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Article

Urban Accessibility Dynamics in Indian Cities: Insights from CityAccessMap Data

Alok Tiwari

Department of Urban and Regional Planning, Faculty of Architecture and Planning, King Abdulaziz University, Jeddah 21589, Saudi Arabia.
Correspondence: atwari@kau.edu.sa

Abstract

This study examines urban accessibility disparities in Indian cities, focusing on Tier 1 and Tier 2 urban centers using CityAccessMap data. With the increasing emphasis on sustainable and inclusive urban planning, the research aims to assess spatial equity in access to essential services within a 15-minute walking radius. Employing quantitative spatial analysis and Local Indicators of Spatial Association (LISA) cluster mapping, the study identifies significant accessibility disparities across cities. Results reveal that Tier 1 cities like Bengaluru and Mumbai demonstrate higher accessibility due to integrated transport systems, while Kolkata and Delhi face critical challenges rooted in systemic planning deficiencies. Among Tier 2 cities, Thiruvananthapuram and Kochi excel with compact urban planning, contrasting with Gwalior and Udaipur, which exhibit severe accessibility deficits. These findings highlight the necessity for tailored, evidence-based interventions to address socio-spatial inequalities and foster equitable urban development.

Keywords: Urban Accessibility; Tier 1 and Tier 2 Cities; CityAccessMap; LISA; Sustainable Urban Development

1. Introduction

Urban accessibility to essential services forms the foundation of equitable and sustainable urban development. It determines the ability of individuals to access critical resources, including healthcare, education, public transport, and recreational spaces, within reasonable travel times (Hansen, 1959; Saha, 2021; Nykiforuk et al., 2021). As cities expand and populations grow, accessibility becomes a critical metric for assessing the inclusivity and functionality of urban systems. The "*15-minute city*" framework, conceptualised by Moreno et al. (2021), has emerged as a transformative paradigm in urban planning, advocating for compact, decentralised urban spaces where essential services are available within a 15-minute walk or cycle. While this concept has been successfully implemented in several European cities, its applicability in rapidly urbanising contexts such as India poses unique challenges.

Indian cities, characterised by significant socio-economic disparities, informal settlements, and fragmented infrastructure, provide a complex landscape for the implementation of equitable accessibility models. Tier 1 cities such as Mumbai, Delhi, Bengaluru, and Kolkata represent major economic and administrative hubs but often face challenges of congestion, inadequate infrastructure, and uneven service distribution. Conversely, Tier

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2 cities like Gwalior, Jamshedpur, and Udaipur are emerging as regional economic centres, yet they encounter with insufficient public transport systems and limited access to essential services. Understanding the nuanced differences in accessibility between these urban tiers is critical for addressing spatial inequalities and fostering inclusive urban environments.

CityAccessMap, an open-source tool developed at TU Delft, offers a powerful methodology for evaluating urban accessibility (Nicoletti et al., 2023). By integrating data from OpenStreetMap and the European Commission's Global Human Settlement Layer (GHSL), it provides spatial insights into service availability and population distribution. This study leverages CityAccessMap to explore accessibility patterns in Indian Tier 1 and Tier 2 cities, with a focus on average walking times and the proportion of the population within a 15-minute walking distance of essential services. Such an approach provides an empirical basis for identifying disparities and informing targeted policy interventions.

Despite the growing discourse on accessibility and the "15-minute city," existing research is predominantly centred on developed nations, where governance systems and urban infrastructure are relatively strong. This leaves a significant gap in understanding how these principles can be adapted to countries like India, where urbanisation is both rapid and unplanned (Roy, 2009). Current literature has yet to adequately address the interplay between tier-specific dynamics and accessibility, nor has it systematically quantified these metrics across diverse urban contexts using advanced tools like CityAccessMap. This study aims to bridge these gaps by providing evidence-based insights into accessibility in Indian cities and proposing actionable strategies to mitigate inequalities.

The objectives of this research are to assess and compare accessibility in Tier 1 and Tier 2 cities and recommend targeted interventions for cities with significant gaps. Central to this exploration are critical questions:

1. How do accessibility patterns differ across urban tiers?
2. What strategies can improve accessibility?

By addressing these questions, this study contributes to the growing body of knowledge on urban accessibility while offering practical solutions tailored to India's unique urban realities.

2. Theoretical Framework: Accessibility and the 15-Minute City

2.1 Defining Accessibility in Urban Contexts

Accessibility in urban contexts encapsulates the ease with which individuals can reach essential destinations—such as workplaces, schools, healthcare facilities, and recreational areas—within acceptable timeframes and cost parameters. This concept goes beyond physical distance, incorporating dimensions such as transport availability, service quality, and socio-economic dynamics. Handy (2005) posits that equitable accessibility depends on a balanced spatial distribution of services, efficient and inclusive transport systems, and socio-economic factors that determine the ability of individuals to utilise these services.

