



Urban Informality, Smart-City Interventions, and Spatial Justice Perceptions among Informal Settlement Residents in Major Pakistani Cities

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ABSTRACT

Background: Rapid urbanization has expanded informal settlements in developing countries, where inadequate services, insecure housing, and limited participation in governance remain persistent challenges. Although smart-city initiatives aim to improve urban efficiency and service delivery, their implications for equity and spatial justice among marginalized communities remain insufficiently understood.

Objective: To examine the relationship between urban informality, smart-city interventions, and spatial justice perceptions among informal settlement residents in major Pakistani cities.

Methods: A mixed-methods cross-sectional study was conducted among 512 residents of informal settlements in Karachi, Lahore, Islamabad–Rawalpindi, and Peshawar using purposive and snowball sampling. Structured questionnaires assessed demographics, service access, digital connectivity, smart-city awareness, spatial justice perceptions, displacement concerns, and trust in governance. Additionally, 21 key informant interviews and secondary data from municipal reports, smart-city plans, media sources, and urban datasets were analyzed. Quantitative analyses included descriptive statistics, factor analysis, t-tests/ANOVA, and multiple regression, while qualitative data underwent thematic analysis.

Results: Perceived spatial justice was generally low, particularly regarding procedural justice and participation. Only 41.8% of respondents were aware of smart-city initiatives, and fewer than 11% had participated in planning consultations. Most participants perceived displacement risks, while 75.6% believed smart-city projects primarily benefited wealthier areas. Spatial justice perceptions were positively associated with service access, smart-city awareness, internet access, and income, but negatively associated with displacement concerns (all $p < 0.001$). Qualitative findings emphasized exclusion, inadequate recognition, and demands for participatory planning.

Conclusion: Inclusive smart-city development requires equitable services, secure housing, digital inclusion, and meaningful community participation to strengthen spatial justice.

INTRODUCTION

Urbanization is one of the most significant demographic and spatial transformations of the twenty-first century (Anestis & Stathakis, 2024; Kundu & Pandey, 2020). More than half of the world’s population currently lives in urban areas, and this proportion is expected to continue increasing in the coming decades, particularly in developing countries (Sun et al., 2020; Angel, 2023). Rapid urban growth has generated new opportunities for economic development, innovation, and improved service delivery; however, it has also intensified challenges related to housing inequality, infrastructure shortages, social exclusion, and uneven access to urban resources (Sukanya & Tania, 2023; Goel & Vishnoi, 2022). These challenges are particularly evident in cities of the Global South, where rapid population growth often exceeds the capacity of formal planning systems, leading to the expansion of informal settlements and marginalized urban communities (Myers, 2021; Cobbinah & Finn, 2023). Urban informality represents one of the most complex challenges facing contemporary cities (Mohanty, 2020; Banks et al., 2020). Informal settlements are characterized by insecure land tenure, inadequate housing conditions, limited access to basic services, and exclusion from formal urban planning processes (Carrilho & Trindade, 2022; Malik et al., 2020). Although informal communities often provide essential housing and economic opportunities for low-income populations, they are frequently viewed as obstacles to urban modernization rather than as integral components of urban systems (Banks et al., 2020;

Suhartini & Jones, 2023). In many developing countries, informal settlement residents contribute significantly to urban economies through informal employment but remain excluded from decision-making processes and public investments (Visagie & Turok, 2020; Swapan & Khan, 2022). This contradiction highlights the need for urban policies that recognize informal communities as legitimate urban citizens rather than temporary or unauthorized populations (Huq & Mirafat, 2020). Pakistan represents a rapidly urbanizing country where urban growth has created significant pressures on housing, infrastructure, and governance systems (Abdul & Yu, 2020). Major cities including Karachi, Lahore, Islamabad–

HIGHLIGHTS	
Research insights	Spatial justice remains low among informal settlement residents, with exclusion, displacement concerns, and limited participation undermining equitable smart-city development.
Practical insights	Equitable services, secure housing, digital inclusion, and meaningful community participation are essential for improving spatial justice in informal settlements.
Industry insights	Smart-city planners should prioritize inclusive governance, equitable service delivery, and participatory planning to prevent displacement and reduce urban inequalities.



