multivariate Analysis of Variance (MANOVA) and hierarchical linear regression modeling.

24 semi-structured in-depth interviews were conducted with key community stakeholders, namely local elders (mohalla representatives), town planning officers, market association leaders, and long-term residents in each neighbourhood typology to gather qualitative field data. Thematic coding was completed using NVivo software to provide rich narrative information about residents' experience of public space, their sense of neighbourhood boundaries and how they interact with informal social networks, in order to provide context to the quantitative survey findings.

The socio-quantitative survey instrument was carefully validated and tested for construct validity and reliability in the diverse demographic groups. Cronbach's alpha coefficients for the three social capital core dimensions were all strong, surpassing the academic boundaries of acceptability: cognitive social capital ($\alpha = 0.84$), relational social capital ($\alpha = 0.88$), and structural social capital ($\alpha = 0.81$). The factor analysis also confirmed the dimensional structure of the survey items with separate factor loadings consistent with theoretical dimensions.

The spatial analysis procedures used included the incorporation of Geographic Information System (ArcGIS Pro) for integrated space syntax modeling, pedestrian walkshed calculations and spatial autocorrelation analyses. Axial maps and segment maps were prepared for every study site and local integration values (R3) and global integration values (Rn) were calculated. Using the network analyst tools, walkshed analyses were used to calculate actual walking distances between street networks, creating precise service coverage areas for public parks, primary schools, commercial markets and healthcare facilities in the form of 300-m and 500-m walksheds.

Data collection procedures emphasized ethical research practices such as informed consent, anonymity and cultural sensitivity. Trained local researchers administered the household survey in Urdu and Punjabi, ensuring clear communication across different levels of literacy with clear communication among diverse levels of literacy. To reduce sampling

bias and provide a fairly even geographical distribution within each neighborhood typology, the data collection was stratified by residential sub-sectors, block types and income groups.

Aerial imagery at a high resolution was used to cross-verify spatial data accuracy and ground-truth field audits, conducted at all study sites. Physical dimensions of street rights-of-way, sidewalk widths, park boundaries and building setbacks were physically measured in sample blocks to validate cadastral GIS layers. This dual validation method allowed for high spatial precision for all morphological measures, providing a reliable empirical basis for multivariate statistical modelling.

5. Empirical Profile and Spatial Analysis of Case Study Neighborhoods

The empirical study focuses on three contrasting neighbourhood typologies representing different stages in Lahore's urban development, which represent the historical development of urban form in Lahore, in the Lahore metropolitan district. The typologies refer to different stages of planning theory, density limits, architectural expression, and infrastructure.

Neighborhood Typology	Historical Era & Origin	Dominant Spatial & Morphological Features	Socioeconomic Profile & Housing Characteristics
Walled City of Lahore	Pre-Mughal / Mughal (Over 500 years old)	High building density, narrow winding pedestrian lanes (kuchas and guzargahs), courtyard houses (havelis), and fine-grained mixed-use street layouts.	Working-class to lower-middle-class residents; high density of small shopkeepers, traditional artisans, and laborers; average monthly income ranging from PKR 20,000 to 50,000.
Allama Iqbal Town	Post-Independence (Established late 1970s to early 1980s)	Medium-density sectorized grid network, planned residential blocks, central recreational parks, and integrated commercial hubs (Moon Market, Karim Block).	Diverse middle-class population; a balanced mix of private sector employees, government professionals, and business owners; average monthly income ranging from PKR 50,000 to 80,000.
Bahria Town Lahore	Contemporary (Developed in the 2000s)	Low-density private gated enclave, wide arterial boulevards, strict land-use zoning, perimeter security walls, and automobile-centric infrastructure.	Affluent and upper-middle-class population; executives, entrepreneurs, and overseas professionals; average monthly income exceeding PKR 80,000 to 140,000+.

Table 1: Comparative Socio-Spatial Profile of Case Study Neighborhoods in Lahore

For each study area, spatial metrics were derived from the high resolution satellite imagery and using the ArcGIS processing of cadastral maps to ensure a rigorous quantification of the physical configuration of each study area. Spatial evaluation was based on the following four morphological indicators:

1. Street Network Permeability and Connectivity: Measured using intersection density and node-link ratios. Compared to the hustle and bustle of Bahria Town, where cul-de-sacs and gated perimeters create a hierarchical layout, the Walled City was found to be the most connected, with a pedestrian-friendly network of organic connections.