The scholarly discourse on accessibility has long emphasised its centrality to urban liveability and equity. Geurs and Van Wee (2004) identify accessibility as a multidimensional construct encompassing land-use patterns, transportation systems, temporal availability, and personal capacity. These dimensions collectively determine the extent to which urban environments foster inclusion, mitigate social inequalities, and enhance quality of life. For instance, well-integrated transport networks can bridge spatial divides, enabling economically disadvantaged groups to access employment opportunities and essential services otherwise beyond their immediate vicinity (Litman, 2017).

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In developing urban contexts, such as those in India, accessibility often intersects with challenges of rapid urbanisation, informal settlements, and fragmented infrastructure. Bhaduri et al. (2020) underscore that accessibility disparities in these regions often reflect systemic inequalities, where socio-economic and spatial factors marginalise vulnerable populations. Poorly planned urban sprawl exacerbates these issues, creating spatial mismatches between service locations and population centres (Torres et al., 2016). Moreover, inadequate public transport systems and poorly maintained pedestrian infrastructure further limit accessibility for lower-income groups, who predominantly rely on walking or non-motorised modes of transport (Cervero & Kockelman, 1997).

Accessibility also holds implications for environmental sustainability. Compact urban forms and accessible neighbourhoods reduce dependency on private vehicles, lowering greenhouse gas emissions and fostering more sustainable mobility practices (Handy, 2005). Thus, accessibility emerges not only as a marker of urban equity but also as a cornerstone for sustainable development. Its comprehensive evaluation requires integrating physical, social, and environmental dimensions to inform inclusive urban planning and policy frameworks.

2.2 The 15-Minute City Concept

The "15-minute city" concept (Moreno et al., 2021) advocates for a paradigm shift in urban planning, emphasising proximity, accessibility, and sustainability. It envisions cities as decentralised, human-centric spaces where essential services—such as healthcare, education, recreation, and public transport—are accessible within a 15-minute walk or cycle ride from residential areas. This model addresses key challenges of urbanisation, including congestion, environmental degradation, and socio-spatial inequality, by reducing dependence on motorised transport and promoting localised living.

While the concept has been celebrated for its successful implementation in European cities such as Paris and Barcelona, its applicability to the Indian context remains contentious. Indian cities, particularly Tier 1 and Tier 2 urban centres, are characterised by infrastructural deficits, high population densities, and significant socio-economic disparities (Tiwari, 2002). These factors complicate the adoption of the 15-minute city model, which presupposes a level of urban planning and resource allocation that is often lacking in India.

The sprawling urban morphology of Indian cities further undermines the feasibility of this model. Indian cities frequently exhibit a dichotomy between formal and informal urbanism, where unregulated settlements lack access to even basic amenities (Dupont, 2013). Consequently, achieving equitable distribution of services within a 15-minute radius is inherently challenging. Furthermore, socio-economic stratification often dictates access to infrastructure, with wealthier neighbourhoods disproportionately benefiting from better connectivity and services (Chakrabarti, 2022).

Nonetheless, the principles underpinning the 15-minute city—localised development, pedestrian-friendly infrastructure, and decentralised governance—hold transformative potential for Indian cities. By adapting these principles to India's unique urban realities, policymakers could address critical issues of urban inequality and sustainability. Future research and pilot projects are needed to test the feasibility of this concept in Indian contexts, balancing global ideals with local constraints.

2.3 Indian Cities in Transition

Indian cities are epitomes of the transformative effects of rapid urbanisation, grappling with escalating population densities, infrastructural deficiencies, and pronounced spatial inequalities (Kundu, 2011). As urban areas expand, the dichotomy between Tier 1 and Tier 2 cities becomes increasingly salient, with each category embodying distinct

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opportunities and challenges. Tier 1 cities, such as Mumbai, Delhi, Bengaluru, and Kolkata, are not only economic powerhouses but also cultural and administrative centres. However, their rapid expansion often outpaces the development of essential infrastructure, resulting in traffic congestion, environmental degradation, and socio-spatial segregation (Annez et al., 2010).

Conversely, Tier 2 cities like Gwalior, Jamshedpur, and Udaipur are emerging as regional economic hubs, driven by industrial growth and urbanisation. These cities present opportunities for decentralised development, relieving pressure on overburdened Tier 1 cities (Pradhan & Bagchi, 2013). However, they face their own set of challenges, including inadequate public transport systems, insufficient access to essential services, and uneven urban development. These issues are exacerbated by limited fiscal capacities and governance inefficiencies, which hinder the effective implementation of urban planning initiatives (Mathur, 2024).