Rawalpindi, and Peshawar have experienced substantial expansion due to population growth, rural-to-urban migration, and economic opportunities (Javed et al., 2020). However, urban development has not progressed equally across social groups, resulting in the growth of informal settlements characterized by inadequate services, insecure housing arrangements, and limited institutional support (Karuga et al., 2023). A substantial proportion of urban residents in Pakistan live in informal settlements where access to clean water, sanitation, transportation, healthcare, and digital infrastructure remains uneven (Javed et al., 2020). These conditions raise important questions regarding fairness, inclusion, and the distribution of urban development benefits. The concept of spatial justice provides an important framework for understanding inequalities within urban environments (Deb & Smith, 2021). Spatial justice refers to the fair and equitable distribution of resources, opportunities, and recognition across geographic spaces and social groups (Madanipour et al., 2022). It consists of three interconnected dimensions: distributive justice, which concerns the allocation of urban resources and services; procedural justice, which focuses on participation and inclusion in decision-making processes; and recognitional justice, which emphasizes respect for the identities, experiences, and needs of marginalized communities (Wijsman & Berbés-Blázquez, 2022). Applying a spatial justice perspective allows researchers to examine not only where inequalities exist but also how they are produced through political, economic, and institutional processes (Gürtler, 2023). In recent years, the concept of the smart city has gained increasing attention as a strategy for addressing urban challenges through the integration of digital technologies, data-driven governance, and innovative infrastructure solutions (Kaluvarachchi, 2022). Smart-city initiatives aim to improve urban efficiency, sustainability, mobility, security, and service delivery through technologies such as digital platforms, sensors, artificial intelligence, and information systems. Governments worldwide have adopted smart-city approaches as part of broader urban modernization strategies. Pakistan has also introduced smart-city programs, including digital governance initiatives, technology-based service delivery systems, and urban infrastructure development projects in major cities (Javed et al., 2020). Despite their potential benefits, smart-city interventions have generated debate regarding their inclusiveness and social consequences. Critics argue that many smart-city models prioritize technological advancement and economic competitiveness while paying insufficient attention to social inequalities and the needs of marginalized communities (Goel & Vishnoi, 2022). Without careful consideration of existing inequalities, smart-city projects may unintentionally reinforce exclusion by directing investments toward already advantaged areas while neglecting informal settlements (Gürtler, 2023). Furthermore, technology-driven urban development can increase displacement risks when redevelopment projects prioritize land value and infrastructure expansion over community rights and housing security (Banks et al., 2020).

The relationship between smart-city development and informal settlements is therefore a critical area of investigation. While digital technologies have the potential to improve access to services and enhance urban governance, their benefits depend on equitable implementation and meaningful community participation (Wijsman & Berbés-Blázquez, 2022). Informal settlement residents often lack awareness of urban development plans and have limited opportunities to influence decisions affecting their neighborhoods (Swapan & Khan, 2022; Karuga et al., 2023). This lack of participation can contribute to mistrust toward government institutions and perceptions that urban modernization processes are designed without considering the interests of marginalized populations (Karuga et al., 2023). Community participation is increasingly recognized as a fundamental component of inclusive urban governance. Participatory planning approaches allow residents to contribute local knowledge, identify community

