CHILDREN'S INDEPENDENT MOBILITY IN URBAN NEIGHBOURHOODS OF INDIA: A CASE OF KOLKATA

Ph.D. THESIS

by

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STUDENT'S DECLARATION

I hereby certify that the work presented in the thesis entitled **"CHILDREN'S INDEPENDENT MOBILITY IN URBAN NEIGHBOURHOODS OF INDIA: A CASE OF KOLKATA"** is my own work carried out during a period from July, 2016 to July, 2021 under the supervision of Dr. Gaurav Raheja, Professor, Department of Architecture and Planning, Indian Institute of Technology Roorkee.

The matter presented in this thesis has not been submitted for the award of any other degree of this or any other Institute.

Dated: 09.07.2021 **(MEGHA TYAGI)**

SUPERVISOR'S DECLARATION

This is to certify that the above mentioned work is carried out under my supervision.

Dated: 09.07.2021 **(GAURAV RAHEJA)**

Abstract

Children's independent mobility (CIM) has a direct impact on improving a child's cognitive skills, environmental resilience and connection with his/her neighbourhood. It also offers opportunities for an increased physical activity level among children. Despite these benefits, several international studies have indicated a widespread decline in the degree of CIM over the last three decades. At the same time, there is a sharp rise in overweight and obesity issues among children, especially in developing countries. Multidisciplinary researchers have argued that the built environment and socio-cultural transformations due to the growing pressure of urbanisation have resulted in children's restrictions on freedom to move. However, owing to the heterogeneous character of these environmental factors, the current state of research remains inconsistent in terms of their effect on CIM. It is attributed to the lack of similar methodologies used and the non-existence of standardised measurement for CIM. Additionally, it was found that a majority of these studies were carried out in developed countries, especially Europe, presenting a semi-picture of a global problem at hand. Narratives on CIM from developing countries remain limited and under-researched, especially in India.

To address the gap, this study, for the first time, aims to generate empirical evidence on the current levels of CIM and the influencing environmental factors within an Indian urban neighbourhood context. It approaches the topic adopting the previously used socio-ecological framework for examining the multi-level influences of socio-demographic, built and social environmental factors on children's mobility. The study follows a comparative case study approach as a methodology by taking the case of five neighbourhoods across three distinct typologies in the eastern metropolitan city of Kolkata.

Each child's neighbourhood was operationalised using the buffer method. The definition of 'neighbourhood' was adopted as an area within an 800 m pedestrian network buffer around each child's home. Further, the study intended to include school as one of the destinations within a child's local surroundings; therefore, only children and their families residing within 800m of school were considered. The purposive sampling technique was employed to collect the cross-sectional data from 673 children aged 7-12 years and their parents belonging to middle-income households. A total of seven schools agreed to participate in the study across five distinct neighbourhoods. These five neighbourhoods are broadly categorised under three

typologies of low-rise (Khidirpur and Behala), mid-rise (Salt Lake Sector 1 and 3) and high-rise (Action Area I, New Town) neighbourhoods.

To collect data on CIM and neighbourhood environmental variables, tools were first finalised and validated by conducting expert reviews and pilot testing in a neighbourhood context of Delhi. This process assisted in contextualising the existing scales for measuring CIM licence and destination within Indian context. At the same time, a total of seven neighbourhood built and social environment variables were finalised. The built environment (BE) variables included land-use mix, street connectivity, traffic exposure and residential density. In order to obtain data for calculating these variables, a GIS dataset containing street networks and land-use were developed for each neighbourhood separately using ArcGIS 10.7.

On the other hand, social environment (SE) variables which included neighbourhood cohesion, connection and safety, were obtained using an online survey method with parents. Further, semi-structured interviews were also conducted with consenting and available parents to obtain insights on their overall understanding of CIM as a concept. For analysis, both CIM licence (obtained from parents) and CIM destination (obtained from children) were analysed separately. Chi-square tests were conducted to check the association between both the measures of CIM and socio-demographic variables (child's age and gender, parent's gender, qualification and employment status, family type and vehicular ownership). Multi-nominal logistic regression in case of CIM licence and binary logistic regression in case of CIM destination was employed for assessing their relationship with neighbourhood BE and SE variables. Lastly, data obtained from parental interviews were analysed using content analysis.

The majority of high CIM levels (CIM licence scores and CIM destination ratios) were obtained from low-rise neighbourhoods. In contrast, the majority of low CIM levels were obtained from high-rise neighbourhoods. Overall, the results reflected a declining trend in CIM across all neighbourhood typologies. Even among neighbourhoods with higher CIM levels, the overall share was less than 50%, raising alarming concern for children's mobility experience in Kolkata.

Among socio-demographic factors, except child's age, other variables (child's gender, parent's gender, qualification, employment status and family type) were not found to be significantly impacting CIM. The most liberal independent mobility licence across all neighbourhoods was 'going to places within walking distances other than school'. This was

most prevalent in low-rise neighbourhoods, with more than half of children granted this permission. The least liberal licence across all neighbourhoods was ‘using public transport alone’. In terms of destination, the highest percentage of independent mobility trips was for parks or playgrounds (40%), followed by the local street (36%). Interestingly, only 17% of children enjoyed independent commuting to school, a figure relatively low compared to various developed countries.

In terms of the relationship between CIM and neighbourhood BE and SE, notable findings emerged. ‘Land-use mix’ was revealed as an influential variable impacting CIM positively. It was further supported by parental interviews, which revealed a positive relationship between walkable child-specific destinations and higher CIM. On the other hand, ‘traffic exposure’ was found to be negatively impacting CIM, especially within low-rise neighbourhoods. ‘Social cohesion’ and ‘neighbourhood safety’ were the only SE variables having a significant effect on CIM within all neighbourhoods, respectively. Overall, parental CIM licence tends to be more affected by the neighbourhood BE while children’s actual independent mobility tends to be affected by neighbourhood SE.

The study's most novel findings were the emergence of neighbourhood ‘verticality’ and ‘spatial growth’ as important predictors of CIM. The findings suggested that low-rise or mid-rise residential neighbourhoods offer a higher degree of safety perception among parents or caregivers than high-rise neighbourhoods. Similarly, organic spatial growth with a high land-use mix than grid or geometrically planned growth was found to be more beneficial for a higher CIM. Further, findings also reveal that a sustainable neighbourhood that offers comfort to families to stay for generations is an indicator of a healthy and positive social environment that adds to CIM's supportive elements.

Overall, this thesis weaves a narration unfolding different macro and microsystems layers affecting children’s independent explorations across distinct neighbourhood typologies. Concludingly, this study, by providing a case of one megacity, initiates an intense discourse on children’s mobility in a country with enormous diversities within social, cultural and urban environment structures. Simultaneously, it calls for large-scale data on CIM identifying patterns for creating an effective child-friendly environment for independent mobility at local levels.

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List of Abbreviations

Abbreviation	Definition
BE	Built environment
BMC	Bidhannagar municipal corporation
BvLF	Bernard van Leer Foundation
CBD	Central business district
CFC	Child friendly city
CFCI	Child-friendly cities initiative
CFSC	Child-friendly smart cities
CIM	Children's independent mobility
CVI	Content validity index
DRC	Declaration of the rights of the child
ECF	Environmental child friendliness
EWS	Economically weaker section
GIS	Geographic information systems
GUIC	Growing up in cities
I-CVI	Content validity index for individual item
IPT	Intermediate public transport
IRC	Indian road congress
IT	Information technology
ITCN	Infant, toddler and caregiver friendly neighbourhood
KMA	Kolkata metropolitan area
KUA	Kolkata urban agglomeration
NIUA	National Institute of Urban Affairs
NPAC	National plan of action for children
PAMP	Parking area management plan
PPGIS	Public participation geographic information system
S-CVI	Content validity index for scale
SDG	Sustainable development goal
SE	Social environment
SPSS	Statistical package for the social sciences
UA	Urban agglomeration
UN	United Nations
UNCRC/CRC	United Nations Convention on Rights of Child
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNICEF	United Nations International Children's Fund
VIF	Variance inflation factor
WHO	World Health Organisation
WSB	Walking school bus

Nomenclature

Term/Symbol	Definition
Km	Kilometre
m	Meter
CI	Confidence interval
SD	Standard deviation
%	Percentage
OR	Odds ratio
p	p-value, statistical significance
χ^2	Chi-square
n	No. of participants from a neighbourhood
z-score	Standard score is the number of standard deviations by which the value of a raw score is above or below the mean value of what is being observed or measured.

