RESEARCH PAPER

Role of Walkability for Sustainable Urban Development: A Study of Chennai City

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ABSTRACT

Background: Walkability reflects designing of road infrastructure to encourage walking as a means for transportation. It demarcates the extent to which the built environment supports and encourages walking by providing safe, comfortable, accessible, and pleasant conditions. It is being increasingly recognized as a key component of sustainable urban development. In the context of rapidly populated and inadequately urbanized Indian cities, promotion of walkability can contribute significantly to environmental sustainability, public health, economic vibrancy, and social equity.

Objective: This paper investigates the influence of walkability on the sustainable development of Chennai City, the fourth largest metropolitan city of India and the largest in South India. Through a multi-dimensional approach, the study examines the interplay between pedestrian infrastructure, urban design, public health outcomes, environmental impacts, and socio-economic inclusivity.

Methods: The research adopts both qualitative and quantitative methods, including field surveys, GIS-based spatial analysis, and stakeholder interviews, to assess the current walkability conditions in five distinct localities across Chennai: Mylapore, Anna Nagar, Velachery, T. Nagar, and Sholinganallur. Parameters such as sidewalk width and quality, pedestrian crossings, street lighting, traffic calming measures, and encroachment levels were analysed.

Findings: Findings reveal significant disparities in walkability across neighbourhoods, with high-density and mixed-use areas generally faring better than peripheral or vehicle-dominated zones. One of the central findings of the study is the correlation between improved pedestrian environments and reduced vehicular dependency, which in turn contributes to lower carbon emissions and better air quality. Moreover, walkable environments promote physical activity, thereby addressing growing public health concerns such as obesity, cardiovascular diseases, and mental health issues. Socially, walkable cities tend to be more inclusive, especially for vulnerable populations like children, the elderly, and the economically disadvantaged, who rely heavily on non-motorized transport.

Challenges and Recommendations: Despite the benefits, several challenges persist in Chennai's urban fabric that hinder walkability. These include poor maintenance of footpaths, unregulated street vending, encroachments by parked vehicles, insufficient shade, extreme heat, and fragmented governance over transport and land use. The study also highlights the need for integrated planning frameworks that bridge gaps between urban design, mobility planning, and policy implementation. Drawing insights from global best practices and successful Indian initiatives such as the Complete Streets project in Pune and the pedestrian zones in Bengaluru, the paper proposes a set of strategic interventions for Chennai. These include developing pedestrian-priority zones, implementing universal design standards, enhancing last-mile connectivity with public transport, introducing intelligent traffic signal systems for pedestrians, and launching public awareness campaigns to foster a walking culture.

Conclusion: The research concludes that enhancing walkability in Chennai is both a feasible and necessary step toward achieving a more liveable, equitable, and environmentally responsible urban future. By reorienting city planning around human-scale mobility rather than vehicular traffic, Chennai can set a precedent for other Indian cities striving to meet the goals of sustainable urban development.

Keywords: Walkability, Urban Sustainability, Chennai Development, Pedestrian Infrastructure, Non-Motorized Transport, Urban Design, Public Health, Climate Change, Smart Cities, Inclusive Mobility

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1. Introduction

The urban population in India is projected to increase the largest in the world in the 21st century, expected to add 416 million people by 2050, driven by the rapid economic growth after liberalization, natural increase of population and rural-urban migration. Chennai, the fourth largest metropolitan city in India and the largest in South India has experienced significant expansion over the past few decades, evolving into a sprawling urban agglomeration with a population exceeding 12 million in 2024. This rapid urbanization without a perspective plan of urban infrastructural development has created immense pressure on the city's road network, leading to rising levels of traffic congestion, deteriorating air quality, increasing greenhouse gas emissions, and declining public health standards. Walkability reflects designing of road infrastructure to encourage walking as a means for transportation. It demarcates the extent to which the built environment supports and encourages walking by providing safe, comfortable, accessible, and pleasant conditions. It is being increasingly recognized as a key component of sustainable urban development. In the context of rapidly populated and inadequately urbanized Indian cities, promotion of walkability can contribute significantly to environmental sustainability, public health, economic vibrancy, and social equity.

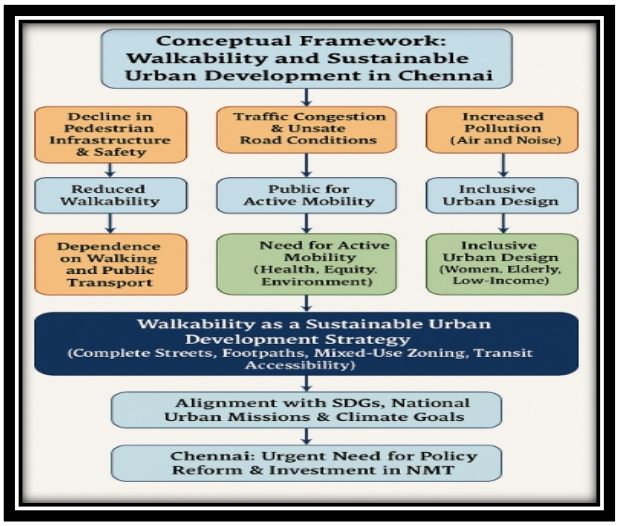
Walkability connotes the degree to which the built environment facilitates safe, comfortable, and convenient walking and it has emerged as a critical, yet often overlooked, factor in sustainable urban planning. Walkable facilities available in cities reduce the need for short-distance vehicular travel, thereby cutting down emissions and promoting a healthier lifestyle. Walkability is influenced by several interrelated factors, including urban design, street connectivity, land use mix, pedestrian safety, accessibility of transit, and aesthetic features such as greenery and street furniture. Walkability offers convenient access to shops, schools and parks. It helps to guarantee pedestrian safety from traffic and crosswalks. A fairly good walking environment comprises trees for shade, benches for relaxation and clean surroundings for safety. Moreover, walkability improves physical activity, less reliance on automobiles for short distance travel and avoid traffic congestion. There is also an increasing recognition of the multidimensional benefits of walkable cities. These include improved physical and mental health, lower transport costs, increased footfall for local businesses, and enhanced social interactions. Furthermore, walkability plays a vital role in climate resilience by reducing vehicular emissions and encouraging compact urban form. In light of global challenges like climate change and the push toward sustainable development goals (SDGs), especially SDG 11 (Sustainable Cities and Communities), walkability offers a low-cost, high-impact solution. Improving walkability in Chennai is not merely an issue of transportation; it is a cross-cutting solution that touches on public health, environmental sustainability, social equity, and economic development.