A critical reflection on these trends highlights the urgent need for a more inclusive and sustainable approach to urban development. The stark disparities between Tier 1 and Tier 2 cities underscore the inadequacies of a one-size-fits-all policy framework. Instead, tailored strategies that address the unique challenges of each urban tier are imperative. For instance, Tier 1 cities require policies aimed at enhancing public infrastructure and mitigating urban sprawl, while Tier 2 cities necessitate investments in capacity-building and resource allocation to support their growth trajectories.

Table 1: CityAccessMap-derived accessibility indicators for selected Indian Tier 1 & Tier 2 cities

Tier	City	Time*	Pop.**	Tier	City	Time*	Pop**
One	Ahmedabad	20	26	Two	Imphal	24	14
One	Kolkata	34	27	Two	Coimbatore	20	15
One	Delhi	24	40	Two	Visakhapatnam	24	15
One	Pune	17	43	Two	Surat	30	18
One	Chennai	17	53	Two	Mangalore	20	19
One	Mumbai	13	60	Two	Dehradun	22	19
One	Hyderabad	14	64	Two	Patna	22	20
One	Bengaluru	8	73	Two	Bhubaneswar	21	22
Two	Gwalior	25	3	Two	Ranchi	25	26
Two	Jamshedpur	25	6	Two	Agra	22	27
Two	Udaipur	29	7	Two	Aurangabad	18	30
Two	Nashik	28	8	Two	Madurai	19	30
Two	Kanpur	33	8	Two	Indore	22	31
Two	Guwahati	28	9	Two	Jaipur	19	32
Two	Rajkot	30	12	Two	Vijayawada	22	33
Two	Vadodara	31	12	Two	Cuttack	16	35
Two	Chandigarh	23	13	Two	Shillong	15	38
Two	Amritsar	24	13	Two	Mysore	13	41
Two	Lucknow	26	13	Two	Thiruvananthapuram	9	55
Two	Bhopal	29	13	Two	Kochi	9	57
Two	Varanasi	36	13				

** Average time taken in the city to avail basic urban services.*

*** Proportion (%) of city population residing within the region where basic urban services are available 15-munites of walking.*

Source: Extracted from CityAccessMap

Note: This table presents the broader CityAccessMap extraction used for initial screening. From this dataset, a subset of 13 cities (all Tier 1 cities and six Tier 2 cities) was selected for detailed LISA-based comparative analysis.

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Indian cities are at a critical juncture. By prioritising equitable development, integrating innovative urban planning tools such as CityAccessMap, and fostering participatory governance, India can harness the potential of its urbanisation to create cities that are both inclusive and resilient.

3. Methodology

The study adopts a quantitative exploratory spatial data analysis (ESDA) approach, integrating CityAccessMap-derived accessibility indicators with LISA-based spatial autocorrelation analysis and interpretive comparative discussion to investigate urban accessibility dynamics in Indian cities. The CityAccessMap tool was developed at TU Delft, which utilizes spatial infrastructure data from OpenStreetMap and population distribution metrics from the GHSL (Nicoletti et al., 2023). To ensure a comprehensive understanding of accessibility disparities, the research examines all Tier 1 cities, including Mumbai, Delhi, Bengaluru, Kolkata, Pune, Chennai, and Hyderabad, alongside selected Tier 2 cities, including Thiruvananthapuram, Kochi, Mysuru, Gwalior, Jamshedpur, and Udaipur.

Although CityAccessMap indicators were extracted for a wider set of Tier 2 cities (Table 1), the analytical focus of this study is restricted to a 13-city subset comprising all Tier 1 cities and six Tier 2 cities (Thiruvananthapuram, Kochi, Mysuru, Gwalior, Jamshedpur, and Udaipur). This subset was selected to represent contrasting accessibility outcomes, geographic diversity, and urban form, and is the basis for all LISA cluster analysis and comparative interpretation.

Accessibility data are extracted from CityAccessMap, having average walking times to essential urban services and the percentage of the population residing within a 15-minute walking radius. These data are complemented by spatial analysis using Local Indicators of Spatial Association (LISA) cluster maps, which identify patterns of high and low accessibility across urban regions. LISA constitutes a statistical instrument utilized in spatial data analysis to discern local patterns of spatial autocorrelation. Such patterns can elucidate clusters or outliers within a dataset, thereby rendering LISA a valuable methodology for exploratory spatial data analysis (Anselin, 1995; Anselin, 2010; Chen, 2022). Such visualization tools are critical in highlighting spatial disparities, enabling a nuanced exploration of accessibility challenges in different urban contexts.

The dataset includes descriptive statistics summarizing accessibility levels, including mean walking times, population coverage, and variability measures. The comparative analysis explores variations across cities to identify systemic challenges and best practices in urban planning.