List of publications

Peer-reviewed journal publications

1. Tyagi, M., Raheja, G. (2020) Indian parents' perception of children's independent mobility in urban neighbourhoods: a case of Delhi. *Children's Geographies*. Taylor & Francis publication. https://doi.org/10.1080/14733285.2020.1797996 [First publication on CIM from India]

2. Tyagi, M., Raheja, G. (2021) Children's independent mobility licence and its association with the built and social environment: A study across neighbourhood typologies in Kolkata. *Children's Geographies.* Taylor & Francis publication. https://doi.org/10.1080/14733285.2021.1891526. [First publication on CIM Licence and its association with neighbourhood environment from India]

Peer-reviewed international conference publications/acceptance

3. Tyagi, M., Raheja, G. (2020) "Are children independently mobile to school anymore?" A comparative study of two neighbourhoods in Kolkata, India. In J. Rodríguez Álvarez & J.C. Soares Gonçalves (Eds.) Planning Post Carbon Cities. *Proceedings of the 35th PLEA Conference on Passive and Low Energy Architecture*. A Coruña: University of A Coruña. DOI: https://doi.org/10.17979/spudc.9788497497947. ISBN: 978-84-9749-794-7.

4. Tyagi, M., Raheja, G. (2021) Understanding children's independent mobility through the lens of universal design: a case of Delhi, India. In I. Verma (Ed.) Universal Design 2021: From Special to Mainstream Solutions. *Proceedings of the 5th International conference on Universal Design, UD2021,* Aalto University, Finland. IOS press. doi:10.3233/SHT1210411.

5. Tyagi, M, Raheja, G. Children's independent mobility to local destinations beyond school: a case of two neighbourhoods in Kolkata, India. Paper accepted to be presented in the *10th Child in the City World Conference 2020,* Dublin, Ireland. (Conference postponed from September 2020 to 2022 due to COVID19 pandemic) https://www.childinthecity.org/2020-conference/

International conference poster presentation

6. Tyagi, M. (2019) Children's independent mobility in urban neighbourhoods. Poster presented in the *International Conference on 'Re-imagining Urban Childhood'*, New Delhi. Organized by NIUA (National Institute of Urban Affairs, Government of India) and BvLF (Bernard van Leer Foundation, Netherlands) https://smartnet.niua.org/content/3afd6e23-c9ff-40bb-8aa2-3ffc2aeec48c.

Chapter 1

Introduction

"Little by little, they disappeared from the streets – no alarm was raised, so subtle was the shift. They were confined to enclosed spaces, held captive for their own safety, all trace of them slowly erased from the common landscape. Think back, try to remember, how long has it been since you last saw a child playing on the street?"

-María José Carmona,
"From productive to kind cities: new urban planning that wants to change the world" (2020)

Chapter 1 Introduction

The Chapter outlines the overarching research rationale, questions, aim and objectives as well as the overall structure of the thesis. The focus remains on the brief introduction on the development of children's independent mobility as a concept and flow of methodology adopted by the research.

1.1. Research Background

For a very long time, 'children' and 'mobility' were never viewed as converging subjects of interest. The goal of 'mobility' was to move people from one point to another. Transportation planners majorly focused upon the needs of an adult male car user moving around the city for work (Tranter, 1994). Children, along with other disadvantaged groups (women, elderly, persons with disability) were hardly considered prime users of this system. In fact, with the rise in industrialization and private motorcar ownership, the long tradition of children playing informally on streets and shared spaces suffered an irreplaceable loss (Ferguson, 2019). Gradually, this deterioration of child-neighbourhood interaction became the focus of literature in planning, sociology and psychology domains (Gaster, 1991). The turning point came with the landmark study by Hillman and colleagues (Hillman et al., 1990) that provided empirical evidence on the generational decline of children's independent mobility (CIM) to school in London. It introduced the concept of CIM as 'children's freedom to move around their local surroundings without adult supervision'. It took into account parent's self-reported independent mobility permission levels or 'licenses' as a barometer to identify the existing status of CIM to school. The study revealed that children were deliberately restricted by their caregivers to move around freely in response to the rising dangers of traffic on street. This study drawing international interest was able to emphasize the need for investigation on children's everyday mobility in neighbourhoods as illustrated in Figure 1.1.

A decade later, the resurgence was seen on this topic among multi-disciplinary researchers owing to the alarming factors of the rise in global rates of childhood obesity, physical inactivity and society's dependency on motorized vehicles (A Carver et al., 2013). Incidentally, the global movement for child-friendly cities triggered as an outcome of various international initiatives like the United Nations Convention on the Rights of the Child (UNCRC) act, Sustainable Development Goals (SDG no. 11) and the New Urban Agenda (Habitat II). Eventually leading to several studies

(Fyhri et al., 2011; Ben Shaw et al., 2015) adopt Hillman's methodology and examine the existing children's mobility licenses against the previously reported levels. A strong link was found between children's freedom to move and higher rates of cognitive skills, spatial awareness (Marketta Kyttä, 2004); as well as increased environmental resilience and overall physical activity levels (Mackett, 2007). However, despite such benefits, data from international studies consistently reflected the decreasing rates of CIM, in line with the results of Hillman's study. For example, in New Zealand, the number of children travelling to school by car was found to have increased from 31% to 59% over the past 20 years (Hannah Badland et al., 2015), while in Australia, more than 50% of children were using the same mode to reach school (A Carver et al., 2013) and just over 20% of German and Portuguese children were travelling independently to school (Cordovil et al., 2015b; J. Scheiner, Huber, O., Lohmüller, S., 2019). This empirical evidence suggested the probability of other plausible explanations for the existing trend, beyond parental fear of motorized traffic.