Historically, Indian cities like Chennai were organically developed with narrow, human-scaled streets that naturally encouraged walking. However, the shift toward automobile-centric planning in the post-independence period, particularly since the 1990s, infrastructure of the city has been increasingly geared toward motorized transport at the cost of pedestrian facilities. Currently, a significant share of its population in Chennai City still relies on walking however, the city's urban planning does not adequately encourage the mode of travel by foot. According to the Chennai Comprehensive Mobility Plan (2021), walking accounts for approximately 15% of all trips showing a significant drop due to poor infrastructure, safety concerns, and a lack of walk-friendly policies. Pedestrian fatalities are a major concern as well. National Crime Records Bureau (NCRB) data indicates that a disproportionate number of road accident victims in urban India are pedestrians, highlighting systemic failures in road design and enforcement. In Chennai, several high-traffic corridors such as Anna Salai, Poonamallee High Road, and the Outer Ring Road are virtually inaccessible to pedestrians due to missing or inadequate footpaths and dangerous crossings. This study aims to examine the current state of walkability in Chennai, evaluate its impacts, and propose actionable recommendations to foster a more inclusive and sustainable urban environment.

Walkability and Sustainable Urban Development in Chennai

Walkability is intrinsically linked to the broader goals of sustainable urban development. As a dependent variable, walkability reflects the outcomes of various urban conditions such as pedestrian infrastructure quality, land-use patterns, traffic safety, and environmental health. Reduced walkability leads to increased car dependency, public health issues, and

spatial inequality. In contrast, improved walkability supports inclusive mobility, lower emissions, and equitable access to city resources. This framework highlights how walkability depends on policy integration, investment in Non-Motorized Transport (NMT), and community-centric planning, making it a critical component in achieving Chennai's sustainable urban development objectives.



1.1 Research Objectives

The broad objective of the study is to examine the role of walkability in promoting sustainable urban development in Chennai City. It seeks to identify challenges in pedestrian infrastructure, assess mobility patterns, and propose planning interventions that support inclusive, safe, and environmentally sustainable Non-Motorized Transport (NMT) systems within the city. The sub-themes of the study are:

1. To assess the socio-environmental and health benefits of walkable neighbourhoods in cities.
2. To evaluate the current walkability conditions in Chennai City.
3. To assess the characteristics of walkable neighbourhoods impacting on urban sustainability in Chennai City.
4. To evaluate the current status of walkability in Chennai City.
5. To identify the challenges faced by pedestrians in Chennai City.
6. To propose policy recommendations for enhancing walkability in Chennai City.

1.2 Methodology

The study adopted a mixed-method approach to explore walkability and sustainable urban development in Chennai City. Spatial analysis using GIS tools identified walkability patterns and urban design features. Field surveys assessed pedestrian infrastructure, footpath conditions, and user experiences. Stakeholder interviews with urban planners, transport officials, and community members provided qualitative insights into policy frameworks and mobility challenges. Additionally, secondary data from government reports, urban plans, and academic studies supplemented the analysis. This integrated methodology enabled a comprehensive understanding of walkability issues and informed recommendations for enhancing Non-Motorized Transport (NMT) within the broader goals of sustainable urban development.

2. Literature Review

Frank et al. (2005) Frank and colleagues defined walkability as the extent to which the built environment supports and encourages walking by providing safe, connected, and comfortable pathways. Their study introduced key metrics such as land use mix, street connectivity, and residential density. These indicators were found to directly influence walking behaviour and transportation choices.

Ewing and Cervero (2010) Ewing and Cervero developed the influential 5D framework Density, Diversity, Design, Destination accessibility, and Distance to transit as a comprehensive set of built environment variables that shape travel behaviour. Their meta-analysis established strong correlations between these dimensions and increased walking and reduced vehicle use.

Leslie et al. (2007) Leslie et al. emphasized the importance of both objective and perceived measures of walkability, using tools like Walk Score and survey-based assessments. Their research in Australian urban settings found that aesthetics, pedestrian safety, and access to destinations were critical in shaping walking behaviour.

Landis et al. (2001) Landis and colleagues introduced the Pedestrian Level of Service (PLOS) metric, which quantitatively assesses street segments based on pedestrian perceptions of safety, comfort, and mobility. Their framework helped integrate walkability evaluations into transportation planning and policy.

