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Literature Review on Metro Public Transport Accessibility Optimization by Walking, Cycling and using Non-motorized Vehicles in Indian Cities

Kalpana Kawathekar[1]*, Pankaj Bahadure[2], Vilas Bakde[3]

[1] PhD Scholar, Part Time at Department of Architecture and Planning, VNIT, Nagpur and Faculty at KITS, Ramtek, Nagpur, M.S., India
[2] Assistant professor, Department of Architecture and Planning, VNIT, Nagpur, M.S., India.
[3] Retired Professor and former Head, Department of Architecture and Planning, VNIT, Nagpur, M.S., India.
*** Corresponding Author Kalpana Kawathekar :** kalpanankawathekar@gmail.com, kalpana@students.vnit.ac.in

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Abstract:
Due to the widespread use of Personal Motorised Vehicles (PMV), such as cars and two-wheelers, Indian cities are experiencing traffic congestion issues. Public transit is typically not desired because of the lack of frequency on pertinent routes, user awareness, etc. On the other side, inadequate street infrastructure, encroachment, and violations of Development Control regulations, traffic and parking restrictions, etc. are impeding pedestrian circulation and raising accident and death rates. The best way to address these problems is to promote walking, cycling and thereby discouraging the use of PMVs by making appropriate local provisions. Numerous recent studies have demonstrated that compact developments with higher densities and mixed land-use stimulate pedestrian travel by shortening trip times and providing a larger range of commuting options. To facilitate pedestrian circulation, a relationship between physical features that represent the urban form of cities can be developed considering its relationships to the social, political, and economic spheres.
By analyzing the various previous studies, the various analytical methods and tools have been identified by the researcher in order to overcome the PT accessibility issues in Indian Cities. Finally, the researcher found that the accessibility of public transportation for non-motorized movement in large cities has to be improved. Even though many communities have made efforts to make space for non-motorized modes of transportation like bicycles and pedestrians, there is still much to be done. Public education and awareness campaigns about the benefits of non-motorized transportation have the power to change people's perspectives and actions towards environmentally friendly transportation. All things considered, the government may foster more sustainable and inclusive urban environments by prioritising non-motorized transportation in large cities.

Keywords: Metro Public Transport, NMT, Walking, Sustainable Transportation, Public Transport Accessibility

Introduction

Indian Cities have spread out over the past few decades, and people are now incredibly dependent on motorised transportation to get around and access services. Due to this, there are issues with extremely congested roads and greenhouse gas emissions. There has been a push in recent years to design communities that rely less on motorised transportation. As a result of the numerous environmental, social, and health advantages, non-motorized

transportation (NMT), such as walking, jogging, and cycling, is regarded as one of the more preferred modes of transportation. Since most journeys begin and end with NMT, its advancement will also benefit motorised transportation. Metro areas have seen an increase in the development of non-motorized and public transit, and it's encouraging to see them place a high priority on environmentally friendly and effective mobility. Cities are investing more on pedestrian and bicycle infrastructure in terms of non-motorized transportation. This includes bike-sharing schemes, walkways that are convenient for pedestrians, and designated bike lanes. It's a fantastic step in the direction of encouraging a healthier lifestyle and lessening traffic congestion. Additionally, public transportation is evolving significantly. The metro and bus systems in many cities are being expanded to improve accessibility and convenience for locals. Technology integration has enhanced the whole experience of using public transit, including contactless payment methods and real-time tracking applications. Public transportation's environmental effect is being lessened by the move towards electric or hybrid buses. These advancements help to create more sustainable and habitable urban settings in addition to addressing transportation-related issues. Without a doubt, a sustainable and effective urban transportation system depends on the cooperation of non-motorized and public transit. First off, the "last-mile" issue can be resolved by combining non-motorized transportation with public transportation, such as walking and cycling. Walking or cycling to and from public transport hubs makes the commute easier and more convenient for commuters. Cities are making sure that public transit stations have bike racks and are progressively implementing bike-sharing programmes. Additionally, urban planners are seeing the value of developing transit-oriented developments (TODs), which centre important hubs for public transportation around the design of residential, commercial, and recreational spaces. This supports a lifestyle that is more sustainable and focused on the community by encouraging a move away from the use of private vehicles. The implementation of dedicated infrastructure, such as bike lanes and pedestrian pathways, between residential areas and public transport hubs improves accessibility and promotes the use of various modes of travel by a greater number of people. It not only eases traffic but also encourages living a better lifestyle. The majority of international comparisons of riding activity have focused on high-income nations and frequently only on the prevalence of cycling, with little attention paid to demographic and trip features. Another well-known example of a sustainable mode of transportation, particularly appropriate for urban use and/or relatively short distances, is walking. Walking, cycling, small-wheeled transportation (such as skateboards, push scooters and hand carts), and wheelchair travel are all non-motorized means of transportation that are frequently crucial to successfully promoting clean urban transportation. Walking is about enjoyment as much as getting somewhere. It is the most adaptable type of travel. A walk might be enjoyed while taking in music, keeping an eye out for wildlife, or conversing with friends or strangers might come across. In order to give a thorough analysis, this article estimates the value of the investment expenses, as well as the additional environmental, social, and economic benefits and costs that the NMT network results in. Depending on the anticipated demand for NMT, the assessment covers both a low- and a high-value scenario. It is crucial to remember that there are added benefits and costs that are avoided in case the more people use the NMT network.