The study encompasses thirteen cities representing diverse geographic and demographic profiles. Tier 1 cities are selected for their status as metropolitan hubs with extensive infrastructure, while Tier 2 cities represent smaller urban centers with varying degrees of infrastructural development. The Tier 2 cities were chosen for their geographical distribution, accessibility performance, and diverse urban characteristics, ensuring a robust comparative framework.

CityAccessMap serves as the primary analytical tool for extracting accessibility measures, while GeoDa software (Anselin et al., 2009) supports spatial mapping and cluster analysis.

4. Results

4.1 Descriptive Statistics

The dataset extracted from CityAccessMap provides insights into urban accessibility across Indian cities, segmented by Tier One and Tier Two cities. On average, the walking

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time required to access basic urban services is approximately 22.1 minutes, with a median value of 22 minutes. The standard deviation of 6.8 minutes suggests moderate variability in walking times across cities. Regarding population accessibility, the average percentage of the city population able to access these services within a 15-minute walking time is 26.7%, with a median of 22%. However, the data demonstrates significant dispersion, as indicated by a standard deviation of 17.7%.

Table 2: Key statistics

Variable	Tier I cities	Tier II cities
Mean walking time in minutes to access basic urban services	18.4	23.0
Mean % of the population covered within 15 minutes of walking to access basic services	48.3	21.4
Cities with higher accessibility	Bengaluru and Mumbai	Thiruvananthapuram, Kochi, Mysuru
Cities with lower accessibility	Kolkata	Gwalior, Jamshedpur, and Udaipur

Though this study has chosen all Tier I cities for the investigation, only 6 Tier II cities were included in the analysis namely Thiruvananthapuram, Kochi, Mysuru, Gwalior, Jamshedpur, and Udaipur. Among Tier II cities, these cities are ideal for comparative analysis due to their diverse accessibility performance, geographic representation, and urban contexts. Thiruvananthapuram and Kochi excel in accessibility, offering benchmarks for urban planning, while cities like Jamshedpur and Udaipur provide contrasting cases. Spanning regions across India, these cities reflect varied development patterns, from coastal hubs to heritage and industrial centers. Their differences in population density, infrastructure, and urban organization ensure robust analysis. This selection enables a nuanced exploration of accessibility dynamics, highlighting transferable strategies and policies for improving service access across diverse urban environments.

4.2 Results from Tier I cities

The comparative analysis of urban accessibility across Tier I cities in India, using LISA cluster maps alongside quantitative metrics, reveals significant disparities in the spatial distribution of access to basic urban amenities (Figure 1). The visual representation of high-high and low-low clusters of accessibility supports these findings, exposing explicit inequalities that require attention in urban planning and policy formulation. This analysis provides a foundation for understanding the underlying spatial dynamics shaping accessibility and the broader implications for urban equity and sustainability.

Bengaluru exhibits the highest accessibility among Tier 1 cities, with 73% of its population within a 15-minute walking radius and an average walking time of eight minutes (High-High clusters). Mumbai also performs strongly, though at a lower level, with 60% population coverage and an average walking time of 13 minutes (High-High clusters). The compact development of Bengaluru near IT corridors and the transit-oriented growth of Mumbai along suburban train networks demonstrate distinct yet successful approaches to promoting accessibility. Their average walking time of just eight minutes to access basic amenities exemplifies how well-integrated transport and land use planning can reduce reliance on motorised transport and enhance environmental sustainability. However, differences in their urban morphology and planning paradigms call for a detailed examination to distil transferable elements of their success.