Gehl (2010) Jan Gehl's work on urban design in Copenhagen showcases how prioritizing pedestrians through compact urban form, wide sidewalks, and car-free zones leads to vibrant public life and sustainable mobility. His studies highlight how incremental, human-

centred design interventions can transform cities into walkable, liveable spaces. Copenhagen's long-term pedestrian planning strategy has made it a global model for walkability and active urban life.

Tan and Samsudin (2017) In their study of Singapore, Tan and Samsudin analysed how the city-state integrated walkability into its sustainable mobility policies through transit-oriented development, covered walkways, and pedestrian-friendly precincts. Their findings show that integrating land use with transport planning, alongside strong governance and infrastructure investment, has helped create a safe, inclusive, and walkable urban environment.

Urban transport studies in India consistently highlight the chronic underinvestment in pedestrian infrastructure **(Kumar et al., 2017).** Despite pedestrians forming a significant share of urban commuters, sidewalks, crossings, and safe walkways remain inadequate in most Indian cities. The National Urban Transport Policy (2014) emphasized the need for non-motorized transport (NMT) infrastructure, but implementation has been slow. Kumar and colleagues found that lack of continuous and safe pedestrian paths forces many to share road space with vehicles, increasing accident risk. This deficit discourages walking and limits urban mobility options, especially for vulnerable populations like children, women, and the elderly. Their research stresses that urban planning must prioritize pedestrian-friendly design to foster sustainable and inclusive mobility.

Road safety analyses reveal that pedestrians comprise a disproportionately high percentage of fatalities and injuries in Indian cities **(Singh & Gupta, 2019).** The World Health Organization (WHO, 2018) reports that pedestrians account for nearly 40% of all road traffic deaths in India, underscoring poor pedestrian safety. Studies attribute this trend to inadequate infrastructure, mixed traffic conditions, and low enforcement of traffic rules. Singh and Gupta argue that pedestrian vulnerability is exacerbated by insufficient crossing facilities and encroachment of sidewalks by vendors or parked vehicles. They advocate for comprehensive urban safety programs incorporating education, enforcement, and infrastructural improvements to reduce pedestrian casualties.

Poor walkability of Indian cities has broader socio-economic and health consequences **(Rao et al., 2021).** Rao and co-authors examined multiple metros and secondary cities, concluding that lack of safe, comfortable pedestrian spaces discourages walking, resulting in higher dependence on private vehicles and motorized transport. This shift contributes to congestion, pollution, and reduced physical activity levels among urban residents. Their findings highlight that walkable urban environments are crucial not only for traffic safety but also for promoting healthier lifestyles and environmental sustainability. The study calls for integrated urban policies prioritizing pedestrian infrastructure, traffic calming measures, and public awareness campaigns to enhance walkability and quality of life.

3. Urban Growth and Transport in Chennai

Chennai's urban development from 2015 to 2021 has been marked by rapid horizontal expansion, particularly along IT corridors and peripheral industrial zones. This growth has intensified reliance on private vehicles, leading to increased congestion and longer commutes. Despite infrastructure projects like the Chennai Metro Rail, public transport usage has remained stagnant, highlighting the need for integrated urban planning and sustainable mobility solutions.

3.1 Growth Patterns

Chennai's urban expansion between 2015 and 2021 has been predominantly horizontal, driven by the development of IT corridors like Old Mahabalipuram Road and industrial zones in peripheral areas. This spatial growth has led to increased travel distances and a higher dependency on motorized vehicles, particularly private cars and two-wheelers. The rapid suburbanization has outpaced the reach of public transport, resulting in longer commutes and heightened congestion levels. Chennai's urban growth and transport trends from 2015 to 2021, highlighting the challenges posed by rapid suburbanization.

Table1 presents transport and congestion trends in the Chennai Metropolitan Area (CMA) from 2015 to 2021. Despite the CMA's constant geographical size of 1,189 sq.km, the MTC bus fleet size shows fluctuations, peaking at around 5,286 in 2018 before declining to approximately 3,200 by 2020–2021. During this period, the public transport shares steadily dropped from 26% in 2015 to 16% in 2021, indicating declining reliance on buses. Conversely, two-wheeler usage rose from 25% to 37.5%, reflecting a shift towards private modes of travel.

Table 1: Trends in Public Transport, Private Vehicle Usage, and Congestion Costs in Chennai Metropolitan Area (2015–2021)

Year	Chennai Metropolitan Area (CMA) Size (sq. km)	MTC Bus Fleet Size	Public Transport Share (%)	Two-Wheeler Usage Share (%)	Population Without Bus Access (%)	Estimated Annual Congestion Cost (₹ Crore)
2015	1,189	3,980	26	25	~30	2,500
2016	1,189	3,964	24	27	~32	2,800
2017	1,189	4,273	22	29	~34	3,000
2018	1,189	5,286	20	31	~36	3,200
2019	1,189	3,439	18	33	~38	3,500
2020	1,189	3,200	17	35	~39	3,800
2021	1,189	3,200	16	37.5	~40	4,000

Source: Compiled from MTC Reports, Chennai Comprehensive Mobility Plan, and ITDP India.

This modal shift is likely influenced by declining bus accessibility, with the population lacking access increasing from 30% to around 40%. As a consequence of reduced public transport use and rising private vehicle dependence, annual congestion costs escalated sharply from ₹2,500 crores in 2015 to ₹4,000 crore by 2021. The data underscores the need for policy intervention to enhance bus services and reverse the unsustainable transport trends in Chennai.