Therefore, in order to identify the research gap in the proposed study, the author took into account the following:
1. Which facets of non-motorized transportation have received the most research, and which may not have received enough?
2. How does the particular state of non-motorized transportation differ from that of other areas or nations?
3. What kinds of effective techniques or interventions have been used up to this point?
4. Is there any way that technology could be better applied to managing fresh opportunities or challenges?

The goal, distance, density, and route can all be used to characterise walking. Pedestrians play a crucial role in the transportation system. When access is restricted, the flexibility and affordability of pedestrians serve as excellent examples. New urbanism is one theory that links the built environment to a community's ability to be walked around. In recent years, methods for influencing travel demand have become more popular, including new urbanism, transit-oriented development, and classic town planning. They all have three similar transportation goals: 1. Decrease the number of motorised journeys, or trip production. 2. Decrease the number of trips made and boosts the percentage of non-motorized trips (by foot or bicycle). And 3. Cut back on the number of trips made, shorten commutes, and boost vehicle occupancy. Measures of land use diversity, intersection density, and the quantity of destinations within walking distance all significantly influence pedestrian flow. E Rickshaw may

be used as an intermittent Non polluting public transport. Use of buses and trains is also influenced by factors relating to street network design and proximity to transit, with land use variety playing a supporting role. Surprisingly, after these additional factors are taken into account, we find that population and job densities have a modest correlation with travel behaviour.

Background of the study

According to the society and the period, non-motorized transport users' accessibility has changed significantly over time. Walking, riding horses, or using carts were the main ways of non-motorized transportation in prehistoric societies like Ancient Egypt, Mesopotamia, or Prehistoric China. Accessibility probably varied according to social class, with the wealthy having access to superior infrastructure and transit alternatives while those in lower social classes could have had to rely on their own physical prowess to get around. During this time period, the majority of people still chose to walk or ride horses as their primary mode of transportation. However, accessibility was constrained because of the shoddy state of the roads and the absence of formalised transportation services. Private transportation choices like carriages or sedan chairs were only available to the rich or high-ranking people.

The early 20th century saw an increase in accessibility issues for non-motorized transport users due to urbanisation and the development of the vehicle. Sidewalks, pedestrian crossings and designated bike lanes were sometimes insufficient or nonexistent, which raised safety issues and restricted accessibility for both bicycles and walkers. Non-motorized transportation alternatives, such as walking and cycling, are increasingly being acknowledged as important for accessible and sustainable mobility. Building a sustainable and accessible urban environment around metro stations requires improving the non-motorized transport (NMT) infrastructure. The areas around metro stations can be planned in the following ways to promote cycling, walking, and using e-rickshaws:

Infrastructure Development Requirements:

In view to optimize public transport accessibility there is a need to have infrastructure development provisions as below;

i. Infrastructure development Policies ;
   a. To create policies that place a high priority on building infrastructure that is conducive to pedestrians, such as pedestrian bridges, crosswalks, and sidewalks.

ii. Walking, cycling infrastructure provisions ;
   a. To provide accessible and secure walking pathways to public transport stations, allocate funds towards the development and upkeep of pedestrian infrastructure.
   b. To put laws into place to designate specific bike lanes, offer bike sharing services and provide safe places to keep bicycles close to public transportation hubs.
   c. To create and maintain bike lanes, implement bike-sharing programmes, and offer bicycle parking spots that are both convenient and safe.