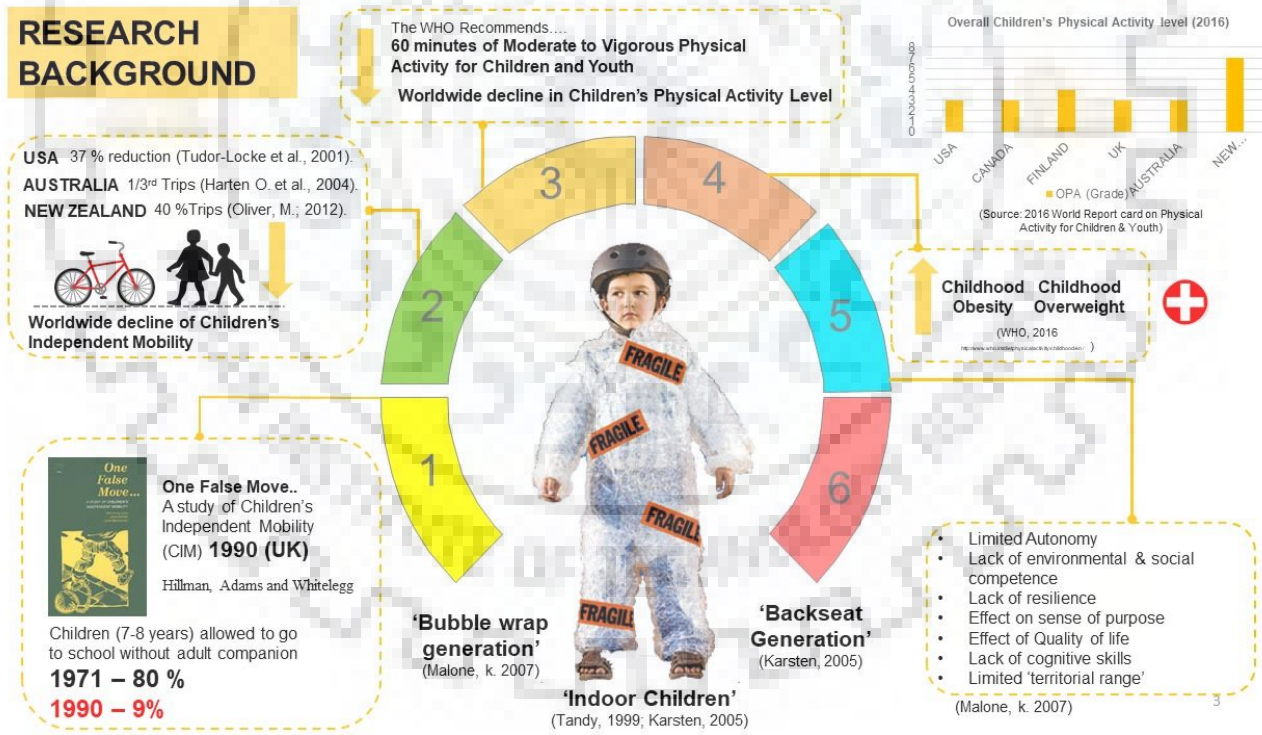


Figure 1.1 Summary of research background (Source: author)

Hillman and colleagues cited the significance of neighbourhood physical planning and cultural differences by conducting a comparison with Germany, as critical influencing factors affecting

parent's decision for children's mobility. Several conceptual models were later developed based on a socio-ecological framework (Brofenbrenner, 1994; Sallis et al., 2006) that incorporated a wide range of influences on CIM at multiple levels. Martin and Wood (Martin & Wood, 2014) conceptualized that parent decision-making for CIM is impacted by perceived and objective built-environment factors, socio-cultural environments and individual environments. Similarly, Pont et al. (Pont et al., 2013) and Oliver and Schofield (M. Oliver, Schofield, G. , 2010) examined multiple levels of influences on children's active travel and physical activity. Advancing on these frameworks, Badland (Hannah Badland et al., 2015) proposed a more robust system model that embraced the interdependencies of various influencing factors, instead of only considering their linear relationships. These factors stretched from the immediate (individual, household, neighbourhood) to distal (societal culture, policy, rule and regulations) environment of a child's everyday life. The built-environment factors which were found to be significantly associated with CIM within literature (Sharmin & Kamruzzaman, 2017) are broadly categorised as (i) distribution of land-use pattern (e.g., land-use mix, distance to destination); (ii) street design pattern (e.g., intersection density, traffic volume); and (iii) settlement pattern (urban vs suburban), establishing the fact that planning and design of urban neighbourhood are crucial in supporting or restricting CIM. On the other hand, the social-environment factors included parent's neighbourhood perception, preference for active travel and attitude towards CIM. Also, the effect of individual and household factors (children's age, gender, older sibling, skill to travel independently as well as parent's education, working status, family type, household income and vehicular ownership) were given equal consideration for understanding CIM in a comprehensive manner.

Presently, owing to the heterogeneous character of these environmental factors and their complex relationships, the existing state of CIM research remains inconsistent in results. It is attributed to the lack of similar methodologies used and non-existence of standardized measurement for CIM (Bates & Stone, 2015; I. Marzi, Reimers, A. K., 2018). Additionally, it was found that a majority of these studies were carried out in developed countries, especially Europe (Sharmin & Kamruzzaman, 2017), presenting a semi-picture of a global problem at hand. Narratives on CIM from developing countries remain limited (Bhuyan & Zhang, 2020; J Rudner & Wickramaarachchi, 2013) and under-researched, especially in India.

India is home to the world's largest population of children, a majority of whom, live in diverse geographical and socio-cultural urban areas of the country. Being one of the main signatories to the UNCRC act since 1992, India has recently launched child-friendly smart cities initiative (CFSC) under the Ministry of Housing and Urban Affairs (MoHUA), Government of India. Still, at a nascent stage, CFSC recognizes mobility and safety as one of the crucial components for creating a child-friendly environment. It focuses on the built environment factors of street connectivity, traffic volume, distance to destination and walkability as vital elements influencing parent's perception of their surroundings and their degree of granting children more freedom to move. Under the same initiative, design guidelines for 'Infant, toddler and caregiver-friendly neighbourhood' (ITCN) were introduced emphasizing on streets as an important 'third-space' for children's well-being. Despite such efforts, these policy documents are based on literature than field-based evidence from Indian cities. One of the reasons is the adult-centric focus of existing research in active commuting within urban neighbourhoods (D. Adlakha et al., 2018), while the needs of children and young adolescents are only assessed in reference to their play provisions within local surroundings (Bahadure & Kotharkar, 2015; Bhonsle & Adane, 2016; S. Chatterjee, 2018).

To address this gap, the research aims to generate empirical evidence on the current levels of CIM and the influencing environmental factors within an Indian neighbourhood context. It advances the topic using the previously used socio-ecological framework for examining the multi-level influences of socio-demographic, built and social environmental factors on children's mobility.
The research follows a comparative case study approach as a methodology by taking the case of five neighbourhoods across three distinct typologies (low-rise, mid-rise and high-rise) in the eastern metropolitan city of Kolkata. Overall, it intends to identify key factors supporting CIM while exploring participatory methods with both children and parents. Finally, it believes that children form an extreme bracket of our society at large; creating facilities for children will ultimately benefit all the users of society.

1.2. Significance of the Research

The key significance of the research is in terms of the contribution to the growing body of literature on CIM, representing countries from the Global South. Previous studies from these countries have majorly reported on children's outdoor activities in relation to their urban neighbourhood

(Mohammed Zakiul Islam, 2008), diversity in CIM (Bhuyan & Zhang, 2020) and spatial behaviour of CIM (Putri, 2019). By complementing the earlier works, this research also directs the flow of children-environment research towards the urban issues of their independent mobility, simultaneously positioning India on the emerging map of CIM domain.

Empirical evidence is generated not only on the existing mobility permission levels but also on children's mobility characteristics (mode of transport and accompaniment status) to school and non-school destinations in an Indian context. Advancing from the previous work of examining the influence of urbanisation levels (Lopes et al., 2014), this research brings a new variable of 'neighbourhood spatial growth' into the discussion, which also influences CIM to a great extent. It takes into account the rich historical, political, economic and cultural layers of Indian neighbourhoods contributing heavily on parent's perception, which in turn affects children's freedom to move.

Additionally, a key methodological strength of this body of work centres around the participatory approach, which is also replicable in other parts of the country. Data from children and parents were obtained by employing survey techniques, adopted and modified from international scales, keeping in view the contextual challenges. Besides, the combined use of parent's perceived information and quantitative data from spatial modelling using GIS for formulating neighbourhood design interventions is one of the earliest in India.

Overall, the research assists in identifying neighbourhood planning and design factors that promote cohesive, safe and inclusive neighbourhoods for children's independent mobility, reviving children-neighbourhood interactions for their overall well-being and development.