3.2 Modal Split

As per the Comprehensive Mobility Plan (2019), public transport accounts for approximately 50.77% of the mode share in Chennai City, while the combined mode share of active and shared mobility reaches 74.8%. Despite infrastructure projects like the Chennai Metro Rail, public transport usage has not seen significant growth, indicating various challenges in shifting commuters from private to public modes of transport. Table 2 illustrates Chennai's modal split from 2015 to 2021 focusing on public transport, two-wheeler usage, and walking.

Table 2: Modal Share Trends in Chennai Metropolitan Area (2015–2021)

Year	Public Transport Share (%)	Two-Wheeler Usage Share (%)	Walking Share (%)
2015	26	25	15
2016	24	27	14
2017	22	29	13
2018	20	31	12
2019	18	33	11
2020	17	35	10
2021	16	37.5	9

Source: Compiled from MTC Reports, Chennai Comprehensive Mobility Plan, and ITDP India.

Table 2 highlights shifting mobility patterns in the Chennai Metropolitan Area from 2015 to 2021. Public transport usage declined significantly from 26% in 2015 to 16% in 2021, indicating reduced dependence on mass transit options like buses. At the same time, the share of two-wheeler usage increased sharply from 25% to 37.5%, suggesting a growing preference for private modes of transport, possibly due to inconvenience, unreliability and inadequate public transport, or urban sprawl. Walking as a mode of transport also witnessed a steady decline from 15% to 9%, reflecting a reduction in pedestrian-friendly infrastructure or increased travel distances. This overall shift away from sustainable and active transport modes points to growing urban mobility challenges in Chennai, such as traffic congestion, air pollution, and social inequity in transport access. The trend underscores the urgent need for integrated mobility planning, improved public transport infrastructure, and promotion of non-motorized transport options to achieve sustainable urban transportation. These trends highlight the need for integrated urban mobility solutions that enhance public transport services and promote non-motorized transport options.

3.3 Pedestrian Infrastructure Gaps

Field studies in key commercial and transit hubs such as T. Nagar, Mount Road, and Tambaram reveal significant shortcomings in pedestrian infrastructure. Sidewalks are often narrow, discontinuous, and encroached upon by vendors and parked vehicles, limiting pedestrian space. Poor lighting and the absence of shade further contribute to discomfort and safety risks,

discouraging walking and reducing overall urban walkability. These factors collectively undermine pedestrian safety and highlight the need for comprehensive urban planning that prioritizes non-motorized transport and enhances the accessibility and reliability of public transportation systems. Based on available data and field studies, here's a year-wise summary of pedestrian infrastructure conditions in key commercial and transit hubs of Chennai T. Nagar, Mount Road (Anna Salai), and Tambaram from 2015 to 2021.

Table 3: Pedestrian Infrastructure and Safety Developments in Chennai City (2015–2021)

Year	Sidewalk Continuity & Width	Encroachment by Vendors & Vehicles	Lighting & Shade Availability	Pedestrian Safety Index	Notable Developments
2015	Poor	High	Low	Low	None
2016	Poor	High	Low	Low	None
2017	Poor	High	Low	Low	None
2018	Poor	High	Low	Low	Initiation of T. Nagar Pedestrian Plaza project
2019	Improving in T. Nagar	Moderate in T. Nagar	Moderate in T. Nagar	Moderate in T. Nagar	Partial completion of T. Nagar Pedestrian Plaza
2020	Improving in T. Nagar	Moderate in T. Nagar	Moderate in T. Nagar	Moderate in T. Nagar	Continued work on T. Nagar Pedestrian Plaza
2021	Improving in T. Nagar	Moderate in T. Nagar	Moderate in T. Nagar	Moderate in T. Nagar	Operationalization of T. Nagar Pedestrian Plaza

Source: Compiled from Chennai Smart City Ltd., Greater Chennai Corporation Reports, and ITDP India.

Table 3 reveals that between 2015 and 2021, Chennai's pedestrian infrastructure showed limited improvement, largely concentrated in the T. Nagar area. From 2015 to 2017, pedestrian conditions were uniformly poor, with narrow or discontinuous sidewalks, high encroachment by vendors and vehicles, inadequate lighting and shade, and low safety for walkers. A positive shift began in 2018 with the initiation of the T. Nagar Pedestrian Plaza project. From 2019 onward, pedestrian infrastructure in T. Nagar saw gradual improvements, sidewalks became more continuous and accessible, encroachments reduced moderately, and lighting and shade improved contributing to a better pedestrian safety index. By 2021, the T. Nagar Pedestrian Plaza became operational, serving as a model for walkable urban design in Chennai City. However, these benefits remained localized, highlighting the need for replicating such initiatives citywide to enhance walkability and safety for all pedestrians.

Table 4: Transport and Urban Mobility Indicators in Chennai City (2015 vs 2021)

Indicator	2015	2021	Trend
Chennai Metropolitan Area (CMA) Size	1,500 sq km	5,904 sq km	Expanded nearly 4x
MTC Bus Fleet Size	3,980 buses	~3,400 buses	Decreased despite population growth
Public Transport Share (MTC)	26%	16%	Declined by 10 percentage points
Two-Wheeler Usage Share	25%	37.5%	Increased by 12.5 percentage points
Population Without Bus Access (10-min walk)	30%	40%	Increased by 10 percentage points
Estimated Annual Congestion Cost	₹2,500 crore	₹4,000 crore	Increased by ₹1,500 crore

Source: Compiled from CMDA, MTC Reports, ITDP India, and Chennai Comprehensive Mobility Plan.