iii. Last-Mile Connectivity provisions:
   a. To create regulations that promote integration between NMT modes (bicycling, walking, etc.) and public transport in order to alleviate the "last-mile" problem.
   b. Provide smooth transitions between various forms of transportation, making sure that there are safe pedestrian paths, bike-sharing programmes, and interconnected walkways that lead to and from public transportation stations.

iv. Demand Management for Transportation (TDM):
   a. To adopt TDM policies, such as congestion pricing or special treatment for non-motorized modes, to encourage the adoption of sustainable modes of transportation, including NMT.
   b. To implement laws that penalise driving a private vehicle and promote using NMT alternatives to get to public transportation.

v. Public Awareness Campaigns:
   a. Create laws to educate the public about the advantages of NMT and how it improves accessibility to public transportation.
   b. Conduct focused public education efforts using several media platforms, highlighting the benefits of walking, cycling, and other non-motorized ways to get to public transport hubs.

vi. Land Use Planning:

a. Encourage NMT as a way to access these places by integrating land use planning rules that support mixed-use projects near public transport hubs.
b. Work together with urban planners to develop pedestrian-friendly communities that include a blend of commercial, residential, and recreational areas close to public transportation hubs.

vii. Rules governing Micro-Mobility and E-Rickshaws:
a. To improve the first- and last-mile connectivity to public transit, regulations governing micro-mobility solutions, such as electric scooters, should be developed and put into effect.
b. In order to guarantee safety requirements and seamless integration with public transport networks, monitor and control the operation of e-rickshaws and micro-mobility services.

viii. Availability to Individuals with Disabilities:
a. Incorporate clauses aimed at ensuring that NMT infrastructure and public transit are accessible to people with impairments.
b. Put in place strategies like ramps, wheelchair-accessible walkways, and signage to improve public transportation terminals' general accessibility for everyone.

While working on infrastructure development the other supports also become necessary.

- Collaboration between local governments, government agencies, and communities is necessary for successful implementation. Mechanisms for monitoring and evaluating policies should be in place in order to determine their efficacy and make the required modifications for on-going improvement. Accessibility for people with disabilities (PWDs) in public transportation has a number of challenges, particularly when it comes to metro stations in India and other cities.
- Many metro stations lack the necessary facilities to meet the needs of people with disabilities. Wheelchair users and others who are visually impaired find it challenging to manoeuvre the stations safely due to the lack of ramps, elevators, accessible restrooms, and tactile paving. In metro stations, signage is frequently absent or insufficiently large or in Braille. This makes it difficult for people who are blind or visually impaired to navigate and find the information they need. In some circumstances, those who use mobility aids may have trouble getting enough room or help.
- Metro stations and trains are typically packed, making it challenging for PWDs to access or exit without difficulty. People using mobility aids may have trouble in these circumstances obtaining enough room or support. Although the metro crew is in charge of guaranteeing accessibility, there is frequently a shortage of trained personnel to help PWDs. For those who need extra help this can cause delays and inconveniences.
- The lack of accessible facilities near metro stations makes it extremely difficult for people with disabilities to travel to the station from their residences or to get there after leaving the station. Beyond the stations, there are frequently difficult or unwelcoming sidewalks, street crossings, and public transportation options. The general populace sometimes lacks awareness of and sensitivity to the needs of people with disabilities. As a result, PWDs may experience bias, discrimination, or unhelpful behaviour when using public transportation services.
- The government must take a holistic strategy to solving these problems. This entails modifying current infrastructure to make it accessible, making sure that assistive technologies are available, enhancing communication and signage systems, training staff members to be inclusive of people with disabilities, enhancing last-mile connectivity, and launching awareness campaigns to promote a more inclusive society.
- Promoting the use of non-motorized transportation (NMT) for PT access may be hampered by the lack of coordination between NMT and PT planning. There may occasionally be a gap in the infrastructure connecting NMT and PT. For instance, people may find it uncomfortable or risky to use NMT to access PT if there are no designated bike lanes or safe pedestrian walkways leading to public transport hubs. NMT and PT system planning is frequently done separately, which can lead to poorly coordinated strategies.
- While NMT planning may emphasise establishing cycle tracks or pedestrian-friendly zones, PT planning often focuses on guaranteeing efficient and frequent bus or metro services. It is difficult to develop a comprehensive system that promotes NMT-PT connectivity since these programmes are not integrated with one another. Lack of Timeliness: Another problem is the misalignment of the NMT and PT

schedules. People may decide against using NMT as a dependable way to obtain PT if the arrival and departure times of public transport do not meet their demands. Other important considerations include making sure PT vehicles have enough room for bicycles and can accommodate pedestrians.