2. Residential Building Density - measured as floor area ratio (FAR) and dwelling units per acre. The Walled City is the most vertically and horizontally consolidated, while Allama Iqbal Town exhibits moderate density multi-story coverage, and Bahria Town has low-density luxury villas and isolated apartment blocks.

3. Land-Use Diversity Entropy: A measure derived by calculating using proportional area allocations for residential, commercial, institutional and recreational use. The traditional organic cores and planned grid sectors have high functional mix, while gated enclaves have strict functional segregation between residential and commercial plazas.

4. Public Open Space Proximity: Assessed using pedestrian catchment areas (300m and 500m walksheds) to public parks and squares. Distributed block parks are best suited for planned grid sectors, and gated developments work best with landscapes that are maintained for private leisure and vehicular view corridors.

The analysis of the buildings in the historic Walled City shows a remarkably high density of intersections (more than 180 per square kilometer) formed by the complex network of narrow lanes (kuchas) and residential dead-end alleyways (mohallas). This organic permeability slows the traffic, and makes public street spaces act as an extension of an outdoor living room, where children play, elders talk and neighbors interact back and forth all day long. Nevertheless, it has its drawbacks such as the ageing of infrastructure, heavy traffic on main bazaars, and physical decay of old havelis.

Allama Iqbal Town is a typical example of mid-density planned grid development from the 1970s and 1980s public sector development. The street hierarchy is highly legible, the intersections have an average density of 65 intersections per square kilometer. Centralized neighborhood parks within each residential block (e.g. Khyber Block, Chenab Block and Ravi Block) allow for more than 82% of residents to be within 300m of a publicly accessible park. The integrated commercial complexes, such as Moon Market, Karim Block, serve as a focus for bringing together a variety of socio-economic groups, creating vibrant public spaces.

In contrast, Bahria Town Lahore is a case of modern private master-planned suburbanism. It features low intersection density (22 intersections per square kilometer) and high percentage of cul-de-sac and gated sub-sector entrance, created specifically for the speed of the private automobile. Physical perimeter walls, security checkpoints and private security guards are used to tightly control physical access. Commercial amenities are well-maintained and updated, but are located in large suburban plazas with long distances to walk and low informal street co-presence.

Comparative spatial analysis shows how the spatial structure directly affects the performance of the environment and human experience. The Walled City is full of pedestrian access and social interaction but also faces serious space restrictions, insufficient sanitation facilities and lack of green space. Allama Iqbal Town is an example of a morphological compromise that provides a regular grid circulation system, public parks that are well

distributed and lively market centers. Bahria Town emphasizes aesthetic neatness, convenience for automobiles, and security, at the expense of the organic vitality of the street and lack of informal integration into the neighborhood.

In addition, spatial micro-climate and shading evaluations show that the narrow canyon-like geometry of streets in the Walled City creates thermally comfortable micro-climate conditions for the street and improves passive solar shading during hot summer months, which will promote lingering and outdoor use during the day. Conversely, the wide asphalt roads and large building setbacks in Bahria Town increase the exposure of pedestrians to intense solar radiation and urban heat island effects, contributing to a lack of incentives for using non-motorized transport, and reducing opportunities for outdoor social activities.

The architectural differences between typologies are further highlighted by morphological analysis of housing floor plans. The Courtyard-housing in the Walled City is characterized by layouts with an open-to-sky courtyard (sehn), which are oriented towards the courtyard, and allow multiple generations to live in one structure, while providing natural ventilation. The exterior threshold is directly linked to the communal street, thus providing a seamless relationship between private domestic space and neighborhood public space. Suburban villas in Bahria Town, on the other hand, have extroverted, setback floor plans, front lawns and walls around the perimeter, which physically segregates occupants from the public street, and underscores spatial privatization.

The results of the space syntax integration modeling show that there are significant differences among the local integration (R3) values in the three neighborhoods. The Walled City shows high local integration (mean R3 = 1.68) along its secondary pedestrian network, meaning it is highly topological accessible and has a high mobility potential at the neighborhood scale. Allama Iqbal Town has moderate level of integration (mean R3 = 1.34) and the maximum level of integration is found on the collector roads, which define the blocks, and along the edges of the central park. The integration scores for local integration are much lower in Bahria Town (mean R3 = 0.89), indicating an internal spatial structure that is highly segregated, which is reflected in limited internal movement and low pedestrian interaction scores.