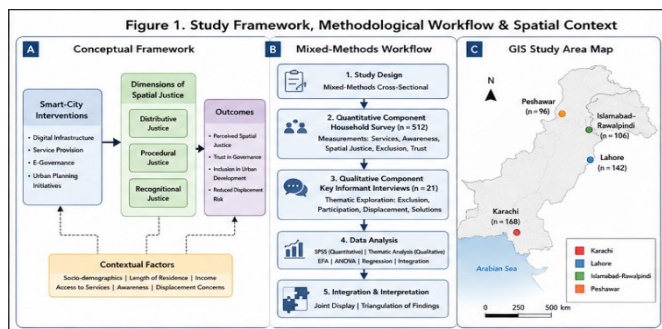
priorities, and influence decisions related to infrastructure and service provision (Swapan & Khan, 2022; Karuga et al., 2023). For informal settlement communities, participation is particularly important because residents possess valuable knowledge about local conditions, vulnerabilities, and adaptation strategies (Banks et al., 2020). Incorporating community perspectives into smart-city planning can improve legitimacy, strengthen trust, and promote more equitable urban outcomes (Lee et al., 2023). Digital inclusion is another important dimension of smart-city equity (Lee et al., 2023). Although digital technologies can improve access to government services, information, and civic participation, unequal access to digital infrastructure may create new forms of exclusion (Sanders & Scanlon, 2021). Residents of informal settlements often experience barriers related to affordability, connectivity, digital literacy, and access to devices (Lee et al., 2020). Therefore, smart-city initiatives must consider digital inequality alongside physical infrastructure development to ensure that technological transformation benefits all segments of society (Lee et al., 2020). Previous research on smart cities has largely focused on technological innovation, efficiency, and economic development, while comparatively less attention has been given to the experiences and perceptions of marginalized urban residents (Lee et al., 2020). Similarly, studies of informal settlements often emphasize poverty, housing insecurity, and service deficits but less frequently examine how residents perceive emerging urban transformation initiatives (Banks et al., 2020). In Pakistan, empirical evidence regarding the relationship between smart-city interventions, urban informality, and spatial justice remains limited (Javed et al., 2020). Understanding residents' perspectives is essential for developing urban policies that are socially inclusive and responsive to community needs (Lee et al., 2023; Lee et al., 2020). Therefore, this study aims to investigate urban informality, smart-city interventions, and spatial justice perceptions among informal settlement residents in major Pakistani cities. Specifically, the study examines how demographic characteristics, socioeconomic conditions, access to services, digital connectivity, and awareness of smart-city projects influence perceptions of distributive, procedural, and recognitional justice (Madanipour et al., 2022). It further explores residents' experiences of exclusion, displacement risk, trust in urban governance, and preferences for inclusive smart-city development (Banks et al., 2020; Lee et al., 2020). By integrating quantitative surveys, qualitative interviews, and policy analysis, this research provides a comprehensive understanding of how smart-city transformations can be aligned with principles of equity, participation, and social justice in rapidly urbanizing Pakistan (Javed et al., 2020).

METHODOLOGY

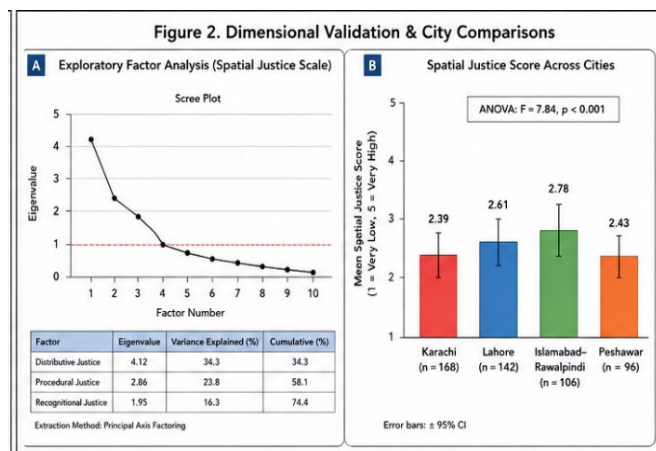
This study employed a mixed-methods cross-sectional research design to investigate perceptions of spatial justice, experiences of urban exclusion, and the implications of smart-city interventions among residents of informal settlements in major Pakistani cities. The study aimed to examine how access to services, digital infrastructure, and awareness of smart-city initiatives influence residents' perceptions of distributive, procedural, and recognitional justice within rapidly urbanizing environments. To achieve a comprehensive understanding of these issues, quantitative household surveys were combined with qualitative interviews and document analysis of urban planning policies and smart-city initiatives.

The study was conducted in selected informal settlements located in major metropolitan areas of Pakistan, including Karachi, Lahore, Islamabad–Rawalpindi, and Peshawar. These cities were selected because they have experienced rapid urban growth, increasing implementation of digital governance initiatives, and ongoing challenges related to informal housing and service provision. The

target population consisted of adult residents living in informal settlements who had resided in their communities for at least one year. Additional participants included urban planners, local government officials, community leaders, civil society representatives, and urban rights activists involved in planning or advocacy activities related to urban development and smart-city projects.



A sample of 400–550 residents was recruited using a combination of purposive and snowball sampling techniques. Community organizations, settlement committees, local activists, and neighborhood representatives assisted in identifying and recruiting participants from diverse socioeconomic and occupational backgrounds. Sampling aimed to ensure representation across different age groups, genders, income levels, and settlement characteristics. In addition, a qualitative subsample of 15–25 key informants was selected for in-depth face-to-face interviews using purposive sampling. These participants included urban planners, community leaders, non-governmental organization representatives, and residents with direct experience of urban redevelopment initiatives.