- It is essential for urban planners and politicians to work towards a more integrated approach in order to encourage the usage of NMT for accessing PT. Coordination of planning enhanced infrastructure connectivity, synchronised timetables, and public awareness campaigns would all be required. Cities may design an efficient and sustainable transport system that encourages people to use NMT to access PT by coordinating the planning of NMT and PT.

Precautionary measures for Walking, cycling and using E rickshaws:

To make things better, governments and towns have begun putting policies like bike lanes, pedestrian-friendly streets, and universal accessibility requirements into place. Accessibility still varies significantly by geography, as some cities prioritise the infrastructure for non-motorized travel more than others. Overall, the accessibility of non-motorized transport users has improved over time, but historical contexts have shaped the availability of transportation options and infrastructure, often creating disparities based on social status, wealth, and technological advancements. While discussing the above, it is important to discuss about the various policies and its implementation of government with regard to NMT usage for PT accessibility. The utilisation of non-motorized transport (NMT) for public transport (PT) accessibility is significantly shaped by government legislation. The government regulations, coupled with implementation considerations and their possible influence on advancing NMT for PT accessibility definitely help improve walkability. Thus areas surrounding metro stations can be made more lively and open to the public, encouraging the use of non-motorized transportation modes, by incorporating components enhancing the sustainability and liveability of the urban surroundings. These provisions are listed as follows;

Walkway provisions ; To Make sure the walkways that travel to and from the metro station are well marked and kept up and Make certain that these walkways are roomy, well-lit, and devoid of obstructions. And with pedestrian safety first, install crosswalks at crossings with obvious signs and pedestrian signals. To improve the pedestrian experience, install benches, lighting, and other features.

Dedicated Bike Lanes: To create distinct bike lanes that are physically and visibly marked for cyclists and set off from motorised vehicles. Provide safe, convenient bike parking spaces close to metro gates to promote cycling as a first- and last-mile option. Installing bike-sharing stations at or close to the metro station will make it simple for passengers to borrow and return bicycles.

E-rickshaw Resources: Designate particular areas where e-rickshaws can pick up and drop off people. This guarantees commuter convenience and aids in traffic flow organisation. To assist the sustainability of this mode of transportation, if e-rickshaws are electric, place charge stations close to the metro station. Installing information kiosks or boards that direct commuters to adjacent e-rickshaw stands can facilitate their access to these means of transportation.

Combining with Public Transportation:

Plan the environment around metro stations to make switching between different forms of transit simple. This includes integration with bus stations, well-marked walkways, and visible signs. To construct integrated hubs for transportation where travellers may easily transition between e-rickshaws, bicycles, walking, and other forms of public transportation.

Safety precautions: In order to improve safety, particularly at night, make sure that the area is well-lit and under monitoring. To protect the safety of e-rickshaw riders, pedestrians, and cyclists, station security staff within and outside the metro station.

Community Involvement: Provide channels for community input so that the NMT infrastructure can be continuously enhanced and modified in response to passengers' demands and experiences. Run awareness programmes to highlight the advantages of using e-rickshaws, bicycles and walking to persuade more people to use these environmentally friendly forms of transportation.

Literature Review :

For the purpose of getting clarity in the selection of topic, reviews were collected on various categories.

1. Understanding Accessibility of Non Motorized Transport users in historic context

Pedestrian and bike accessibility was greatly influenced by the historic setting. The presence of small streets, a lack of convenient crossing spots, and inadequate infrastructure were noted as accessibility obstacles. The study also emphasised the significance of maintaining historical figures while enhancing accessibility for non-motorized transport users (Li, Zhao, and Chen, 2018). The historic setting caused difficulties for accessibility because of the congested foot traffic and small streets. The report suggested enhancing pedestrian infrastructure, such as adding larger walkways and better signage, to increase accessibility without sacrificing the neighbourhood's historic charm (Rüdiger and Gade, 2016). The land use patterns, roadway design, pedestrian infrastructure, and historical context all had an impact on accessibility. To increase accessibility in historic districts, they recommended the deployment of traffic calming strategies, pedestrian-friendly streetscapes, and mixed-use developments (Joerger and Golub, 2012). The historic setting frequently imposed accessibility restrictions because of the presence of small streets, a lack of parking spaces, and a deficient pedestrian infrastructure. The study emphasised the necessity for thorough planning and design interventions in transport to provide non-motorized transport users' requirements in historic regions first priority (Henneberry and Young, 2001). The current system, pinpoints obstacles, and suggests design choices that maximise accessibility. And also walking and cycling, two non-motorized modes of transportation might increase public transportation accessibility in Indian cities (Piyush Tiwari et al., 2013).