1.3. Research Questions

The research questions address the more general issues of contemporary neighbourhood design as it relates to children's needs for independent mobility. The questions present a broad framework for the research and are aimed to provide an evidence-based conclusive statement. The primary research question is:

'What is the relationship between CIM and neighbourhood environments within an urban Indian context in a metropolitan city?'

This research question is further sub-divided into two parts:

1. What is the relationship between CIM and built-environment of urban neighbourhoods?
2. What is the relationship between CIM and social-environment of urban neighbourhoods?

1.4. Aim

To study and investigate the relationship between CIM and distinct urban neighbourhood environments in a metropolitan city context of India.

1.5. Objectives

To achieve the above aim, following objectives are formulated:

1. To understand the theoretical and empirical relationship between CIM and urban neighbourhoods.
2. To identify the CIM levels to local destinations within distinct typologies in an urban Indian context.
3. To analyze and compare the influence of objectively measured built environment (BE) and perceived social environment (SE) on CIM levels across distinct neighbourhood typologies.
4. To propose strategies and guidelines for the design of urban neighbourhoods that support CIM.

1.6. Thesis Delimitations

This thesis establishes some delimitations to narrow the scope of the current research, which are described by the following points:

1. The research was conducted in Kolkata and as such results may not be generalizable to other regions in India. Specifically, due to the unique socio-demographic and cultural context of Kolkata.
2. This research was cross-sectional with children within the age group of 7-12 years from middle-income families.
3. The research restricts itself within the three neighbourhood typologies based on their verticality: low-rise, mid-rise and high-rise.
4. Several definitions exist to operationalize neighbourhood in an Indian context. In this research, each child's neighbourhood was defined as the area within an 800 m pedestrian network buffer around his/her home.

5. The investigation of children's mobility includes their independent (alone or with friends or sibling below the age of 18 years) walking or cycling or use of any public transport for commuting to school and local non-school destinations.
6. Children's preferred route choices, route taken for local destinations, distance travelled, and route characteristics are beyond the scope of this research.

1.7. Research Methodology

The research methodology developed to achieve research objectives is presented in Figure 1.2 in sequential order. The need for this research developed due to the fundamental concern of childhood happening in the existing urban fabric of cities wrapped within a fragile cover restricted from the outside world. Researchers across the globe were reporting on the negative impact of rapid urbanisation on children's well-being and the city's lack of preparedness. Therefore, 'children are the key users of our urban environment' became a point of reference for the initial literature review. The review assisted in understanding the fundamentals of children-environment relationship while also identifying key studies, terminologies, theoretical domains, sub-themes and data collection tools. The sub-themes were broadly categorised as children's 'outdoor physical activity', 'independent mobility'; 'health and well-being'; 'perception and experience'; and 'outdoor behaviour'. The key data collection tools were categorised as 'observatory', 'participatory', 'self-engaging'; and 'mapping'.

Further, to gain field-based evidence of the problem, the literature review was followed by expert discussions and a preliminary study in Gurugram. Conducting informal discussion sessions with two national experts at an early stage proved to be extremely beneficial in providing insights into India's urban issues concerning children. Similarly, a preliminary study assisted in research tool testing and supported in evolving stakeholder rapport building skills, age-specific observations, and understanding the ground issues faced by parents or caregivers. In the end, owing to the significance of mobility and its overlapping impact on other dimensions of children's everyday life, CIM was selected as the focus of the research at a neighbourhood scale.

CIM theories, definition, debates, benefits, indicators and its influencing factors were critically reviewed. It led to the generation of a chronological timeline spanning across different countries along with the review of their existing policies and guidelines supporting CIM. Besides, an overview of the neighbourhood concept and its evolution was also reviewed, followed by its

linkages with CIM. This exercise laid the foundation for developing a theoretical and conceptual framework and the formulation of key question(s), aim and objectives of the research.

Before moving forward with the data collection, a three-step process was adopted to finalise the research design. The first step included revisiting the literature to identify CIM measuring tools and neighbourhood variables influencing CIM. The second step included validating the variable scales by conducting semi-structured interviews and obtaining content validity index (CVI) from a group of national experts. The third and final step included applying data collection tools on-field by conducting a pilot study in the capital city of Delhi. This three-tier approach aided in finalising and contextualising seven influencing variables and two CIM indicators for India.

Once the tools were finalised, it was decided to select two neighbourhoods of similar typologies from two or three mega cities in India and compare the results. However, since this was going to be one of India's earliest in-depth studies, it was decided to focus on one single megacity and diversify in terms of neighbourhood typologies. As a result, Kolkata was selected as the primary research site. As a city with more than 300-year-old history, Kolkata inherited an urban fabric interwoven with the complex layers of socio-economic, political and cultural factors. Months of reconnaissance study was carried out to identify, locate and understand the distinct neighbourhood typologies. Finally, seven schools from five neighbourhoods across three typologies of low-rise, mid-rise and high-rise neighbourhoods were finalised.

The data collection process was undertaken in four stages involving stakeholder surveys (children and parents), telephonic interviews (parents), GIS neighbourhood mapping and visual surveys of child-neighbourhood interactions. Each data set was first processed carefully and analysed using quantitative (Chi-square test and logistic regression) and qualitative (content analysis) methods. In case of an error, the data was processed again for final analysis. Further, data interpretation was carried out under three levels corresponding to the research objectives. Firstly, CIM levels were computed and compared for each neighbourhood. Secondly, the relationship between CIM and neighbourhood variables were investigated and then compared across typologies. Thirdly, by revisiting the literature, the results were compared with previous studies. The research concludes by presenting effective recommendations for existing and new neighbourhoods at all three levels of ‘urban design, planning and policy’.