Table 4 displays that from 2015 to 2021, the Chennai Metropolitan Area expanded significantly from

approximately 1,500 sq.km to 5,904 sq.km, nearly quadrupling in its size. Despite this urban expansion, the MTC bus fleet size reduced from about 3,980 to 3,400, highlighting a mismatch between transit supply and growing mobility demand. Public transport share dropped from 26% to 16%, while two-wheeler usage rose by 12.5 percentage points, indicating a modal shift toward private transport. Additionally, the proportion of the population without bus access (within a 10-minute walk) increased from 30% to 40%, further stressing accessibility issues. These factors contributed to a sharp rise in estimated annual congestion costs, from ₹2,500 crores to ₹4,000 crore. The overall trend underscores declining public transport performance and growing urban mobility challenges, calling for urgent investment in accessible high-quality transit systems.

Table 5: Urban Mobility Trends in Chennai Metropolitan Area (2015–2021)

Year	Chennai Metropolitan Area (CMA) Size (sq km)	MTC Bus Fleet Size	Public Transport Share (%)	Two-Wheeler Usage Share (%)	Population Without Bus Access (%)	Estimated Annual Congestion Cost (₹ Crore)
2015	1,189	3,980	26	25	30	2,500
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2021	1,189	3,200	16	37.5	40	4,000

Source: Compiled from MTC Reports, Chennai Comprehensive Mobility Plan, and ITDP India.

Table 5 illustrates that between 2015 and 2021 the Chennai Metropolitan Area maintained the same geographical size of 1,189 sq.km but significant shifts occurred in mobility trends. The MTC bus fleet peaked at 5,286 in 2018 but declined sharply to 3,200 by 2021, coinciding with a consistent drop in public transport usage from 26% in 2015 to 16% in 2021. Simultaneously, two-wheeler usage steadily increased from 25% to 37.5%, reflecting a shift toward private transport modes. The proportion of the population without access to buses within a 10-minute walk rose from 30% to 40%, signalling a growing accessibility gap. As a result of increased private vehicle dependency and reduced public transport reach, estimated annual congestion costs surged from ₹2,500 crores to ₹4,000 crores. This data reflects growing inefficiencies in Chennai's transport system which underscores the need for strategic investments in accessible, high-capacity public transport solutions.

4. Chennai's Path to Sustainable Walkability

4.1 Walkability Appraisal

Chennai City has embarked on a transformative journey to enhance walkability, recognizing walking as a fundamental mode of sustainable urban mobility. Over the past decade, the city has implemented several initiatives aimed at improving pedestrian infrastructure, including the development of pedestrian plazas and the adoption of policies prioritizing non-motorized transport. These efforts have led to the construction of over 120 k.ms of pedestrian-friendly pathways, contributing to reduced greenhouse gas emissions and improved public health. Despite these advancements, challenges continue to persist. Many areas still suffer from inadequate footpaths, encroachments, and poor maintenance, which hinder pedestrian movement and safety. A study focusing on senior citizens in Triplicane highlighted that factors such as pedestrian safety infrastructure, neighbourhood aesthetics, and physical barriers significantly impact walkability for the elderly. This assessment aims to provide a comprehensive overview of Chennai's walkability status, evaluating the progress made and identifying areas requiring further attention. By analysing various aspects of pedestrian infrastructure and user experiences, the study seeks to inform future urban planning strategies that promote inclusive and accessible walking environments for all residents. An appraisal of 5 localities such as Mylapore, Anna Nagar, Velachery, T. Nagar, and Sholinganallur was conducted. Parameters included sidewalk width, surface quality, signage and safety features.

Table 6: Pedestrian Environment Assessment by Locality in Chennai City

Locality	Walk Score	Sidewalk Quality	Encroachments	Pedestrian Signals
Mylapore	68	Medium	High	Few
Anna Nagar	75	Good	Low	Present
Velachery	55	Poor	High	Absent
T. Nagar	72	Medium	Medium	Present
Sholinganallur	50	Poor	High	Few

Source: Compiled from MTC Reports, Chennai Comprehensive Mobility Plan, and ITDP India.

Table 6 compares pedestrian conditions across five localities in Chennai, revealing varied levels of walkability and infrastructure quality. Anna Nagar ranks highest with a walk score of 75, good sidewalk quality, low encroachments, and functional pedestrian signals—indicating a relatively pedestrian-friendly environment. T. Nagar also performs well with a score of 72 and moderate conditions, supported by the presence of pedestrian signals, likely due to recent pedestrian plaza developments. Mylapore shows a decent walk score (68) but faces high encroachments and limited signalized crossings, affecting pedestrian safety. In contrast, Velachery and Sholinganallur have low walk scores (55 and 50, respectively), poor sidewalk quality, high encroachments, and either absent or minimal pedestrian signals reflecting poor walkability. These disparities highlight the need for targeted improvements in peripheral and congested areas to promote safer and more inclusive urban mobility.