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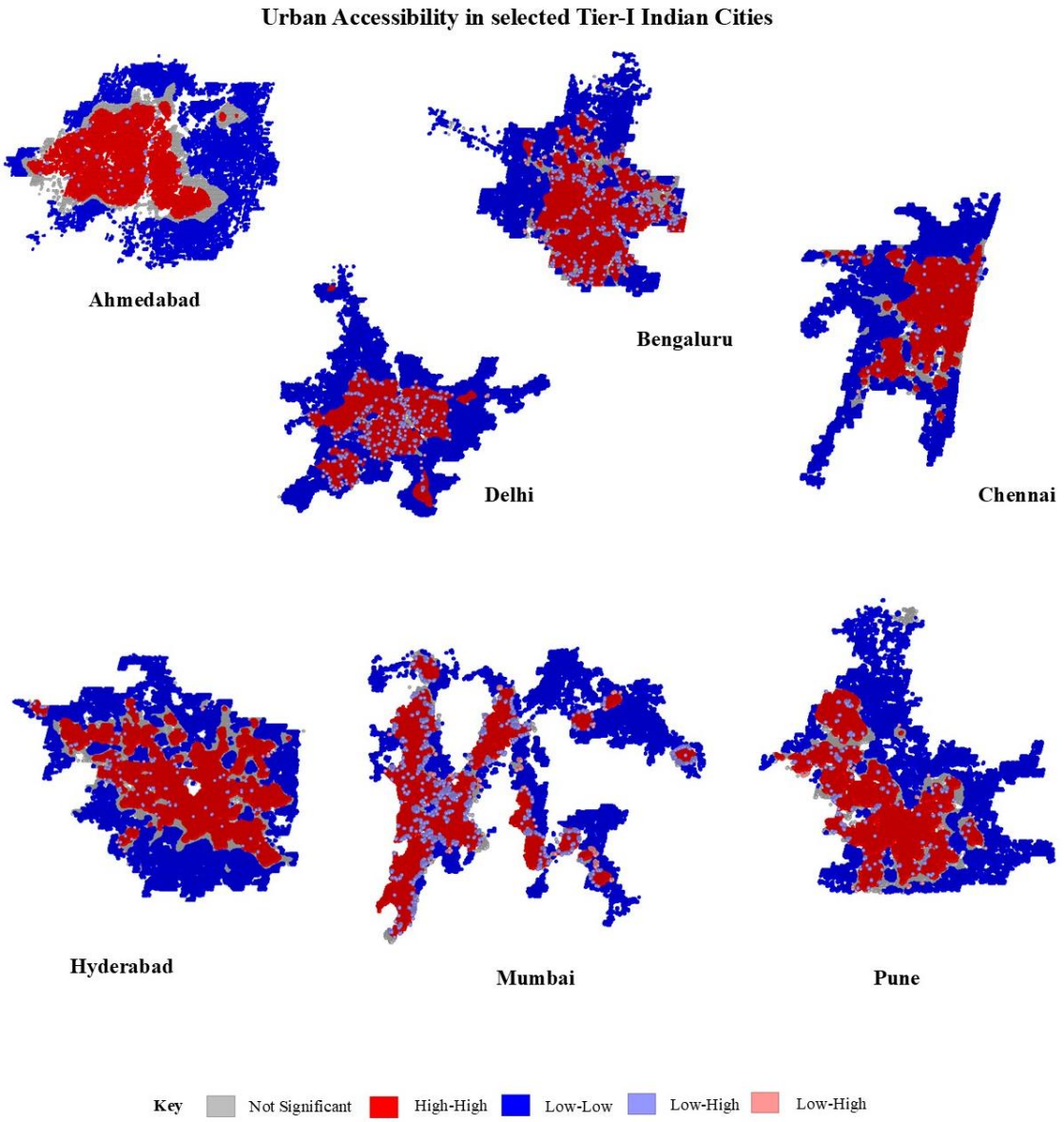

Figure 1: Urban Accessibility in Tier I Indian Cities.

Hyderabad occupies an average position, with an average walking time of 14 minutes and 64% of its population within a 15-minute walking radius. The LISA maps reveal mixed clusters, reflecting a fragmented spatial distribution of accessibility. While certain neighbourhoods benefit from strong connectivity, others remain underserved, indicating uneven urban development. This fragmentation, shaped by differential investments and planning priorities, could exacerbate socio-economic inequalities, as access to basic amenities is pivotal in fostering urban equity.

In contrast, cities such as Chennai and Pune reveal more noticeable challenges in accessibility. With average walking times of 17 minutes and population coverage of 53% and 43%, respectively, these cities highlight the consequences of insufficient infrastructure integration and rapid urban expansion. Extended walking time in Chennai is likely stem from the spatial mismatch between residential areas and amenities, whereas lower accessibility in Pune reflects the struggle of the city to align infrastructure development with its sprawling growth. The dominance of low-low clusters in these cities further increases the urgency for targeted interventions to promote inclusivity and resilience.

Delhi and Ahmedabad represent extreme cases of poor accessibility, with average walking times of 24 and 20 minutes, and only 40% and 26% of their populations residing

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within a 15-minute walking radius, respectively. The spatial clustering of low accessibility in these cities exposes systemic deficiencies in urban planning frameworks. In Delhi, the national capital, this is particularly concerning given the resources at its disposal to support equitable infrastructure. Ahmedabad's even lower accessibility underscores the challenges of managing rapid urbanisation, where the pace of growth has outstripped the development of essential infrastructure, deepening accessibility disparities.

Kolkata presents an alarming scenario as an outlier, with an average walking time of 34 minutes and only 27% of its population within a 15-minute walking radius. The dominance of low-low clusters in the LISA maps highlights a critical accessibility crisis, rooted in deep-rooted inefficiencies and spatial injustices. Such disparities are striking for a major metropolitan centre and indicative of systemic planning failures that could impede socio-economic progress. The situation of Kolkata demands immediate policy attention to address its accessibility gaps and the broader implications for its urban trajectory.