The three case study sites are also differentiated by analysis of the street visual permeability. Within the Walled City, ground floor active frontages (small retail stores, open workshops and low level window sills) make up 78% of the total street frontage, establishing a continuous visual transparency and natural oversight. Active frontages in Allama Iqbal Town are mainly situated around commercial corridors and block corners, accounting for 52% of street edges. In Bahria Town 84% of street frontages are blank perimeter walls, garage doors and solid boundary fences, making it hard to make connections between the indoor living space and the public street and limiting natural surveillance opportunities.

The spatial differences in pedestrian infrastructure assessments further reinforce these differences. Even though there are no dedicated sidewalks for pedestrians, in Walled City everything on the street is a communal area for walking, and vehicles are physically limited to walking speed. 68% of residential streets in Allama Iqbal Town have functional, shaded sidewalks to provide safe pedestrian access to local parks and schools. In Bahria Town,

although paved footpaths exist along the major boulevards, there are no continuous shade trees or seating, and no crosswalk protection making it unattractive for people to walk in hot weather.

6. Multivariate Statistical Results and Findings

Analysis of survey data (N = 400) across the three case study sites shows considerable variation in social capital formation, revealing the direct relationship between the physical urban morphology and interpersonal trust, civic engagement and community cohesion.

Twenty different sub-indicators were standardized by min-max normalization on cognitive, relational and structural dimensions to obtain distinct Composite Social Capital Index (SCI) scores for each typology:

Despite low levels of trust in institutions, Walled City showed high levels of cognitive and relational social capital (SCI = 0.72), associated with high levels of informal support, frequent face-to-face street interaction and high level of localized identity.

Allama Iqbal Town (SCI = 0.61): Showed balanced scores in all indicators, with structured neighborhood associations, accessible community parks and moderate network diversity.

Bahria Town (SCI = 0.45): Reported lower relational and structural scores, with limited network diversity, few spontaneous interactions on the street, and a strong focus on institutional security rather than neighborly trust.

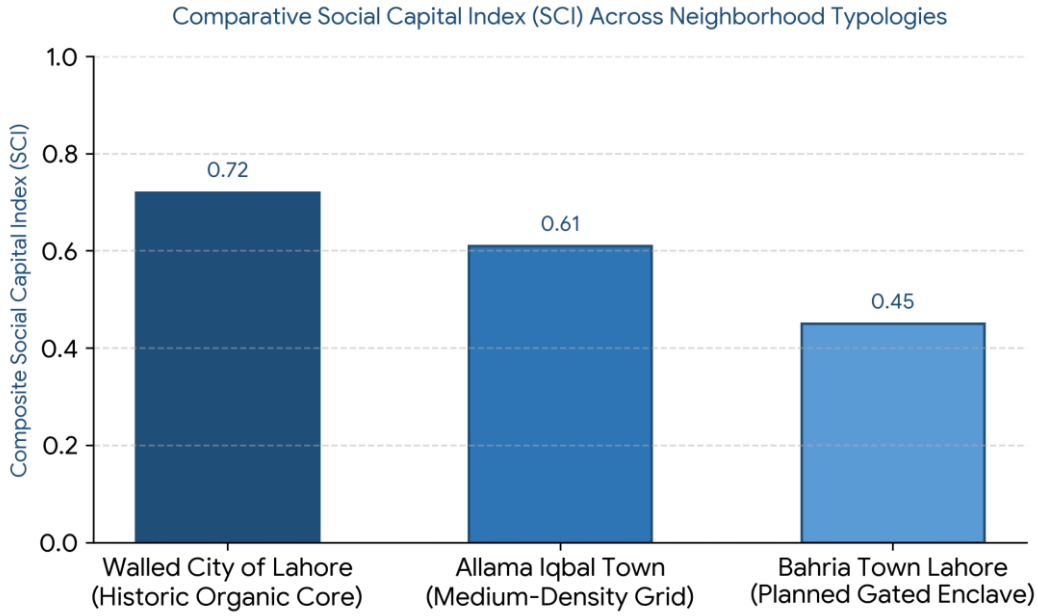


Figure 3: Comparative Social Capital Index (SCI) Scores Across Case Study Typologies

With the socioeconomic covariates (age, income, occupation and tenure length), a multivariate analysis of variance (MANOVA) was performed to determine if the set of social capital indicators differed significantly across the three spatial typologies. The multivariate test confirmed the highly significant effect of neighborhood typology (Wilks' Lambda = 0.58,

$F = 14.82$, $p < 0.001$) on overall social capital profiles, meaning that social capital profiles vary significantly by urban form after controlling for the individual socioeconomic status.