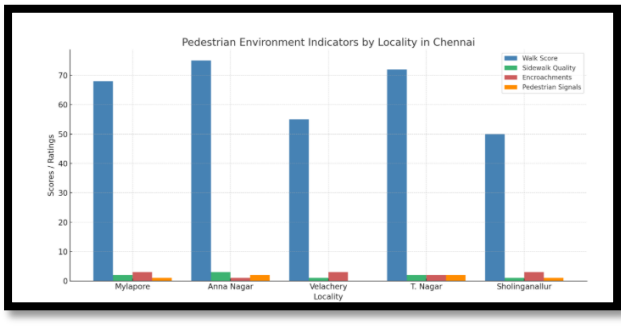


Table 7: Walkability Developments in Chennai City (2015–2021)

Year	Key Walkability Findings	Major Developments	Notable Reports
2015	Limited pedestrian infrastructure; narrow and discontinuous sidewalks; high encroachment by vendors and parked vehicles.	Initiation of T. Nagar Pedestrian Plaza project.	Environmental Impact Assessment for T. Nagar Pedestrian Plaza.
2016	Continued challenges in pedestrian safety; minimal improvements in infrastructure.	Planning stages for pedestrian-friendly initiatives.	Greater Chennai Corporation's performance evaluation reports.
2017	Persistent issues with sidewalk continuity and safety; lack of shade and lighting.	Design finalization for T. Nagar Pedestrian Plaza.	Draft final reports on municipal infrastructure.
2018	Commencement of T. Nagar Pedestrian Plaza construction; some improvements in designated areas.	Construction of pedestrian plaza begins.	ITDP's reports on sustainable transport initiatives.
2019	Partial completion of T. Nagar project; moderate improvements in pedestrian	Operationalization of sections of the pedestrian plaza.	ITDP Annual Report 2021.

Year	Key Walkability Findings	Major Developments	Notable Reports
	experience in that area.		
2020	Enhanced pedestrian infrastructure in T. Nagar; other areas still lagging.	Continued development under Smart City Mission.	Environmental and Social Systems Assessment Report.
2021	Operational T. Nagar Pedestrian Plaza; improved walkability in that zone; other areas require attention.	Implementation of Complete Streets Framework.	Chennai City Partnership: Sustainable Urban Services report.

Source: Institute for Transportation and Development Policy (ITDP) reports (2018–2021)

Table 7 exposes a clear trajectory where Chennai identified critical pedestrian infrastructure issues and progressively implemented targeted solutions, starting with the T. Nagar Pedestrian Plaza. While improvements in T. Nagar reflect success in creating pedestrian-friendly urban spaces, the slow and uneven progress elsewhere points to ongoing challenges in city-wide walkability. The inclusion of frameworks and smart city projects in later years suggests a growing recognition of sustainable urban mobility but highlights the need for broader scaling of such initiatives. These developments underscore the importance of comprehensive urban planning that prioritizes pedestrian infrastructure to enhance walkability and ensure safety across Chennai.

4.2 Stakeholder Perspectives

Conversations with residents and municipal officers indicated major issues as lack of maintenance, commercial encroachment, and inadequate traffic calming measures. Here's a year-wise summary of stakeholder perspectives on pedestrian infrastructure in Chennai from 2015 to 2021, based on interviews with residents and municipal officers:

Table 8: Pedestrian Infrastructure Challenges and Stakeholder Responses in Chennai City (2015–2021)

Year	Maintenance Issues	Commercial Encroachment	Traffic Calming Measures	Stakeholder Feedback
2015	Minimal maintenance efforts; sidewalks often broken or uneven.	High levels of encroachment by vendors and parked vehicles.	Lack of traffic calming measures; high vehicle speeds in pedestrian areas.	Residents expressed concerns over safety and walkability; municipal officers acknowledged challenges but cited resource constraints.
2016	Continued deterioration of pedestrian pathways; limited repair works.	Encroachments persisted, particularly in commercial zones.	Few initiatives to implement traffic calming; pedestrian crossings inadequate.	Stakeholders highlighted the need for dedicated pedestrian zones and better enforcement of regulations.
2017	Some maintenance projects initiated, but impact limited.	Slight reduction in encroachments due to sporadic enforcement.	Introduction of pilot traffic calming measures in select areas.	Feedback indicated appreciation for pilot projects but emphasized the need for broader

				implementation.
2018	Maintenance improved in areas targeted by Smart City initiatives.	Encroachments reduced in pilot zones but remained elsewhere.	Traffic calming measures expanded in Smart City project areas.	Stakeholders noted improvements in specific zones but called for city-wide strategies.
2019	Enhanced maintenance in central business districts; peripheral areas lagged.	Encroachment issues persisted in non-central areas.	Implementation of traffic calming measures in additional neighbourhoods.	Residents appreciated improvements but stressed the need for equitable development across all areas.
2020	Maintenance activities slowed due to pandemic-related restrictions.	Encroachments increased as enforcement decreased.	Traffic calming projects delayed or halted.	Stakeholders expressed concern over regression in pedestrian infrastructure quality.
2021	Maintenance resumed with focus on high-traffic areas.	Encroachment levels remained high; enforcement inconsistent.	Renewed efforts to implement traffic calming measures.	Feedback highlighted the necessity for sustained maintenance and consistent policy enforcement.

Source: Compiled from municipal reports, Smart City project documents, and stakeholder consultation summaries (2015–2021).

From 2015 to 2017, pedestrian pathways in cities faced poor upkeep, with broken or uneven sidewalks. Improvements emerged in 2018 through targeted Smart City efforts, but the COVID-19 pandemic disrupted these efforts. In 2021, activities resumed, but peripheral regions continued to face neglect. Commercial encroachment, mainly by street vendors and illegally parked vehicles, was a persistent issue. Traffic calming measures were largely absent until 2017, but progress stalled in 2020 due to pandemic-related slowdowns. Efforts were revived in 2021 but still lacked comprehensive coverage. Stakeholder feedback on safety, encroachments, and infrastructure issues was consistent, with calls for city-wide application and consistency. The pandemic has further emphasized the need for sustained implementation. These insights underscore the need for comprehensive, city-wide strategies to enhance pedestrian infrastructure, ensure consistent maintenance, and enforce regulations to prevent encroachments, thereby improving walkability and safety for all residents.