Encouraging non-motorized transportation in Indian cities will provide significance on infrastructure for safe cycling and walking and the necessity of integration with public transport systems. (The Indian government's Ministry of Urban Development, 2012). The tactics to encourage bicycling and walking, such as enhancing the infrastructure, coordinating with public transportation, and developing intermittent, non-polluting public transportation options will be important for Sustainable Urban Transport (The World Bank, 2010). The public transportation use is being affected in Indian cities by non-motorized transportation infrastructure, such as bike lanes and walkways for pedestrians. It evaluates the viability and accessibility of combining bicycling and walking with public transportation (Konidari et al., 2019). The current transportation network, pinpointed obstacles to active transportation, and suggested ways to increase accessibility (Gupta et al., 2018).

Cycling and non-polluting public transport, such e-buses and rickshaws, are integrated in Indian towns and there are some possible paths, infrastructure needs, and operational factors to support smooth transitions between these modes (Kumar et al., 2017). In order to improve accessibility to public transport by non-motorized methods, it is necessary to integrate land use and transport planning, as well as the significance of infrastructure and policy interventions (Madhu Bhaskaran et al., 2015). The study evaluated a number of variables, such as public space design, cycle-sharing programmes, and pedestrian infrastructure that affect non-motorized accessibility to the metro stations (Rajat Rastogi et al., 2019). The street design can also affects the accessibility for non-motorized transportation to public transportation networks, safety concerns, and legislative responses (Dorina Pojani et al., 2017).

Walking and Cycling, among other non-motorized transport modes, contribute to increased accessibility to public transport in London (2008). Non-motorized transport infrastructure, such as bike lanes and pedestrian walkways, affect public transport accessibility in Bogota (2012). The non-motorized transportation modes including cycling and walking can be integrated to improve accessibility to public transport in Tokyo (2015). There are more initiatives taken by a number of European cities to maximise public transport accessibility by using non-motorized transportation (2018). The public transportation in Curitiba, Brazil, integrates non-motorized transportation modes including cycling and walking. The city's accessibility to public transit is affected by programmes like the Bus Rapid Transit system and the Ciclovia network (2020). It is emphasised that the necessity of connecting trails, places to rent bikes, and easily accessible locations for the significance of smooth integration between non-motorized transport modes and metro systems (2015).

To encourage more people to choose non-motorized options, design changes like designated bike lanes, well-lit pedestrian zones, and secure bike parking can be done (2017). Commuting decisions were positively impacted by awareness efforts, and that the transition from private vehicles to environmentally friendly forms of transportation was greatly aided by easily accessible locations (2018). Making investments in pedestrian and bicycle infrastructure enhanced the local economy and the environment. This led to the development of a more sustainable urban economy (2019).

The digital platforms that promote community involvement for sustainable transport projects, as well as smart phone apps that provide real-time information on the availability of bike sharing services and smart parking

options (2020). People were choosing non-motorized solutions more frequently and giving sustainability and health top priority when it came to their transportation needs (2021). The usage of technology is important to make public transit systems more accessible, and to integrate them with other forms of transportation (Raktim Mitra's, 2013). There is an importance of effective public transport networks which facilitates for improving urban mobility and lessening environmental effects, particularly metros (Mohit Sharma et al., 2019). With an emphasis on sustainability, the issues like pedestrian amenities, integration with other forms of transportation, and the effect of metro stations on land-use patterns are playing a vital role (Sachin B. Pandya et al., 2017). The sustainable urban mobility of European metropolitan areas is the main topic of this review study. It evaluates the ease of use of public transportation systems and looks at the successes and setbacks seen by different cities in enhancing sustainable mobility (Vinther and Nielsen's, 2018).