Primary quantitative data were collected through structured paper-based or tablet-assisted questionnaires administered door-to-door at participants' homes or community centers. The questionnaire was developed in Urdu and English and consisted of several sections covering demographic characteristics, livelihood conditions, service access, awareness of smart-city projects, perceptions of spatial justice, experiences of exclusion, trust in urban governance, and preferences regarding inclusive urban development. Demographic variables included age, gender, length of residence in the settlement, occupation, monthly household income, educational attainment, and household size. Information regarding access to water, sanitation, electricity, transportation, internet connectivity, and other basic services was also collected. The independent variables included age, gender, occupation, income level, duration of residence, access to basic services, access to digital infrastructure, and awareness of local smart-city initiatives. The dependent variables comprised perceived spatial justice, experiences of displacement risk, perceptions of exclusion from urban development interventions, trust in urban governance,

and preferences for inclusive smart-city features. Spatial justice was assessed through a multidimensional scale measuring distributive justice (fair allocation of resources and services), procedural justice (participation in decision-making processes), and recognitional justice (respect and recognition of community identities and needs). Experiences of exclusion and displacement risk were evaluated through participants' perceptions of redevelopment projects, land tenure insecurity, and concerns regarding relocation or eviction.

Qualitative data were collected through semi-structured face-to-face interviews with key stakeholders. Interview guides explored perceptions of urban inequality, community participation in planning processes, experiences with smart-city initiatives, concerns regarding displacement, and recommendations for inclusive urban development. Interviews were conducted in Urdu or local languages, audio-recorded with participant consent, and supplemented by detailed field notes. In addition, content analysis was conducted on publicly available smart-city master plans, municipal policy documents, urban development reports, media publications, and open urban datasets to examine how informal settlements were represented within official planning frameworks. Quantitative data were entered and analyzed using SPSS version 24. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize participant characteristics and key study variables. Exploratory factor analysis was conducted to validate the multidimensional spatial justice scale and identify underlying dimensions of justice perceptions. Independent-samples t-tests and one-way Analysis of Variance (ANOVA) were used to compare justice perceptions across cities, settlement types, and demographic groups. Multiple linear regression analysis was performed to identify predictors of perceived spatial justice and trust in urban governance. Statistical significance was established at $p < 0.05$.

Qualitative interview transcripts were transcribed verbatim and analyzed using thematic analysis. Coding procedures involved the identification of recurring themes related to urban exclusion, participation, displacement concerns, governance, and perceptions of smart-city development. Findings from qualitative interviews and document analysis were integrated with quantitative results to provide a comprehensive understanding of how smart-city interventions influence experiences of spatial justice among residents of informal settlements.

Ethical approval for the study was obtained from the relevant Institutional Review Board prior to data collection. Written informed consent was obtained from all participants before participation. Confidentiality and anonymity were maintained throughout the research process, and respondents were informed of their right to withdraw from the study at any stage without penalty. All research activities were conducted in accordance with internationally recognized ethical principles for social science research involving human participants.

RESULTS

A total of 512 residents from informal settlements located in Karachi ($n = 168$), Lahore ($n = 142$), Islamabad–Rawalpindi ($n = 106$), and Peshawar ($n = 96$) participated in the survey. In addition, 21 key informants, including urban planners, community leaders, activists, and local government representatives, participated in semi-structured interviews. The mean age of respondents was 36.9 ± 12.4 years, and the average duration of residence within settlements was 14.7 ± 8.3 years.

Table 1: Demographic Characteristics of Respondents (N = 512)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	279	54.5

	Female	233	45.5
Age Group	18–29 Years	146	28.5
	30–44 Years	218	42.6
	≥45 Years	148	28.9
Occupation	Daily Wage Labour	182	35.5
	Street Vendor/Small Business	117	22.9
	Domestic Work	74	14.5
	Transport Services	68	13.3
	Other Informal Employment	71	13.9
Monthly Income	< PKR 30,000	223	43.6
	PKR 30,000–60,000	196	38.3
	> PKR 60,000	93	18.2

Most respondents were employed in informal-sector occupations, with nearly half reporting monthly household incomes below PKR 30,000.

Table 2: Access to Basic Services and Digital Infrastructure

Service/Infrastructure	Yes (%)	No (%)
Electricity Access	82.8	17.2
Improved Water Supply	58.4	41.6
Sanitation Facilities	61.7	38.3
Internet Access	69.5	30.5
Smartphone Ownership	73.8	26.2
Access to Public Transport	84.6	15.4

While access to electricity and public transportation was relatively high, substantial gaps remained in water supply, sanitation, and internet access.