Analysis of social capital sub-dimensions gives important empirical findings. The Walled City had the highest score for cognitive social capital (4.12 out of 5.0), followed by Allama Iqbal Town (3.65) and Bahria Town (2.88). 88% of the people in Walled City confirmed that they would turn to their neighbors to monitor their property or to help them in an emergency situation, compared with 72% in Allama Iqbal Town and 39% in Bahria Town. In Bahria Town, people were much more likely to rely on private security personnel and private service providers than on neighborly help.

The pattern of relational social capital (informal social interaction, shared meals, and daily conversation) was similar. The informal neighborly interaction of the Walled City residents was 4.5 while 2.1 informal interactions in Allama Iqbal Town and 0.6 in Bahria Town were reported. The layout of the Walled City's mohallas, in which house thresholds face an open space that facilitates both interaction and pedestrian access, ensures that everyone is face-to-face at least every day. In contrast, Bahria's villa and car-centric layout ensures that the majority of interactions are purposeful rather than serendipitous, separating the residents from the outside by automated garage gates and setback villa entrances.

Structural social capital, defined as the active participation in formal neighborhood associations, block committees and neighborhood civic organizations, showed a more complicated pattern. Allama Iqbal Town recorded the highest structural social capital score (mean = 3.52), which may be associated with the presence of active neighbourhood welfare societies and traders' associations, the neighborhood welfare societies are active and managing the parks and also there is an association of traders (tajir union) in this town. Social organization in the Walled City was moderately developed (mean value = 3.10), and most was found in the form of informal clan networks (biradaris) and traditional bazaar unions, not formal NGOs. The mean score for structural was lowest for Bahria Town (2.45), since residents tend to leave the management, maintenance and security of their communities to the private corporate management entity (Bahria Town Pvt. Ltd) and thus feel less need for active citizen involvement.

The theoretical hypotheses were tested and relative predictive power of spatial variables and socioeconomic controls was examined using hierarchical multiple regression modeling. After accounting for socioeconomic variables (income, education, age, tenure), 18% ($R^2 = 0.18$, P value < 0.001) of the variance in the Composite Social Capital Index scores for Model 1 was explained. The addition of spatial morphological parameters (street connectivity, land-use entropy, walkability, proximity to open space) to Model 2 resulted in a significant increase in the explained variance to 54% ($R^2 = 0.54$, $\Delta R^2 = 0.36$, $p < 0.001$). Pedestrian walkability and proximity to public park were found to be the strongest positive predictors of social capital; this was consistent with Hypothesis 1 and Hypothesis 2.

The bivariate correlation analysis showed a very high positive correlation between pedestrian accessibility and network diversity ($r = 0.85$, $p<0.01$). On the other hand, building density was found to have a non-linear relationship with trust; moderate density in grid-planned neighborhoods is linked to the development of localized trust, and extreme

unmanaged density in parts of the organic core is linked to occasional spatial friction, as suggested by Hypothesis 3. This suggests that density is conducive to social interaction, but should not be so high that open space and public facilities are not provided to prevent overcrowding and stress.

Some breakdown of income sub-samples shows that spatial design has an extremely high protective effect for low and middle income households. Local social capital is important for lower income citizens in Walled City as it helps provide informal credit, shared child care, and mutual emergency support. In higher-income gated developments, residents tend to replace informal social capital with formal social capital, as formal social capital is a purchased good (private security, home maintenance services, private recreation clubs). This shift, however, isolates enclave dwellers from the rest of society and exposes them to disruptions of the formal market when it fails.

The survey results on perceptions of neighborhood safety show a contradiction between indicators of physical safety and perceived psychological safety. While Bahria Town has gated perimeters and CCTV surveillance and is patrolled 24 hours a day, residents in Bahria Town also said they felt more threatened by crime when walking alone at night (38%) than residents in the Walled City (14%). While it is difficult to quantify, qualitative interview data indicate that the lack of eyes on the street and empty pedestrian sidewalks in Bahria Town increase the feelings of vulnerability, the physical presence of neighbors and bustling street frontage in the Walled City generate a pervasive sense of informal neighborhood protection.