Overall, prior research has consistently emphasised the impact of the historical environment on non-motorized transport users' accessibility. They have noted difficulties like congested pedestrian traffic, few crossing places, small streets, and poor infrastructure. Through actions like wider walkways, better signage, traffic calming, and mixed-use developments, these studies stress the significance of maintaining the historic character while enhancing accessibility.

2. Issues in Public Transport Accessibility to NMT users with special reference to metro Stations surrounding influence areas in present urbanization context in Indian and other Cities.

There is a serious lack of services and infrastructure for non-motorized transport users close to metro stations. This included a lack of designated bike lanes, a lack of bike parking spaces, and poor pedestrian walkways. The report suggested that better infrastructure be put in place and that the network of non-motorized transportation be integrated with the metro system. India brought attention to the dangers that non-motorized transport users face close to metro stations. It concluded that non-motorized transport users had substantial difficulties due to poor lighting, a lack of safe pedestrian crossings, and excessive traffic near metro stations. The report suggested installing appropriate lighting and putting in place traffic-calming measures close to metro stations. Better signage, more bicycle parking spaces, and traffic management strategies to increase accessibility for non-motorized transport users. Bikers faced difficulties due to a lack of bicycle parking spaces and the limited capacity of the already-existing bike racks. To increase accessibility for non-motorized transport users, increasing bicycle parking spaces and putting in place secure bike storage facilities at metro stations.

Despite the fact that Delhi Metro has considerably increased accessibility for users of public transit, there are still obstacles. Unsecure bicycle parking, insufficient pedestrian facilities, and a lack of thorough integration with feeder bus services were among the problems found (2014). While the metro system gave users of motorised transportation good connection, non-motorized transportation users had to contend with issues like a lack of designated bicycle lanes, a lack of sidewalks, and subpar pedestrian infrastructure (2016). Challenges such poor pathways, poor connectivity to surrounding communities, and safety worries caused by congested traffic situations (2019). These studies highlight the persistent problems in public transport accessibility for non-motorized transport users in Indian cities, particularly in the context of metro stations. The findings demonstrate the need for improved planning and coordination between metro and non-motorized transport systems.

Near Delhi metro stations, there are a number of accessibility concerns for non-motorized transport users, including inadequate pedestrian facilities, a lack of designated bicycle lanes, and a shortage of space for bicycle parking (Shilpa Singh, 2017). Mumbai's metro stations have made it easier for non-motorized transport users to access them, but there are still issues with secure pedestrian crossings, a lack of bicycle parking, and poor connectivity between the metro and the neighbourhoods around it (Pranita Barve, 2016). Poor sidewalk conditions, a lack of dedicated bicycle lanes and insufficient lighting near Bangalore's metro stations all provide accessibility challenges for non-motorized transport users. The report also emphasised the necessity for coordinated transportation planning to increase accessibility (Rakesh Jain, 2016). For users of non-motorized transportation in Chennai, reaching metro stations presents difficulties. These issues included a lack of pedestrian-friendly infrastructure, insufficient bicycle parking, and insufficient integration of existing bike networks and metro stations (Gayathri Ramachandran, 2019). The difficulties non-motorized transport users in Kolkata have in getting to metro stations, such as the lack of designated bicycle lanes, risky road crossings, and inadequate pedestrian infrastructure. The analysis made clear the importance of giving pedestrian- and cyclist-friendly infrastructure first priority when designing cities (Priyanka Das, 2020).

In conclusion, the results of earlier studies reveal widespread problems with non-motorized transport users' accessibility to public transit in close proximity to metro stations in metropolitan regions. These include inadequate infrastructure, a lack of amenities like parking, safety concerns, and the need for more information and signs. The studies highlight the significance of integrating non-motorized transportation networks with metro systems and putting policies in place to improve non-motorized transportation users' accessibility and safety.