Table 3. Awareness of Smart-City Initiatives

Variable	Frequency (n)	Percentage (%)
Aware of Local Smart-City Projects	214	41.8
Not Aware	298	58.2
Participated in Public Consultation	52	10.2
Received Information from Authorities	67	13.1

Less than half of respondents reported awareness of smart-city projects, and only a small proportion had participated in formal consultation processes.

Table 4. Spatial Justice Perception Scores

Dimension	Mean ± SD
Distributive Justice	2.74 ± 0.81
Procedural Justice	2.31 ± 0.77
Recognitional Justice	2.58 ± 0.73
Overall Spatial Justice Score	2.54 ± 0.68

Scale: 1 = Very Low to 5 = Very High

Participants generally reported low perceptions of spatial justice, particularly regarding participation in planning and decision-making processes.

Table 5: Experiences of Exclusion and Displacement Risk

Variable	Frequency (n)	Percentage (%)
Concerned About Forced Relocation	301	58.8
Experienced Threat of Eviction	176	34.4
Felt Excluded from Urban Development Decisions	349	68.2
Perceived Smart-City Projects Favor Wealthier Areas	387	75.6

A large majority of respondents believed that smart-city projects primarily benefited wealthier communities while neglecting informal settlements.

Table 6: Trust in Urban Governance

Variable	Mean ± SD
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Trust in Municipal Authorities	2.41 ± 0.82
Trust in Urban Planning Institutions	2.36 ± 0.79
Trust in E-Governance Systems	2.71 ± 0.76
Overall Governance Trust Score	2.49 ± 0.71

Participants reported relatively low trust in urban governance institutions and planning authorities.

Table 7: ANOVA Comparing Spatial Justice Scores Across Cities

City	Mean Spatial Justice Score ± SD
Karachi	2.39 ± 0.64
Lahore	2.61 ± 0.69
Islamabad–Rawalpindi	2.78 ± 0.67
Peshawar	2.43 ± 0.71

F = 7.84, p < 0.001

Significant differences were observed across cities, with respondents in Islamabad–Rawalpindi reporting relatively higher perceptions of spatial justice compared with other cities.

Table 8: Multiple Regression Analysis Predicting Spatial Justice Perceptions

Predictor Variable	β	t-value	p-value
Access to Basic Services	0.38	9.26	<0.001
Awareness of Smart-City Projects	0.22	5.47	<0.001
Length of Residence	0.14	3.18	0.002
Internet Access	0.17	4.05	<0.001
Monthly Income	0.11	2.67	0.008
Displacement Concerns	-0.29	-6.91	<0.001

The regression model was statistically significant ($F = 49.83$, $p < 0.001$; $R^2 = 0.46$). Access to basic services emerged as the strongest positive predictor of spatial justice perceptions, while displacement concerns significantly reduced perceived justice.

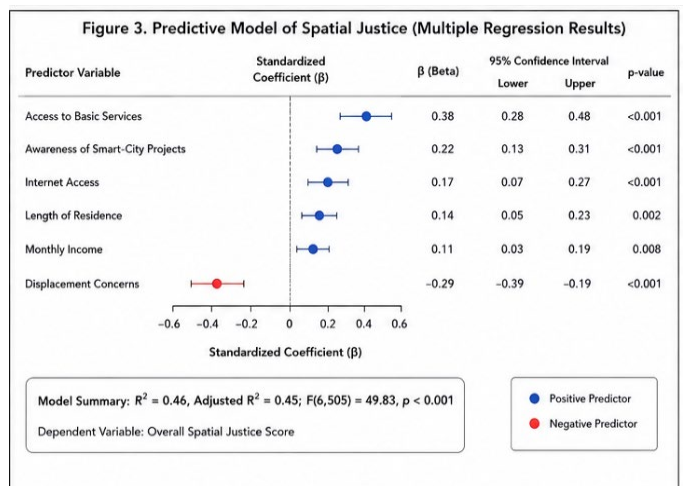


Table 9: Exploratory Factor Analysis of Spatial Justice Scale

Factor	Eigenvalue	Variance Explained (%)
Distributive Justice	4.12	34.3
Procedural Justice	2.86	23.8
Recognitional Justice	1.95	16.3

Total Variance Explained = 74.4%

Factor analysis supported the multidimensional structure of the spatial justice construct.