Collectively, the analysis underscores a persistent core-periphery divide across Indian Tier I cities, where high-accessibility zones are disproportionately concentrated in central areas. The patterns observed in cities such as Ahmedabad, Pune, and Kolkata highlight the impact of rapid urbanisation and inadequate resource allocation on accessibility outcomes. In contrast, the relative success of cities like Bengaluru and Mumbai demonstrates the potential of well-integrated urban planning to mitigate spatial disparities. Nevertheless, even these cities are not immune to challenges, as evolving urban pressures threaten to exacerbate existing inequalities if left unaddressed.

The findings underscore the urgent need for a comprehensive, participatory approach to urban accessibility planning. Enhanced resource allocation must be coupled with strategies that prioritise spatial justice and sustainable development. LISA cluster maps, when integrated with quantitative metrics, offer a valuable tool for identifying and addressing accessibility gaps, thereby enabling more equitable and resilient urban futures. By positioning accessibility as a cornerstone of urban equity and sustainability, policymakers and planners can better navigate the complexities of contemporary urbanisation, ensuring that the benefits of growth are shared equitably across all communities.

4.3 Urban Accessibility in Tier II cities

The analysis of urban accessibility in Tier II Indian cities, as supported LISA cluster maps, provides critical insights into the spatial equity of basic urban service provision (Figure 2). The visual differentiation of High-High clusters (depicted in red) and Low-Low clusters (in blue) starkly illustrates the disparities in accessibility. When examined alongside quantitative metrics, these visuals underscore significant variations in urban accessibility that warrant detailed examination.

Thiruvananthapuram and Kochi emerge as the most accessible Tier II cities, with average walking times to basic amenities at just nine minutes. A notable proportion of their populations—55% and 57%, respectively—reside within a 15-minute walking distance of such services. These results indicate relatively equitable spatial distributions of urban services, supported by the dominance of High-High clusters in their LISA maps. Thiruvananthapuram's slightly higher coverage reflects the success of its compact urban planning strategies, while Kochi's performance suggests room for further optimization despite its commendable inclusivity.

Mysuru presents a mixed picture. With an average walking time of 13 minutes and only 41% of its population within the 15-minute accessibility threshold, Mysuru lags behind the coastal cities. The LISA maps for Mysuru likely display a fragmented pattern of High-High and Low-Low clusters, highlighting spatial disparities in service accessibility. These variations suggest challenges in integrating peripheral areas, possibly due to uneven urban sprawl, planning inefficiencies, or infrastructure limitations.

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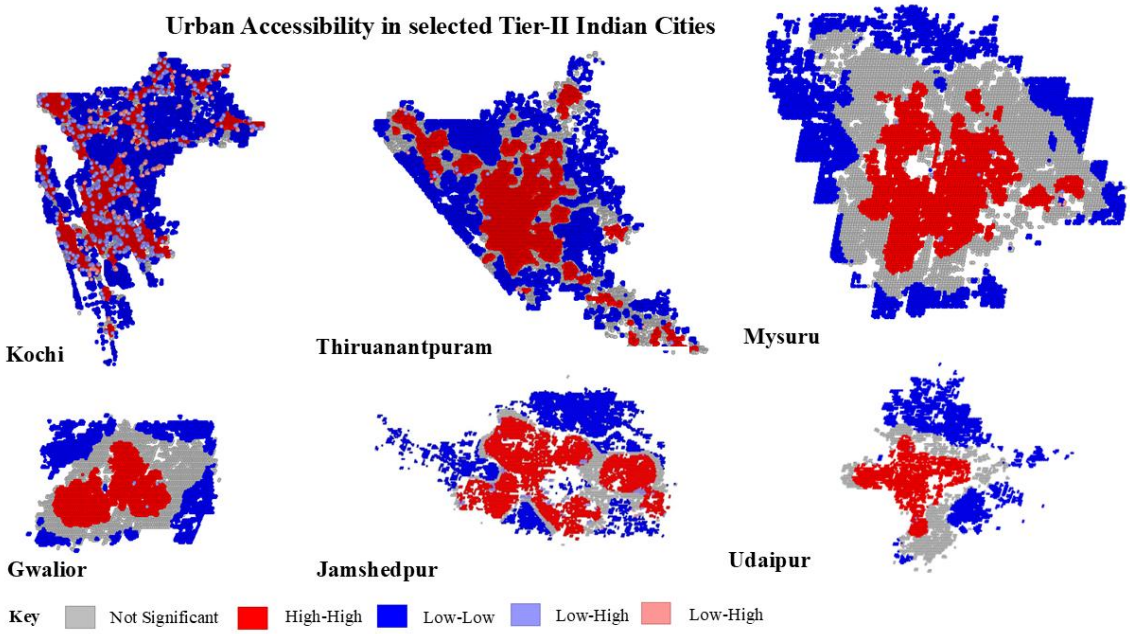

Figure 2: Urban Accessibility in Tier II Indian Cities.