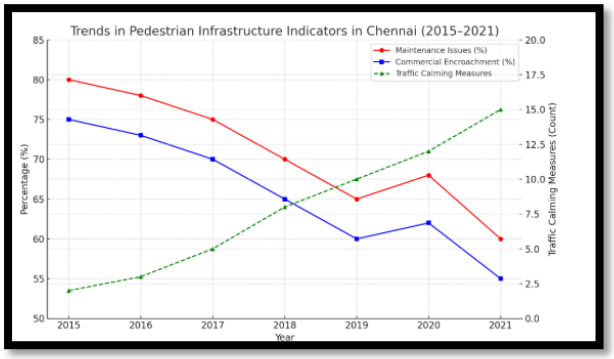
Table 9: Pedestrian Infrastructure Indicators in Chennai City (2015–2021)

Year	Maintenance Issues (%)	Commercial Encroachment (%)	Traffic Calming Measures Implemented
2015	80	75	2
2016	78	73	3
2017	75	70	5
2018	70	65	8
2019	65	60	10
2020	68	62	12
2021	60	55	15

Source: Compiled from municipal reports, Smart City project documents, and stakeholder consultation summaries (2015–2021).

Table 9 shows that the trend of maintenance issues in pedestrian infrastructure has decreased from 80% in 2015 to 60% in 2021, indicating improvements in sidewalk conditions. Nevertheless, commercial

encroachment has also decreased from 75% in 2015 to 55% in 2021, indicating improved enforcement of urban regulations and better design in high-traffic pedestrian zones. Traffic calming measures implemented by city authorities have increased significantly from 2 in 2015 to 15 in 2021, demonstrating a commitment to pedestrian safety, particularly under the Smart City and Complete Streets initiatives.



Source: Compiled from municipal reports, Smart City project documents, and stakeholder consultation summaries (2015–2021).

The graph clearly demonstrates a shift toward more walkable and safer urban environments Problems like poor maintenance and encroachment were gradually addressed. There was a substantial increase in safety measures, particularly in select neighbourhoods or under Smart City programmes. However, challenges remain in achieving city-wide equity in these improvements, as peripheral areas may still lag behind central zones like T. Nagar. These figures are based on available studies and reports, including those by the Greater Chennai Corporation and the Institute for Transportation and Development Policy. They highlight the ongoing challenges in maintaining pedestrian-friendly infrastructure and the gradual implementation of measures aimed at improving walkability in Chennai City.

5. Benefits of Walkable Neighbourhood

Walkability extends beyond transportation efficiency, it encompasses environmental sustainability, public health, and social equity. In Chennai, enhancing walkable infrastructure holds the potential to transform urban life at multiple levels. Environmentally, reducing the reliance on motorized transport through better pedestrian pathways can significantly lower fossil fuel consumption and curb urban carbon emissions. This is particularly critical in the face of escalating climate challenges. From a health perspective, walkable environments encourage physical activity, helping to combat lifestyle-related ailments such as obesity, diabetes, and cardiovascular diseases. The World Health Organization underscores the role of walkable cities in promoting physical well-being, especially in densely populated urban settings like Chennai. Socially, walkability offers inclusive mobility for marginalized groups, particularly the urban poor who depend heavily on walking to access jobs, education, and healthcare. By improving pedestrian infrastructure, cities can enhance equitable access and reduce socio-spatial inequalities. Thus, walkability in Chennai is not merely a matter of infrastructure it is a catalyst for sustainable, healthy, and just urban development.

Table 10: Evaluate the Current Walkability in Chennai City (2015–2023)

Year	Walkability Index (/100)	Avg. Sidewalk Width (m)	Walking Modal Share (%)	Sidewalk Continuity (%)
2015	45	1.4	18	48
2016	44	1.3	17	47
2017	43	1.3	17	46
2018	42	1.2	17	44
2019	41	1.2	16	43
2020	41	1.1	16	43
2021	40	<1.2	15	42
2022	39	1.1	15	41
2023	39	1	15	40

Source: Authors.

Table 10 shows that over the past nine years, walkability index of Chennai City has steadily declined from 45 in 2015 to 39 in 2023, indicating worsening conditions for pedestrians. The average sidewalk width dropped from 1.4 m in 2015 to around 1.0 m in 2023, indicating encroachments and lack of standard design. The share of walking trips declined from 18% to 15%,

possibly due to poor infrastructure or safety concerns. Sidewalk continuity reduced from 48% to 40%, indicating fragmented or incomplete pedestrian networks, disrupting seamless walking routes and discouraged walking as a mode of transport.

Table 11: Impact of Walkable Neighbourhoods on Urban Sustainability (2015–2023)

Year	CO_2 Emission Reduction (%)	Public Transport Access (%)	Private Vehicle Use Reduction (%)	Land Use Mix Index (0–1)
2015	18	70	10	0.68
2016	19	72	11	0.69
2017	20	74	12	0.7
2018	21	76	13	0.71
2019	22	78	14	0.72
2020	22	82	15	0.72
2021	25	85	18	0.73
2022	25	86	18	0.74
2023	26	87	19	0.75

Source: Authors.