Table 10: Preferred Inclusive Smart-City Features

Feature	Frequency (n)	Percentage (%)
Improved Water and Sanitation Services	417	81.4
Affordable Housing Programs	394	77.0

Community Participation Platforms	361	70.5
Digital Access and Connectivity	327	63.9
Secure Land Tenure Mechanisms	436	85.2
Accessible Public Transportation	291	56.8

Secure land tenure and improved service provision emerged as the most preferred features of future smart-city initiatives.

Figure 4. Mixed-Methods Joint Integration Matrix (Joint Display Table)

	Quantitative Findings (Statistical Results)	Qualitative Themes (Thematic Findings)	Illustrative Quotes from Key Informants	Integrated Interpretation (Triangulation)
	Access to Basic Services $\beta = 0.38, p < 0.001$ (Strongest positive predictor of spatial justice)	Theme 1: Essential Services Gaps in water, sanitation, and reliable electricity undermine dignity and fairness.	"We still don't have clean water on time. How can they call this a smart city?" – Karachi Resident	Service provision is central to residents' sense of fairness and inclusion in urban development.
	Awareness of Smart-City Projects $\beta = 0.22, p < 0.001$	Theme 2: Limited Awareness Low knowledge and communication about smart-city initiatives.	"We only hear about projects from TV. No one tells us anything directly." – Community Leader, Lahore	Limited awareness restricts engagement and participation in decision-making processes.
	Displacement Concerns $\beta = -0.29, p < 0.001$ (Significant negative predictor)	Theme 3: Fear of Displacement Strong fear of eviction and loss of livelihood due to redevelopment projects.	"They say this land is illegal. We are always living in fear of being thrown out." – Peshawar Resident	Displacement fears significantly erode perceptions of justice and trust in governance.
	Participation in Planning (Participation Rate: 10.2%) Low involvement in public consultation	Theme 4: Exclusion from Decisions Residents rarely included in planning meetings or policy discussions.	"Decisions are made in offices. We are never invited to have a say." – Urban Planner, Islamabad	Exclusion from participation undermines procedural justice and democratic governance.
	Internet Access $\beta = 0.17, p < 0.001$	Theme 5: Digital Divide Internet access improves information access and opportunities.	"With internet, we can get information and apply online. It helps a lot." – Youth Participant, Lahore	Digital connectivity enhances awareness and engagement, supporting greater inclusion.

Qualitative Findings

Thematic analysis identified four major themes:

1. Smart Cities Without Informal Communities

Many participants perceived that smart-city projects focused primarily on affluent neighborhoods while overlooking the needs of informal settlements.

2. Fear of Displacement and Eviction

Residents frequently expressed concerns that redevelopment projects could lead to forced relocation and loss of livelihoods.

3. Limited Community Participation

Participants reported minimal involvement in planning processes and insufficient consultation by municipal authorities.

4. Demand for Inclusive Urban Development

Respondents emphasized the need for participatory planning, secure housing rights, improved services, and equitable digital infrastructure.

Summary of Findings

The results indicate that residents of informal settlements experience low levels of perceived spatial justice and trust in urban governance. Although awareness of smart-city initiatives varied across cities, most respondents reported limited participation in planning processes and substantial concerns regarding exclusion and displacement. Access to basic services, digital infrastructure, and awareness of urban development initiatives positively influenced perceptions of justice, while displacement fears significantly reduced them. The findings suggest that current smart-city interventions often fail to adequately address the needs and rights of informal settlement residents, highlighting the importance of more inclusive, participatory, and socially equitable urban planning approaches in Pakistan.

DISCUSSION

The present study examined perceptions of spatial justice, experiences of exclusion, and the implications of smart-city interventions among residents of informal settlements in major Pakistani cities. The findings reveal significant concerns regarding distributive, procedural, and recognitional justice, highlighting persistent inequalities in urban development and governance. Although smart-city initiatives are often promoted as mechanisms for improving urban efficiency, sustainability, and service delivery,

the results suggest that many residents of informal settlements perceive these interventions as insufficiently inclusive and inadequately responsive to their needs. The study contributes to the growing literature on urban informality and spatial justice by providing empirical evidence from a developing-country context where rapid urbanization, informal housing, and digital transformation are occurring simultaneously (Banks et al., 2020; Madanipour et al., 2022; Lee et al., 2020).