In contrast, Gwalior, Jamshedpur, and Udaipur exhibit alarming deficiencies in accessibility. Gwalior and Jamshedpur have average walking times of 25 minutes, while Udaipur exceeds this with 29 minutes. The proportions of populations residing within the 15-minute accessibility threshold are critically low—3%, 6%, and 7%, respectively. The LISA maps for these cities are expected to be dominated by Low-Low clusters, reflecting a systemic lack of accessible infrastructure and exclusionary urban landscapes. These prolonged walking times and minimal accessible populations signify planning failures compounded by socio-economic stratification, historical development patterns, and insufficient focus on decentralized service provision.

This comparative analysis highlights an urgent need to address disparities in urban accessibility. The contrast between Thiruvananthapuram and Kochi, on the one hand, and Gwalior, Jamshedpur, and Udaipur, on the other, underscores a broader governance challenge. While the more accessible cities benefit from compact urban design and prioritized investment in service delivery, the underperformance of less accessible cities reveals the adverse consequences of neglecting peri-urban and underserved areas.

The findings call for targeted policy interventions to address the accessibility deficits in cities such as Gwalior, Jamshedpur, and Udaipur. Prioritizing the integration of accessibility metrics into urban planning, adopting best practices from high-performing cities, and leveraging spatial data analytics for informed decision-making could help bridge these gaps. LISA cluster maps prove to be an invaluable tool for visualizing disparities and guiding data-driven, equitable urban development strategies. Addressing these disparities is essential not only to enhance spatial justice but also to foster sustainable and inclusive urban futures.

5. Discussion

The results of this study critically underscore the profound and multifaceted disparities in urban accessibility across Tier I and Tier II Indian cities, explaining the systemic inequalities embedded within their spatial and infrastructural configurations. By using CityAccessMap and LISA cluster maps, this analysis not only measures accessibility metrics but also provides a strong visual framework for assessing the inequities inherent in

urban service delivery. The findings reveal an explicit contrast between cities that have embraced inclusive urban planning principles and those where accessibility gaps remain rooted due to socio-economic and governance failures.

Additionally, in Tier I cities, the disparities in urban accessibility reflect a constant core-periphery divide, shaped by uneven investment in infrastructure and services Bengaluru and Mumbai emerge as exemplars of effective urban planning, although at different levels; Bengaluru records the highest accessibility with 73% population coverage and an average walking time of eight minutes, while Mumbai follows with 60% coverage and an average walking time of 13 minutes. Their success is attributed to distinct strategies: compact IT-centric development of Bengaluru and transit-oriented growth of Mumbai along suburban rail corridors. These approaches highlight the transformative potential of integrating transport and land-use planning to enhance accessibility and sustainability. However, even within these cities, socio-spatial inequalities persist, necessitating a more granular examination of neighborhood-level dynamics to ensure equitable access to the benefits of urban infrastructure.

Conversely, cities such as Kolkata, Delhi, and Ahmedabad exhibit critical accessibility challenges. Kolkata, as the extreme case, is marked by an average walking time of 34 minutes and the lowest population coverage (27%), revealing an accessibility crisis rooted in systemic inefficiencies and spatial injustices. Similarly, Delhi and Ahmedabad's accessibility metrics, with 40% and 26% population coverage, respectively, reflect planning deficits exacerbated by rapid urbanization and inadequate infrastructure expansion. These findings are consistent with prior studies highlighting the consequences of unregulated growth and fragmented service delivery (Bhaduri et al., 2020; Tiwari et al., 2020). The dominance of Low-Low clusters in the LISA maps of these cities underscores the spatial exclusion of marginalized populations, raising pressing concerns about the socio-economic and environmental implications of such disparities.

Again, tier II cities present an equally complex picture, revealing stark contrasts between well-performing cities like Thiruvananthapuram and Kochi and underperforming ones such as Gwalior, Jamshedpur, and Udaipur. Relatively high accessibility of Thiruvananthapuram and Kochi, with population coverage of 55% and 57%, respectively, reflects the benefits of compact urban planning and prioritized infrastructure investments. Dominance of High-High clusters in these cities demonstrates the potential for smaller cities to achieve equitable spatial configurations when governance structures are aligned with inclusive development goals. However, fragmented accessibility patterns and mixed clusters of Mysuru highlight the challenges of integrating peripheral areas in to the urban fabric, a finding consistent with the broader literature on uneven urban sprawl (Chaplin, 2011).