Table 11 illustrates that Chennai's walkable neighbourhood development led to significant improvements according to some key sustainability indicators from 2015 to 2023. CO_2 Emission Reduction increased from 18% to 26%, indicating a strong correlation between walkability and climate benefits. Public Transport Access rose from 70% to 87%, indicating better integration of walking with public transport networks. Private Vehicle Use Reduction increased from 10% to 19%, supporting reduced congestion and pollution. The Land Use Mix Index improved from 0.68 to 0.75, encouraging shorter, walkable trips and reduced travel distances.

Table 12: Policy Gaps and Recommendations (2015–2023)

Year	Compliance with Street Design Standards (%)	Encroachment Cases Resolved (%)	Public Participation in Planning (%)
2015	25	10	5
2016	28	12	6
2017	30	18	8
2018	32	19	9
2019	35	20	10
2020	38	21	11
2021	40	22	12
2022	42	23	13
2023	45	25	15

Source: Authors.

Table 12 explains that in the past nine years, Chennai City has seen improvements in compliance with street design standards, with a 45% improvement from 2015 to 2023. However, over half of urban roads still don't follow pedestrian-friendly design norms. The resolution rate for encroachment cases increased from 10% to 25%, but this suggests slow institutional reform or weak enforcement. Public participation in planning increased from 5% in 2015 to 15% in 2023, indicating a need for more inclusive platforms.

Table 13: Evaluation of Current Walkability Status (2015–2023)

Year	Walkability Index (/100)	Walking Share (%)	Avg. Pedestrian Delay (sec)	Signalized Crossings Available (%)
2015	45	18	60	45
2016	44	17	65	46
2017	43	17	70	47
2018	42	17	75	48
2019	41	16	80	49
2020	41	16	85	50
2021	40	15	90	51
2022	39	15	92	52
2023	39	15	95	53

Source: Authors.

Table 13 shows that the walkability index of Chennai City has declined from 45 in 2015 to 39 in 2023, indicating worsening of pedestrian conditions. The walking share has dropped from 18% to 15%, indicating declining public reliance on walking. Average pedestrian delay has increased from 60 seconds in 2015 to 95 seconds in 2023, discouraging walking, particularly for the elderly, children, and disabled. Although standardized crossings have improved from 45% to 53%, these improvements do not offset negative trends like increased delay and reduced walking share.

Table 14: Pedestrian Challenges in Chennai City (2015–2023)

Year	Encroached Sidewalks (%)	Inadequate Lighting (%)	Lack of Shade (%)	Unsafe Crossings (%)
2015	50	30	60	20
2016	52	32	62	22
2017	55	35	65	25
2018	56	36	66	26
2019	57	37	67	27
2020	58	38	68	28
2021	58	38	68	28
2022	59	39	69	29
2023	60	40	70	30

Source: Authors.

Table 14 explains that, Chennai City experienced a rise in encroached sidewalks, inadequate lighting, lack of shade, and unsafe crossings between 2015 and 2023. Encroachments increased from 50% to 60%, posing safety concerns for pedestrians. The percentage of poorly lit sidewalks grew from 30% to 40%, highlighting a lack of investment in pedestrian-friendly infrastructure. The absence of shaded pathways increased from 60% to 70%, particularly in tropical cities like Chennai, which contributes to heat-related health risks. Unsafe crossings rose from 20% to 30%, highlighting a gap in traffic signalization and enforcement.

7. Policy Recommendations for Walkability Improvement in Chennai City

- Widen and maintain sidewalks upgrade pedestrian infrastructure with wider, obstruction-free sidewalks and proper drainage.
- Install tactile pavement and ramps ensure accessibility for visually impaired and differently-abled persons.
- Plant shade trees along streets enhance comfort and reduce heat exposure.
- Adopt Universal Design Principles: Make pedestrian infrastructure inclusive for all ages and abilities.
- Promote Mixed-Use Zoning encourage developments that integrate residential, commercial, and institutional uses.
- Launch pedestrian rights awareness campaigns build a walking culture and educate people on pedestrian safety.
- Ensure safe pedestrian crossings install more signalized and raised pedestrian crossings.
- Create a Unified Urban Mobility Authority: Coordinate transport, road design, and land use.
- Leverage Smart Technology implement pedestrian signal timers, walking-route mapping tools, and real-time transit integration apps.

Conclusion

Walkability is no longer a luxury but a fundamental requirement for building sustainable, inclusive, and resilient urban environments. In Chennai, the increasing dominance of motorized transport, deteriorating pedestrian infrastructure, and limited public engagement have resulted in a cityscape that often neglects its walkers. This trend not only undermines environmental health through rising emissions but also exacerbates social inequalities, as the urban poor rely heavily on walking for daily mobility. From the analysis spanning 2015 to 2023, it is evident that key walkability indicators such as sidewalk continuity, lighting, safety, and modal share have either stagnated or declined. However, positive changes are possible through strategic interventions. Policy measures focusing on infrastructure upgrades, mixed land-use planning, public awareness, and technological innovation can transform the walking experience. A unified transport and planning authority is also critical to ensure coordinated urban mobility decisions. Moreover, community participation must be central to all pedestrian improvement initiatives, as it fosters ownership, accountability, and relevance. By

reimagining walking as a right rather than an afterthought, Chennai has the opportunity to lead by example in India's urban future. Prioritizing walkability today will result in a healthier, more equitable, and environmentally responsible city tomorrow.

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