One of the most important findings was the generally low level of perceived spatial justice among informal settlement residents. Participants reported particularly low scores for procedural justice, indicating limited opportunities to participate in urban planning and decision-making processes. This finding is consistent with theories of spatial justice that emphasize the importance of equitable participation in the production and governance of urban spaces (Madanipour et al., 2022; Wijsman & Berbés-Blázquez, 2022). Procedural exclusion can reinforce existing inequalities by preventing marginalized communities from influencing decisions that directly affect their livelihoods, housing security, and access to services. Similar findings have been reported in studies of informal settlements across Asia, Africa, and Latin America, where urban planning processes often fail to incorporate the voices of low-income residents (Visagie & Turok, 2020; Swapam & Khan, 2022).

The study also found that a substantial proportion of respondents perceived smart-city projects as benefiting wealthier neighborhoods more than informal communities. This perception reflects concerns about distributive justice, which refers to the equitable allocation of resources, services, and development benefits (Madanipour et al., 2022). Existing research has highlighted that smart-city initiatives frequently prioritize technological innovation, infrastructure modernization, and economic competitiveness while paying insufficient attention to social equity and inclusion (Lee et al., 2020). In many developing countries, investments in digital infrastructure and urban modernization are concentrated in affluent areas, potentially widening spatial inequalities rather than reducing them (Sanders & Scanlon, 2021). The findings of the present study suggest that similar patterns may be emerging in Pakistan, where residents of informal settlements often feel excluded from the benefits of urban development.

Displacement concerns emerged as a major issue among respondents, with more than half expressing fears of forced relocation. The regression analysis demonstrated that displacement risk was a significant negative predictor of perceived spatial justice. This finding aligns with previous studies indicating that urban redevelopment projects frequently create uncertainty and insecurity for residents of informal settlements (Banks et al., 2020; Carrilho & Trindade, 2022). Smart-city initiatives sometimes involve land-use restructuring, infrastructure expansion, or redevelopment schemes that may threaten informal housing arrangements. Consequently, residents may associate urban modernization with eviction risks rather than improved living conditions. Such concerns highlight the need for urban planning approaches that prioritize housing security and community protection alongside technological advancement (Huq & MirafTAB, 2020).

Another important finding was the positive association between access to basic services and perceptions of spatial justice. Residents with better access to water, sanitation, electricity, transportation, and digital infrastructure reported higher levels of perceived fairness and inclusion. This result is consistent with urban justice theories emphasizing that equitable service provision is fundamental to achieving socially just cities (Madanipour et al., 2022). Access to essential services not only improves living conditions but also strengthens residents' sense of belonging and citizenship. The findings suggest that efforts to improve service delivery within informal settlements could significantly enhance perceptions of fairness and trust in urban governance institutions.

Awareness of smart-city projects was also found to positively

influence perceptions of spatial justice. Residents who possessed greater knowledge of local urban initiatives reported more favorable views regarding fairness and governance. This observation may reflect the importance of information accessibility and transparency in fostering trust between communities and public institutions. Previous studies have demonstrated that transparent communication and public engagement contribute to greater acceptance of urban development initiatives and strengthen perceptions of procedural legitimacy (Lee et al., 2023). However, the low overall levels of awareness observed in this study indicate that communication between planning authorities and informal settlement communities remains limited.

Trust in urban governance emerged as another significant issue. Participants reported relatively low levels of trust in municipal authorities and planning institutions. These findings are consistent with evidence suggesting that marginalized urban populations often experience distrust toward government institutions due to historical patterns of neglect, exclusion, and unequal service provision (Banks et al., 2020; Javed et al., 2020). Trust is a critical component of effective governance because it influences citizens' willingness to participate in planning processes and support public initiatives. The low trust levels identified in this study may therefore undermine the effectiveness of future smart-city interventions unless deliberate efforts are made to improve accountability, transparency, and community engagement (Lee et al., 2023).

The study also identified significant differences in spatial justice perceptions across cities. Respondents in Islamabad–Rawalpindi reported relatively higher levels of perceived justice compared with those in Karachi, Lahore, and Peshawar. These differences may reflect variations in urban governance capacity, service provision, infrastructure development, and local planning practices. Previous research has shown that city-specific institutional arrangements can significantly influence urban development outcomes and perceptions of fairness (Abdul & Yu, 2020; Javed et al., 2020). Consequently, urban policies designed to promote spatial justice should be sensitive to local contexts and governance structures.