Gender-differentiated analyses indicated that the relationship between spatial morphology and social interaction varied between female and male respondents, as shown by the gender-differentiated statistical analyses. Women in Allama Iqbal Town and the Walled City reported enhanced levels of daily informal social interaction within neighborhood streets and block parks where they use semi-public communal spaces for social networking and child supervision. Female respondents reported on substantial obstacles to spontaneous social interaction, which was blamed on lack of places to walk, lack of shade on the footpaths, and having to use the car all the time in Bahria Town. This underscores the gender-specific aspect of urban design and indicates the importance of creating walkable, mixed-use areas for women's social inclusion and mobility.

The mediating role of spatial morphology in the social impacts on vulnerable groups is highlighted using age-stratified regression models. As to subjective life satisfaction and community inclusion, seniors (60+ years) from the Walled City and Allama Iqbal Town had significantly higher scores (mean = 4.25 out of 5.0) than the elderly residents from Bahria Town (mean = 2.40). In walkable areas, older people live independently, walk to local mosques, corner shops, and neighborhood parks, where they meet with other older adults on a regular basis. By comparison, the elderly in gated suburban enclaves suffer from high-level spatial isolation, with limited mobility due to their dependence on a car and on family members for transport.

The same applies to children's levels of independent mobility and their engagement in outdoor play activities, which are significantly different between typologies. The proportions of parents who gave children ages 8-12 permission to play alone in local alleys or block parks

were 76% in the Walled City. Only 22% of parents allowed unsupervised outside play in Bahria Town due to high vehicular speed on wider avenues and the absence of eyes on the street. This decreased autonomy in children's space use also affects early social development and the building of peer networks, as urban design that focuses on cars affects social development from generation to generation.

7. Comprehensive Discussion, Planning Implications, and Policy Frameworks

The empirical results in this study offer strong and local evidence from a large South Asian city, showing that specific urban forms have a direct connection to the opportunities for building trust, engaging in community, and providing social support. This research deals with the evaluation of the historic fabric of the Walled City, the post-independence planned grid of Allama Iqbal Town and the modern gated enclave of Bahria Town, which is the concrete result of the theories of morphology.

The quantitative and qualitative findings affirm the hypothesis that physical spatial design serves as a catalyst and/or obstacle to social sustainability. In traditional organic environments, like the Walled City, cognitive and relational social capital is high. These spaces are designed with smaller pave blocks to create pathways for people to walk and pass each other; mixed uses; and small courtyards to encourage frequent, unplanned, and unexpected meeting spaces. As Gehl (2010) and Jacobs (1961) suggested, this micro-scale permeability generates ‘eyes on the street' that encourage informal social control, trust and attachment to place.

On the other hand, current developments such as Bahria Town focus on car supremacy, perimeter security and functional segregation. These enclaves provide contemporary conveniences and spatial organization, but they also create unintended limitations on variety of networks and unplanned neighborhood interactions. In such motorized neighbourhoods, inhabitants say they receive less informal support than in other neighbourhoods, which is instead provided by institutional security mechanisms, rather than by organic trust among neighbours. These findings are consistent with international research on social problems associated with suburban sprawl and gated urbanism, and show that there is a direct link between physical fragmentation and socio-spatial isolation.

It is especially important to learn from the contrast of Allama Iqbal Town and Bahria Town for the future planning in Pakistan. Allama Iqbal Town is proof that high social capital does not have to be part of a modern planned development. With its legibility of the grid, high level of accessibility to the park, and the human scale of residential blocks and integrated commercial centers, grid planning can foster a balance between modern vehicle convenience and rich community life. Strikingly, Bahria Town's extreme private control of space, perimeter gating, and auto-centric design creates a social ecology that is fragmented, with high material affluence coupled with low social cohesion.

It is crucial to shift away from functionalist or vehicular-centric master planning approaches to translate these empirical findings into actionable urban planning practices. Municipal governments, urban designers and real estate developers need to proactively apply

human-scale spatial concepts to new design and development of neighborhoods and urban renewal projects:

Active Non-Motorized Transport: Retrofit or plan urban areas from the start for pedestrian connectivity and walkability that creates smaller blocks to promote active transport and encourage more frequent casual interactions.

Residential and commercial/civic functions should not be completely removed from each other, as this reduces the vibrancy of the community. Planners should promote mixed use vertical and horizontal development that allows for the convenient walking access to social nodes, shopping and errands.