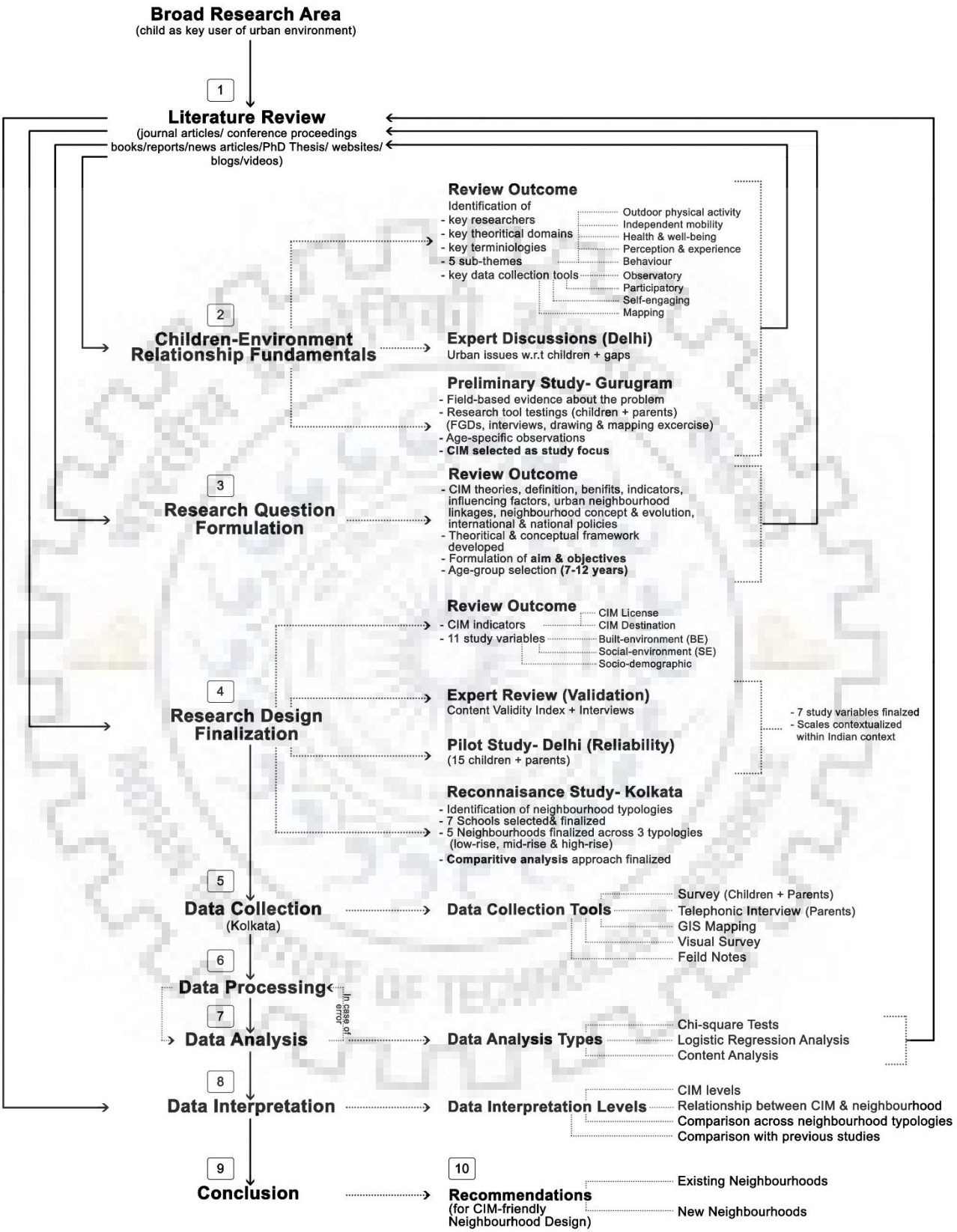


Figure 1.2 Research methodology

1.8. Thesis Structure

The thesis comprises of a total of seven chapters to address the overarching thesis question, that is to explore the relationship between CIM and urban neighbourhood. Overview of thesis structure in correspondence to research objectives is provided in Figure 0.3.

The rationale for undertaking the research is presented in this Chapter, followed by the state-of-the-art literature review in Chapter 2. This Chapter summarizes the theoretical concepts related to environmental child-friendliness by mapping the various studies conducted in the early twentieth century. It builds upon the concept of child-friendly city to explain the evolution of CIM and its current status across the globe. The role of the urban neighbourhood is further discussed through international initiatives, policy framework and case studies. Critical review assists in identifying the gaps while placing this work in the larger domain.

Chapter 3, acting as the thesis 'blueprint', describes the research philosophy, theoretical and conceptual framework that informs the research design of the study detailed in the next Chapter. Theoretical foundations are linked with the methodology followed by an elaborate on the conceptual framework developed for the research. Chapter 4 introduces the context of the research, its history, built and social environment while specifying the sampling strategy employed for data collection. The Chapter stretches from tool development, finalization of neighbourhoods, data processing to data analysis.

Chapter 5 provides the results of large-scale data analysis for both the measures of CIM used in the research. It presents the data across all five neighbourhoods in sequential order, which is discussed in the following Chapter 6. This Chapter forms the core of the thesis, explaining the results in comparison to the previous CIM studies. It describes explicitly the unique urban, social, cultural and political background of different neighbourhoods that affects CIM as a whole.

Chapter 7 includes suggestions to strategize interventions for design and planning of urban neighbourhoods to promote CIM. It concludes by acknowledging the methodological limitations of the research and provides direction for future investigations.

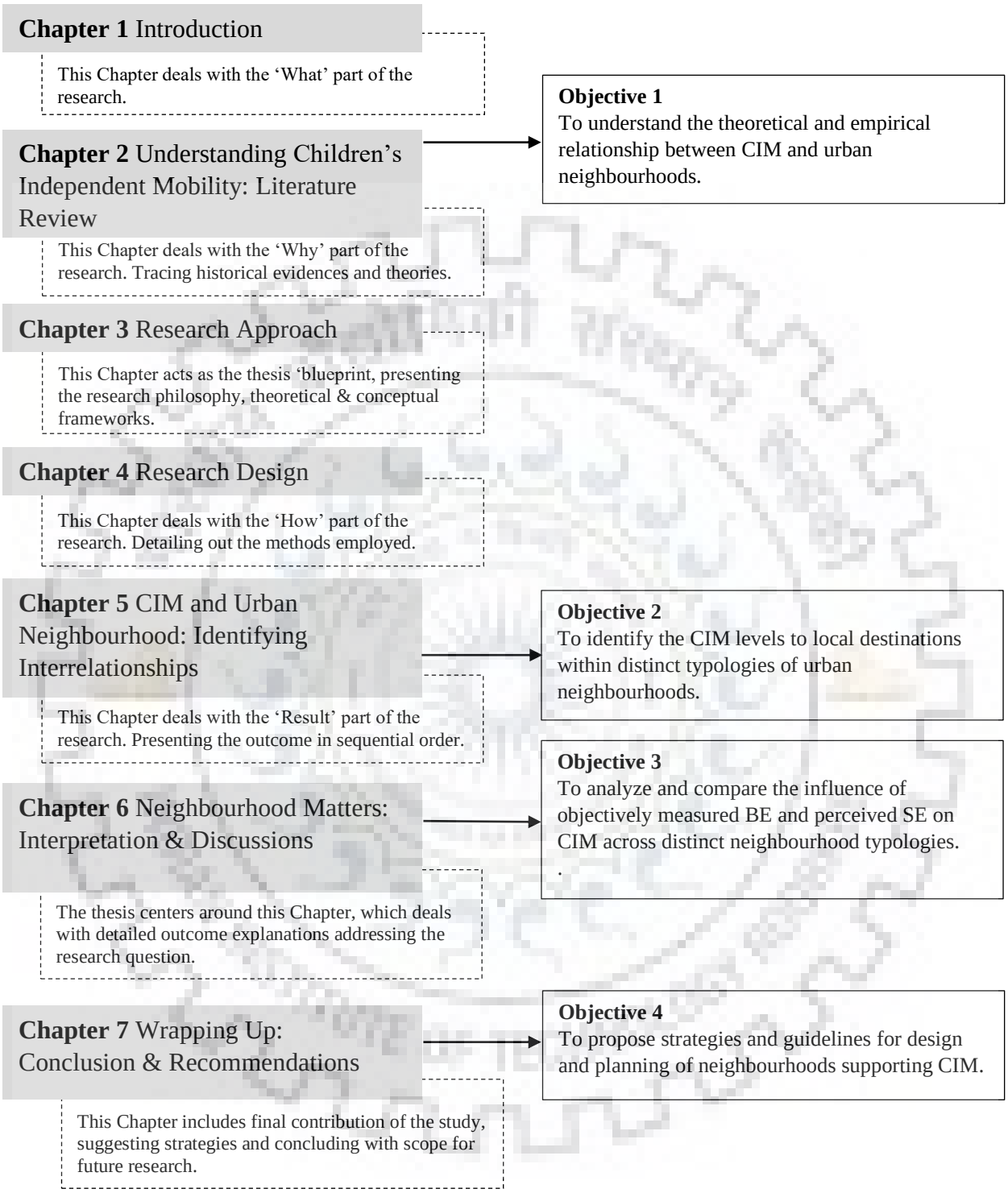


Figure 1.3 Thesis overview flowchart

Chapter 2

Understanding Children's Independent Mobility: Literature Review

'Our built environment is making kids less healthy, less independent and less imaginative. What those hungry brains require is freedom.'