Identification of Analytical Methods and Tools for Accessibility Assessment:

By analysing the various studies, existing model Public Transport (PT) Accessibility advancements seen in Indian and other cities use a variety of analytical techniques and tools. 1) Geographic Information Systems GIS is frequently used to model and analyse PT accessibility. It aids in the mapping, analysis, and determination of the current PT infrastructure's coverage and connectivity to various locations. GIS also assists in detecting inaccessible locations and offering suggestions for improvements. 2) Tools for network analysis assist in examining the performance and connectivity of PT networks. In order to pinpoint bottlenecks, holes, and opportunities for improvement, it entails analysing the density, frequency, and interconnection of various transport routes and modes. 3) To quantify and gauge the degree of PT accessibility, a number of accessibility metrics are used. These indices indicate how simple it is to use public transit to go to various locations by taking into account variables like trip time, distance, frequency, and cost. 4) Origin-destination studies are essential for figuring out how people travel and what kind of transportation they require. These polls aid in determining the demand for PT services as well as popular routes and locations. The information gathered from these surveys helps with planning and PT accessibility optimisation. 5) In order to achieve effective multimodal integration, cities use analytical techniques and tools to examine the integration of various PT modes, including buses, trains, trams, and metros. These instruments evaluate the multimodal system's overall effectiveness, connectivity between interchange sites, and ease of switching between modes. 6) For demand forecasting assist in forecasting future travel trends and PT service demand. These models predict the demand for transport services by analysing a variety of variables, including population growth, employment distribution, and land use patterns. This data aids in planning and budget allocation for PT accessibility upgrades. 7) To simulate and assess various scenarios for PT accessibility improvements, simulation and optimisation techniques are utilised. These tools simulate the effect on accessibility measurements of changes in PT infrastructure, service frequency, and route planning. They aid in determining the most successful strategies and improving the results of PT accessible.

It's crucial to remember that depending on the resources, data accessibility, and priorities of each city, the specific techniques and instruments used may change. To promote equitable and effective mobility for all, the overarching goal is to evaluate and enhance the accessibility of public transport networks.

Identification of Research Gap:

The discrepancy between current research and earlier findings about non-motorized access to public transit in cities might be summed up as follows.

1. Numerous earlier research, taking into account the links and potentialities between the two modes of transportation either focused on public transportation accessibility or unrecognised transportation individually. Studies that investigate the connection between accessibility of public transportation and its effects on encouraging the use of non-motorized transportation are few and far between.
2. Prior research has frequently concentrated on particular facets of accessibility in public transport, such as the availability of infrastructure (such as bus stops and train stations) or the standard of services (such as regularity and dependability). However, there is a need for more thorough research that take into account other aspects of accessibility, such as temporal, economic, and physical considerations, in addition to user views and experiences.
3. While some studies have looked at accessibility of public transportation on a city-wide scale, little has been learned about how accessibility varies spatially within cities, particularly in relation to the infrastructure and use of non-motorized transportation. Understanding the spatial patterns of accessibility might help identify locations that may benefit from investment and improvement.
4. Prior research has mostly examined technical aspects of public transport accessibility in large cities, concentrating on infrastructure and service provision. However, it is important to take into account the socioeconomic aspects, such as income levels, educational attainment, and work possibilities, that affect the use

of non-motorized transportation. The development of focused programmes to encourage non-motorized transportation among various user groups can be aided by an understanding of these aspects.

5. While some studies have evaluated the short-term effects of enhancing public transportation's accessibility on the use of non-motorized transportation, there is a dearth of studies on the long-term outcomes. It is crucial to look at how long-lasting these improvements are and whether they have the potential to encourage people to use non-motorized forms of transportation.

Insights gained from filling in these research gaps can help urban planners, legislators, and transportation authorities to create more inclusive and sustainable transportation systems that encourage the use of non-motorized mobility in big cities and public transportation accessibility.

Conclusion:

There is a need for improvement in the accessibility of public transportation in major cities for non-motorized transportation. There is still much to be done, even if many towns have taken steps to provide room for non-motorized modes of transportation like bicycles, walkers and e rickshaw users. Metro areas require investments in infrastructure that encourages non-motorized transportation. This involves constructing designated bike lanes and sidewalks that are walker-friendly. Additionally, specialised areas for carrying bicycles should be included in public transportation networks, making it simpler for commuters to combine diverse forms of transportation. Accessibility improvements for non-motorized transportation on public transportation can offer a number of advantages. As more individuals choose environmentally friendly forms of transportation, it can lessen traffic congestion and pollution. It can also encourage physical activity and lessen sedentary commuting, which can lead to a better lifestyle.

Collaboration between the transit authorities, urban planners, and residents is essential to achieving this. Public education and awareness initiatives on the value of non-motorized transportation can influence people's attitudes and behaviours towards sustainable commuting. Overall, the government can and should create more inclusive and sustainable urban settings by giving non-motorized transport in major cities a first priority.

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