In sharp contrast, the deficiencies in Gwalior, Jamshedpur, and Udaipur—where population coverage within the 15-minute threshold is below 10%—reveal critical governance and planning failures. Prolonged walking times and predominance of Low-Low clusters in these cities underscore the systemic neglect of peri-urban and underserved areas, compounded by historical inequities and resource constraints. The socio-economic stratification evident in these cities reflects broader patterns of exclusion that limit access to basic urban amenities for vulnerable populations, reinforcing findings by Chakrabarti (2022) on the intersections of socio-economic and spatial inequalities.

Moreover, the comparative findings across urban tiers illuminate the inadequacies of a one-size-fits-all approach to urban planning in India. While Tier I cities require strategies to address congestion and the equitable distribution of services, Tier II cities necessitate targeted investments in capacity-building and the integration of accessibility metrics into urban planning frameworks. The demonstrated success of Thiruvananthapuram and

Kochi underscores the potential for best practices to be adapted and scaled, offering valuable lessons for cities grappling with accessibility deficits.

Furthermore, these results hold significant implications for policy and practice. First, they underscore the need for participatory governance models that integrate accessibility considerations into urban planning processes. LISA cluster maps and spatial analytics tools, such as CityAccessMap, provide invaluable resources for visualizing disparities and guiding evidence-based decision-making. Second, the findings call for tailored interventions that address the unique challenges of each urban tier. This includes expanding public transport networks, improving pedestrian infrastructure, and decentralizing service delivery to enhance accessibility in underserved areas. Finally, the results affirm the importance of adopting sustainable urban planning paradigms, such as the 15-minute city model, albeit with adaptations to account for India's socio-economic complexities and infrastructural constraints.

By addressing the systemic drivers of accessibility disparities, this study advocates for a paradigm shift in urban governance that prioritizes spatial justice and inclusivity. Such an approach is essential not only for bridging existing accessibility gaps but also for fostering urban environments that are resilient, equitable, and sustainable. These findings contribute to the broader discourse on urban equity and provide actionable insights for policymakers, planners, and researchers committed to shaping India's urban future.

6. Conclusion

The study sought to assess urban accessibility disparities across Tier 1 and Tier 2 Indian cities using CityAccessMap data, focusing on walking times to essential services and population coverage within a 15-minute accessibility threshold. It aimed to identify systemic disparities, examine underlying factors, and propose strategies to mitigate inequalities while contributing to the discourse on equitable and sustainable urban development (Nicoletti et al., 2023; Moreno et al., 2021).

The findings reveal pronounced disparities in accessibility across urban tiers. Tier 1 cities such as Bengaluru and Mumbai exhibited higher accessibility, attributed to integrated transport systems and relatively compact urban planning; Bengaluru recorded the highest coverage, with 73% of its population within a 15-minute walking radius, while Mumbai followed with 60% coverage (Handy, 2005; Litman, 2019). Conversely, cities like Kolkata and Delhi faced significant challenges, including fragmented service distribution and prolonged walking times, reflecting systemic planning deficiencies and spatial injustices (Chakrabarti, 2022). Among Tier 2 cities, Thiruvananthapuram and Kochi demonstrated better performance due to prioritized infrastructure investment and compact urban design, achieving over 55% population coverage within the 15-minute threshold. In contrast, Gwalior, Jamshedpur, and Udaipur lagged significantly, with less than 10% coverage, underscoring governance failures and socio-economic stratification (Bhaduri et al., 2020; Chaplin, 2011).

These results underscore the inadequacies of a uniform urban planning approach in addressing accessibility challenges across diverse urban contexts. The observed disparities resonate with existing literature emphasizing socio-spatial inequalities in rapidly urbanizing regions (Tiwari et al., 2020; Dupont, 2011). By integrating spatial analytics and accessibility metrics, the study advances theoretical understanding and provides empirical evidence for tailored interventions. The findings advocate for adapting global planning paradigms, such as the "15-minute city," to the unique socio-economic and infrastructural complexities of Indian cities (Moreno et al., 2021; Geurs & Van Wee, 2004).

In practical terms, the results inform policy and planning strategies to address spatial inequalities, enhance pedestrian infrastructure, and decentralized service provision. However, limitations include the exclusion of dynamic variables and potential

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inaccuracies in data sources. Future research should explore real-time accessibility changes, longitudinal trends, and pilot interventions to validate scalable models for improving urban equity (Nicoletti et al., 2023; Saha, 2021).

In conclusion, this study contributes to the broader discourse on urban sustainability and equity by highlighting the systemic drivers of accessibility disparities and offering actionable insights for fostering inclusive and resilient urban environments in India.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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