- Alexandra Lange,
'The Design of Childhood' (2018)

Chapter 2 Understanding Children's Independent Mobility: Literature Review

This chapter presents a review of the current status of CIM and urban neighbourhood studies adopting a thematic structure. Themes are generated to logically and clearly explain the conceptual and methodological development of CIM since last three decades. Simultaneous development in international and national policies are discussed to offer a legal lens to the problem. Gaps are identified, and the chapter concludes by summarising the knowledge while positioning this research within the larger domain.

2.1. Children and Environment

Children experience their environment differently from adults. Social scientists often use the word 'environment' that includes physical, social, cultural, political and economic aspects in the context of children's lives. These multi-layered aspects shape children's environment, providing them unique experiences that in turn, shapes their intellectual and emotional development. For adults, different environments have different pre-defined functions with often rigid distinctions. Paula Lillard (Lillard, 1972) distinguishes this approach by clearly stating that children view environment as spatial explorations and thus use it in improving themselves, while adults use their knowledge to improve environments. Environment is therefore referred to as the 'third teacher' (Strong-Wilson & Ellis, 2007) and an educational aid (Day & Midbjer, 2007) by many researchers. Psychologist Jean Piaget (Piaget, 1955) even establishes that children below the age of 6 years largely gain knowledge from experiences than instructive methodology.

Interest in children and environment grew from 18th century onwards when Romantic literature explored the theme of children and nature. 19th century saw the interests of social science researchers on children's welfare living and providing an exploitative form of labour in the industrial cities. In the 20th century, multidisciplinary fields developed separate forms of inquiry, adopting a mix-method approach to understand the impact of built and designed environments on children's physical, cognitive, social and emotional needs. This era saw a rise in families leaving core cities for suburban areas following post-world wars leading to increase in child-centric studies conducting post-occupancy evaluations. At the beginning of 21st century, due to the rapid rise in urbanisation, vehicular traffic and children's adiposity, 'children and environment' became an

active area of inquiry seeking solutions for a sustainable environment for children's overall well-being (L. Chawla et al., 2012). The following section furthers this discussion by mapping the shift in society's attitude towards children from 'disturbing element', 'vulnerable' to 'active citizens' leading to the development of environmental child-friendliness as an area of research. Figure 2.1 provides a summary of critical writings on children and environment since the 1950s.

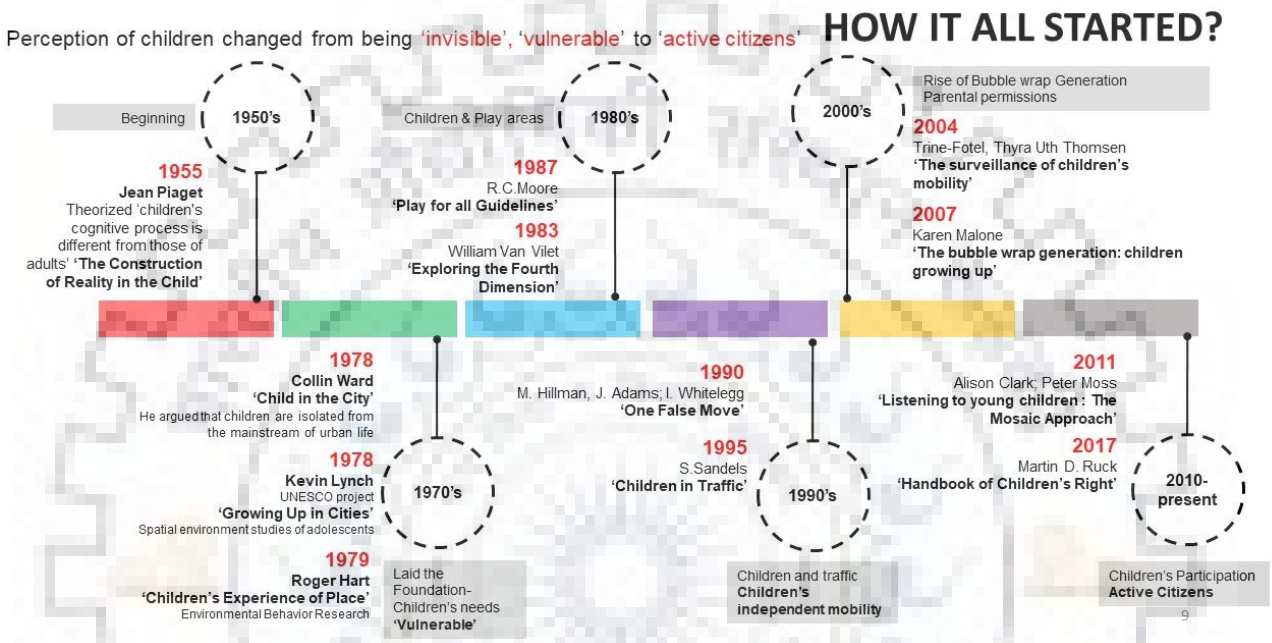


Figure 2.1 Summary of key writings in the field of children and urban environments (Source: author)

2.1.1. Theories of Childhood: Shifting Perspectives

Children are historically defined and understood in several ways across societies and cultures. The theories of childhood inform the way adults viewed, treated and interacted with children. James and colleagues (James et al., 1998) refer to various theoretical models of childhood into two categories: Pre-sociological and sociological. A critical distinction between the two lies with the former viewing children as 'adults in the making' and latter seeing children as 'active social agents'.

The pre-sociological models initially viewed children as 'disturbing elements' to an adult's social order in the absence of control and discipline (Phillips, 2010). School systems were thus developed to discipline with the expectation that over time children will become responsible adults in later life (James et al., 1998). Through instructional curriculums and rigid timetables, no space or value

was given to children's opinions and interest. Such regressive systems eventually led researchers to view children as 'blank slates' (Luke, 1989), having no knowledge or experience to form any meaningful opinion of their own. Based on this view, adults assume higher status and exercise control over children, influencing social policies in western societies to label children as 'incompetents' (Morrow, 2002). With societal and environmental changes in the early 20th century, adult's guidance translated into restrictions in the name of protection and care of ignorant or incompetent children. Thus, establishing the viewpoint on children as 'vulnerable', requiring constant protection against the outside world.

It was the advent in the rise of sociological models of childhood that children were viewed from the perspective that they share equal space with adults (Corsaro, 2005) and thus can be considered as 'competent social actors.' Children were understood as inhabiting an autonomous world separate from adults, where they are capable of making their own decisions. Thus, they are born with civil, political, social and economic rights as proved by the launch of United Nations Convention on the Rights of the Child (CRC, 1989) act as the first human-rights treaty to explicitly recognise children's civil rights (Upadhyay, 2008). Currently, because of these developments, children all across the domain of practice and research are considered as 'active citizens' capable of collaborating in the decision-making process related to their surrounding environments.

2.1.2. Environmental Child-friendliness

The interest towards children and environment grew with the attitudinal shift towards viewing children from 'vulnerable' to 'active citizens', leading to researchers identify environmental child-friendliness (ECF) as a critical area of inquiry. The literature offers an abundance of definitions for ECF, where the criteria of child-friendliness is broad, diverse and multi-layered (Broberg et al., 2013). One of the initial attempts was made by Horelli (Horelli, 2007) who defined it as 'the settings and environmental structures that provide support to individual children and groups who take an interest in children's issues so that children can construct and implement their goals or projects'. The resulting definition includes ten normative dimensions of housing and dwelling; essential services (health, education, transport); participation; safety and security; family, kin, peers and community; urban and environmental qualities; resource provision and distribution; poverty reduction; ecology; sense of belonging and continuity and lastly good governance. When

this framework was applied to children from different countries, only a few themes were found to be significant (Broberg et al., 2013).