Designing Inclusive and Accessible Public Spaces: Parks, communal squares and shared courtyards need to be spread across all income levels and residential types. These public areas should be preserved not only as 'breathtaking green spaces' but as active social infrastructure which enables intergenerational and intercultural contact.

High building density might be land-efficient, but high levels of building density not managed can cause interpersonal trust to suffer. Social friction can be avoided by pairing density policies with mandatory public open space, and human scaled street sizes.

The recommendations outlined above need to be translated into actionable policy and regulatory changes in the Pakistani urban setting, and there is a strong need to get this done at the municipal and provincial levels of governance:

The by-laws governing buildings should be amended by provincial urban development authorities (LDA, Lahore Development Authority) to limit the maximum length of any block (not more than 120 meters), to ensure pedestrian rights of way and to increase the minimum provision of public open space in all new private and public housing schemes (by 15%).

Prohibition of Enclosed Gated Perimeters on Arterial Roads: Municipal planning codes should provide for an active street frontage and publicly accessible commercial corridor that connects developments to the surrounding urban fabric and not create fortress-style perimeter walls around mega-housing developments.

3. Urban Regeneration Frameworks for Historic Cores: In historic areas such as the Walled City, urban renewal works must include both the preservation of the historic structures and improvements to infrastructure, while also taking care of the preservation of the community, including the maintenance of the micro-scale spatial character and traditional social networks during the modernization process.

4. Institutional Support for Neighborhood Block Committees: Give recognition and support to neighborhood welfare associations (mohalla committees) formally, with micro-grants for community-led public space improvement, urban gardening, and local cultural programming.

The adoption of these spatial policy changes will need to shift the approach for the evaluation and approval of urban development projects in Pakistan. Mostly, environmental impact assessments (EIAs) are performed on physical environmental parameters, such as air quality, traffic volume, waste management, and do not include any socio-spatial impact

assessments. Large residential developments featuring Social Capital Impact Assessments (SCIAs) would have to consider the effects of proposed street layouts, open space planning and access barriers on community cohesion before approval.

In addition, municipal investments should focus on providing pedestrian facilities and community facilities in suburban developments that are oriented to cars. Transforming unused street space into linear parks, establishing pedestrianized plaza nodes in commercial areas and creating shaded walking paths can help add social vitality at a human scale to auto-centric neighborhoods. The urban planner can play a proactive role in creating a place for social interaction and reconnecting an urban community in suburbs with privatised urban space by retrofitting suburban spaces with a walkable public destination.

Urban regeneration strategies should consider the social preservation aspect of historic urban cores such as the Walled City, while modernizing the infrastructure. The changes to infrastructure – including undergrounding utilities, upgrading drainage systems, and regulating commercial traffic – should be done in a way that doesn't change the fine-grained street layout or evict long-term neighborhood residents. Maintenance of the physical and social structure in the historic cores is necessary to ensure that the informal social capital that continues to serve the residents of these areas is not lost and that the quality of life for these residents is improved.

In order to develop socially sustainable cities in South Asian metropolises, multi-stakeholder governance mechanisms must be put in place and local communities must be actively involved in the planning process. The urban development authority has to move from a technocratic and top-down approach to decision-making to a participatory planning approach, with citizens' input in the design of parks, in street retrofitting and in neighborhood regeneration. Incorporating local communities' participation in the design of public spaces can promote spatial ownership, social responsibility and responsiveness to community needs.

In conclusion, there is a need to reform the academic and professional education of urban planning in Pakistan so as to introduce socio-spatial analytical methods in the main curriculum. In addition to engineering and graphic design skills, space syntax analysis, social impact assessment and participative mapping tools should be included in architecture and urban planning courses. It is crucial to educate the next generation of urban designers to assess the social implications of physical morphology to foster a new cadre of socially engaged practitioners who can build socially vibrant, resilient and inclusive cities.

The study provides a detailed examination of the evolving socio-spatial reality of Lahore but has some methodological limitations which need to be recognized. The cross-sectional design and self-reported survey data only allow for strong correlations and multivariate group differences, and strong causal claims are not possible. Longitudinal tracking, hierarchical linear modeling and advanced spatial regression should be included in future inquiries to assess changes in social capital over time. Cross-city analysis will be further enriched by comparative analysis of urban morphology in various cultural and regional contexts across Pakistan and the Global South, thereby enhancing our understanding of urban morphology's impact on the human experience.

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