The qualitative findings further reinforced the quantitative results by revealing widespread concerns regarding exclusion from planning processes and fears of displacement. Participants frequently described smart-city development as a top-down process in which decisions were made without meaningful community consultation. These perceptions are consistent with critiques of technocratic urban governance models that prioritize efficiency and technological solutions while neglecting social and political dimensions of urban development (Lee et al., 2023; Lee et al., 2020). Residents emphasized the importance of participatory planning mechanisms that allow communities to influence decisions affecting their neighborhoods and livelihoods.

The demand for secure land tenure emerged as one of the most prominent themes in both the quantitative and qualitative findings. Secure land rights were identified as the most preferred feature of inclusive smart-city development. This finding reflects extensive evidence demonstrating that tenure security is fundamental to improving housing conditions, encouraging investment in communities, and reducing vulnerability to displacement (Malik et al., 2020). Integrating tenure security into smart-city strategies could therefore enhance both social equity and community resilience.

The findings of this study have important policy implications. First, urban development initiatives should move beyond technology-centered approaches and incorporate principles of social inclusion and spatial justice (Lee et al., 2020). Second, planning authorities should establish meaningful mechanisms for community participation, particularly within informal settlements (Lee et al., 2023; Swapan & Khan, 2022). Third, investments in digital infrastructure and smart-city technologies should be accompanied

by efforts to improve access to basic services and housing security (Javed et al., 2020; Sanders & Scanlon, 2021). Finally, policymakers should adopt rights-based approaches that recognize informal settlement residents as legitimate urban citizens rather than temporary occupants or obstacles to modernization (Huq & MirafTab, 2020; Banks et al., 2020).

Several limitations should be acknowledged. The use of purposive and snowball sampling may limit the generalizability of the findings to all informal settlements in Pakistan. In addition, perceptions of justice and governance were measured through self-reported responses, which may be influenced by personal experiences and contextual factors. Future studies could employ longitudinal designs and comparative analyses across a larger number of cities to further investigate the long-term impacts of smart-city interventions on marginalized urban populations.

In conclusion, the study demonstrates that residents of informal settlements frequently perceive smart-city interventions as insufficiently inclusive and often associated with risks of exclusion and displacement. Access to services, digital infrastructure, and information positively influence perceptions of spatial justice, while limited participation and housing insecurity undermine trust in urban governance. Achieving equitable urban development in Pakistan requires smart-city strategies that prioritize participation, housing security, service provision, and social justice alongside technological innovation (Lee et al., 2023). Such an approach is essential for ensuring that the benefits of urban transformation are shared by all residents, including those living in informal settlements.

CONCLUSION

This study concludes that smart-city initiatives in Pakistan can improve urban efficiency and service delivery but may also reproduce existing spatial inequalities when informal settlements are excluded from planning and decision-making. Perceptions of spatial justice are strongly shaped by access to basic services, digital infrastructure, secure housing, information, and meaningful community participation. Procedural and recognitional justice remain particularly important, as limited participation and inadequate recognition of community needs weaken trust in urban institutions. Inclusive smart-city development therefore requires participatory planning, affordable housing, secure tenure, improved services, digital inclusion, and community empowerment. Integrating spatial justice into smart-city strategies can support equitable and sustainable urban transformation.

Ethical Considerations

Ethical approval for the study was obtained from the relevant Institutional Review Board prior to data collection. Written informed consent was obtained from all participants before their participation in the study. Confidentiality and anonymity were maintained throughout the research process, and participants were informed of their right to withdraw from the study at any stage without penalty. All research activities involving human participants were conducted in accordance with internationally recognized ethical principles for social science research.

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to appropriate ethical and confidentiality considerations. No publicly accessible dataset was generated for this study.

Author Contributions

Zahid Latif, Ahtisham Subhani, and Taimoor Raza: Conceptualization, methodology, investigation, data collection, formal analysis, data curation, and writing-original draft preparation. All authors contributed to the interpretation of the findings and the critical

revision of the manuscript. All authors approved the final version of the manuscript and accept responsibility for the integrity and accuracy of the research work.

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Conflict of Interest

The author declares no conflict of interest.

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Use of AI

Grammarly was used for language correction. Gemini AI was used for image generation. The authors reviewed and approved all AI-assisted content and remain responsible for the accuracy, originality, and integrity of the manuscript.

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