Similar attempts to understand and define the scope of ECF was made through a rights-based approach by the child-friendly cities concept of UNICEF (United Nations Children's Fund). It encourages the local government to collaborate with children to create child-friendly environments (detailed discussion is provided in Chapter 2 section 2.4.1). In contrast to these two viewpoints, Chatterjee (S. Chatterjee, 2005) proposed a different theoretical construct of place friendship to evaluate ECF of any physical setting. She conceptualised six-dimensions of an environment from a socio-physical perspective for which children experience a friendly relationship. Empirical investigations were done using this place friendship framework at city and neighbourhood levels in different countries (Ramezani & Said, 2012), resulting in inconsistent outcomes.

To offer a fresh direction for a deeper understanding of urban structures promoting child-friendliness, Kyttä (Broberg et al., 2013) introduced a more focused model named 'Bullerby' to assess ECF. It is based on two central criteria: children's possibilities for independent mobility and their opportunities to actualise environmental affordances. The background understanding behind this model is that if more children are allowed to travel and roam around their local surroundings, more affordances will be actualised by children (detailed discussion is provided in Chapter 3 section 3.3.1). In line with the Bullerby model, this thesis investigates CIM for evaluating the child-friendliness of Indian neighbourhoods to promote their independent mobility.

2.2. Children's Independent Mobility (CIM)

2.2.1. Definition and Perspectives

CIM as a concept was first introduced through a significant study by Hillman and colleagues (Hillman et al., 1990) in London, describing it as 'children's freedom to move around their local surroundings without adult accompaniment.' It gave equal importance to destinations beyond home, school, and parks in children's daily lives often referred to as the 'fourth environment' (Vliet, 1983). However, the factor that separated an 'independent mobility' from a 'dependent mobility' was explicitly the presence or absence of adult in children's daily journeys. An understanding which was embedded among social scientists before the advent of technological intervention in the daily lives of children and families. So, when the interest towards CIM

momentously grew in the beginning of 21st century, it resulted into a debate behind the theoretical and conceptual underpinnings related to the definition of CIM.

One of the arguments put forward by Mikkelsen and Christensen (Mikkelsen, 2009) was that parent's use of telecommunication technology like mobile phones to monitor children adds a grey component to the black and white nature of 'independent' and 'dependent' mobility. In fact, they noted that dependency or independency in case of children's mobility is not a fixed attribute rather possess fluid characteristics. The said argument was based on the fact that accompaniment status also involves 'invisible actors', particularly children's peers, friends or pets. The assumption that only when a child is travelling alone without any adult accompaniment can be considered independent mobility ignores the activities of children in groups, rendering a cultural focus on individuality. Another study (Pooley, 2005) suggested that the perceived potential and experience of CIM cannot be solely examined on the basis of practical functions of moving for need-based activities involving journey to school or park. Instead, two other aspects of social and cultural functions (including mobility to meet friends, attend a social function etc.) of everyday mobility should be considered, which will further enrich the holistic understanding of CIM.

Hence, the existing literature suggests that CIM is a complex phenomenon which needs to be investigated from contextual perspectives. In this thesis, whenever a child undertakes a journey to school or other local destinations with friends or siblings (below the age of 18 years), but without adult accompaniment is considered independently mobile.

2.2.2. Benefits to Physical Activity

CIM offers immense benefits to children in improving their physical activity levels, life-long health and social outcomes. Physical activity is vital for children's muscular and bone strength, aerobic fitness, reduced risk of adiposity, motor skills and protection against chronic disease later in life (Hallal et al., 2006; Janz et al., 2010; Loprinzi et al., 2012). WHO recommends a minimum of 60 minutes of moderate-to-vigorous physical activity (MVPA) levels for children below 18 years (WHO, 2010). CIM offers the potential to increase daily MVPA levels of children (S. Schoeppe, Duncan, M., Badland, H., Oliver, M., Browne, M., 2014). Since children with higher CIM levels interact more with their peers (both indoors and outdoors) and their territorial range is far greater, their unstructured movements are more than children having less CIM levels. Several

studies had provided empirical evidence confirming that with an increase in CIM, overall physical activity increases (Page et al., 2009; S. Schoeppe et al., 2013; Stone, 2014).

CIM in the majority of these studies is overlapped with active travel. Active travel (use of walking or cycling) is a part of CIM. Studies investigating the relationship between CIM and physical activity majorly did not consider public transport as a mode of commuting. Additionally, research has even pointed out that instead of examining only the type of physical activity levels, intensities (moderate to vigorous) can also be examined for both structured and unstructured leisure activities of children (S. Schoeppe, Duncan, M., Badland, H., Oliver, M., Browne, M., 2014). Nevertheless, besides physical activity, CIM contributes to improving children's environmental competence, spatial awareness and cognitive skills to navigate risky situations (Julie Rudner, 2012) and adds to their overall wellbeing (Leung & Loo, 2017).

2.2.3. Indicators

CIM has been measured using various indicators in literature broadly classified by Sharmin and Kamruzzaman (Sharmin & Kamruzzaman, 2017) as CIM licence, CIM destination, CIM range and CIM time. CIM licence is described as the mobility permission levels granted by parents to their children. This is the first and most used indicator within empirical studies. As there might be differences between permission levels given to children and their actual mobility behaviour, the second indicator is used as CIM destination. This is primarily based on destination types such as market, friend's house, park etc., which provides data on children's actual mobility. In line with this, the third indicator of CIM range includes the territorial distance from the child's home. Parents are often asked to indicate a range till which they can allow their child to exercise his/her right of independent mobility. Several studies have even adopted a comparative approach to examine the reasons behind these differences in range. The last indicator of CIM time considers the time spent independently outside of home by children. This is the least used and researched indicator within empirical studies.

Researchers agree that there is an overlap between all these four indicators and due to the heterogeneity among them, the most relevant indicator for CIM remains to be determined (I. Marzi, Reimers, A. K., 2018).

2.2.4. Influencing Socio-demographic Factors

Children's individual and household factors play an essential role in influencing overall CIM. Several studies have established that the probability of independent mobility increases with child's age (Ayllon et al., 2019; Cordovil et al., 2015b; Janssen et al., 2016; R. Mitra et al., 2014) and parent's trust on child's maturity level. The issues of 'trust and being trusted' (Rooney, 2010) are important for children's everyday independence, encouraging a favouring setting for liberal mobility limits. Although, child's age and maturity may affect CIM differently in different urbanisation levels (Lopes et al., 2014; J. Scheiner, 2016). A higher percentage of younger children from less urbanised environments (villages and small towns) were found to be more independently mobile than their counterparts from more urbanised environments (large towns, suburban and urban). Many studies also indicate that boys tend to experience higher CIM than girls (Fyhri & Hjorthol, 2009; Pacilli et al., 2013; Stephanie Schoeppe, Paul Tranter, et al., 2015). This difference is attributed to the universal parental fear of girls' safety from stranger danger (Alparone & Pacilli, 2012). However, few other studies did not find any significant gender differences (M Kyttä et al., 2015; Lopes et al., 2014).

CIM outcome is also found to be influenced by household factors such as parent's gender, education and employment status, but the results are mostly inconsistent. One study has suggested that comparatively, parents with lower education levels were less likely to permit greater distances for children's independent travel (S. Schoeppe et al., 2015). Few studies have even revealed that fathers are more likely to escort their children when both parents (fathers and mothers) are full-time working (J. Scheiner, Huber, O., Lohmüller, S., 2019). In fact, fixed-working hours tend to increase the likelihood of the child being escorted to school as many times temporal matching occurs between school and service sector (J. Scheiner, 2016). While other studies establish that dual-earning parents experience constraints in accompanying children to school or other local destinations, and hence such children have more freedom to move around unsupervised (He & Giuliano, 2017). A similar debate occurs concerning children's family type. It is found that children living in joint family systems tend to have greater independent mobility than nuclear family systems. Also, single-parent families offer more freedom to children's mobility than dual-parent families. As single parent finds it challenging to escort children everywhere to their daily local destinations and have to teach their children independence at an early age (J. Scheiner, 2016).

Moreover, children from high-status households measured by income, parental education, home and car ownership tend to have lower independent mobility as parents' fear of crime among this group is comparatively higher. As a matter of fact, car is seen as a more convenient and faster mode of transport especially for 'trip chaining' (A. Carver et al., 2019; Johansson, 2006; Witten et al., 2013) and when children's out-of-school leisure activity destinations are located at a greater distance from home.

A number of studies have also investigated the impact of having an older sibling, a family dog, child position within siblings and children having household keys on CIM. It is found that children are granted higher CIM licenses when they are accompanied by an older sibling or a family dog as it reduces the fear component among parents (Christian et al., 2016). It is generally assumed that moving with an older sibling (especially of the same gender) results in children gaining essential spatial skills to negotiate risky traffic situations, thereby building confidence to travel independently. Likewise, a dog can be considered as a non-adult accompaniment for children, offering company and increasing children's physical activity and CIM levels, supporting the above-discussed significance of 'invisible actors' in children's daily mobility.

2.3. CIM and Urban Neighbourhood Linkages

2.3.1. Neighbourhood Concept and Evolution

Neighbourhood concept was one of the significant landmarks in the literature of urban planning since the late 19th century. Its conceptualisation corresponds to the significant population growth and an increase in the size of urban agglomerations (UAs) post-industrial revolution (Moudon et al., 2006). Popularised in the 1920s, the neighbourhood unit concept is regarded as a descendent of Ebenezer Howards' Garden City concept introduced in England (Brody, 2013). Clarence Perry is much credited and celebrated as introducing this concept based on children and families being able to walk safely from their homes to elementary schools and community centres (Johnson, 2002). Perry's concept was essentially a combined synthesis from the concepts of sociology, architecture, urban planning and real estate development (Kallus, 2000). It also relates to the modern phenomenon of spatial division between residence and work, resulting in different social status among residents. In terms of its application, it guided post-World War II urban and suburban developments, especially in many American and European countries. Radburn in New Jersey is

cited as one of the prime examples that incorporated its urban design and planning principles successfully (Patricios, 2002). Since then, researchers from social sciences often viewed neighbourhood as a solution to urban social problems capable of generating communal relations.

However, the idea of neighbourhood as a residential model containing community facilities, parks, local shopping and housing for the population needed to support an elementary school as the central function was later seen by researchers as naïve and problematic (Kallus, 2000). Catherine Bauer (Bauer, 1945) termed it a racist and elitist concept, particularly relating it to affordable housing and urban renewal. Banerjee and Baer (1984) established that residents display little consistency in perceiving their surroundings as any type of social cohesive unit. In addition, Jacob (1961) and Alexander (1964) argued that neighbourhood unit concept fails to capture the complexity of organic social life. Such widespread criticisms and debates led researchers to re-look at neighbourhood from a social and ecological perspective. Advancing from its conceptual understanding, Galster (2001) defined neighbourhood as a bundle of spatially based attributes associated with clusters of residences sometimes in conjunction with other land uses.

In current times, it is understood that a single generalisable interpretation of neighbourhood does not exist. Rather, neighbourhood is a dynamic and ever-evolving concept, custom-made to fit the contemporary professional and theoretical context as they arise (Kallus, 2000). Broadly, neighbourhood exists in four different scales, each with its own predominant function and purpose (Suttles, 1972). First is the block face, or the area over which children can play without supervision. Second, the "defended neighbourhood" is the smallest area possessing a corporate identity as defined by mutual opposition or contrast to another area. Third, the "community of limited liability," is a district represented by a local governmental body, in which individuals' social participation is selective and voluntary. And fourth, at the highest geographical scale, the "expanded community of limited liability," covers an entire sector of the city. These scales combine neighbourhood geography and sociology and help conceptualise different interaction levels between neighbourhood environment and behaviour.

2.3.2. Operational Definitions of Neighbourhood

As seen earlier, conceptually neighbourhood is recognised as dynamic having multiple cognitive, economic, geographical, behavioural, cultural and temporal dimensions (Moudon et al., 2006).

However, moving beyond conceptualisation, defining neighbourhood has always been a complicated and contested process (Chaix et al., 2009; Coulton, 2012; Galster, 2001; Hasanzadeh et al., 2017). This is because neighbourhood boundaries are considered not physically static but as a shared entity among residents whose daily social interactions shape the meaning of place. Residents can embrace some of the surrounding space and disavow other parts of it, making it more or less relevant to their everyday lives (Coulton, 2012; Gotham & Brumley, 2002). Given this, researchers have argued and introduced several methods for operationalising the definition of neighbourhoods, especially for children, that can be categorised under four sub-heads as discussed below:

a. Territorial definition

Territorial neighbourhoods are often referred to as mutually exclusive areas that make up a territory (Guo & Bhat, 2007). Administrative areas or service catchment areas correspond to this territory-subdividing approach to neighbourhood delimitation. These pre-defined boundaries are easily identified, replicable, and allow for the use of secondary source data. However, its disadvantages rest in possible discrepancies with settlement patterns and resident perceptions of neighbourhood boundaries. In addition, exclusive reliance on secondary source boundaries may be inefficient for studies involving primary data collection, as it may be impossible to discern, prior to the start of data collection, if factors of interest are present in the selected geographic areas (Weiss, 2007). Therefore, researchers agree that territorial boundaries offer an imperfect operational definition for neighbourhoods in research and policy (Robert J. Sampson et al., 2002).

b. Resident's perception-based definition

In eco-epidemiological, psychological, social and behavioural research, the personal definition of a neighbourhood is given more consideration than territorial definition (Chaix et al., 2009). It relies on the participant's perception of a neighbourhood by adopting mental maps as one of the methods. Residents are asked to locate the area they consider a part of their neighbourhood usually based on their most frequent local destinations. Even in children studies within neighbourhood context, techniques to gather children's perception includes mapping methods (James C. Spilsbury et al., 2009), use of mobile phones (moblogging), boundary-marking and freehand map-sketching (Stanton Fraser et al., 2013).

Irrespective of the methods used, social sciences have long recognised that the scale of one's perceived or experienced neighbourhood is dissimilar for distinct individuals even if they reside in the same area. Researchers have also established that individual socio-demographic characteristics (e.g. length of residence, socio-economic position, etc.) shape neighbourhood scale (Chaix et al., 2009) and obtaining perspective from each participant is a time-consuming process.

c. Home-range based definition

Multiple studies related to children and neighbourhood have focused on the concept of 'home-range' (Aitken, 1994; Gaster, 1995; J. C. Spilsbury, 2005). This concept refers to the distance children travel away from home for play and other social activities. It is obtained by employing GPS or asking parents how far they allow their children to travel for play or other leisure activities. One study argued and demonstrated (James C. Spilsbury et al., 2009) that equating home range with perceived neighbourhood boundaries of children may not be an appropriate measure. Often, neighbourhood boundaries, in reality, are larger than the range children are allowed to go. Thus, although these approaches take promising steps toward defining child-specific neighbourhood boundaries, the rigidity originating from their purely distanced based nature contradicts the flexile characteristic of shared neighbourhood spaces.

d. Person-centric buffer definition

Another most common approach to operationalise neighbourhood boundaries is to draw buffers around each individual's place of residence. Different types of buffers are used, such as circular or elliptic zones, and road network buffers (L. N. Oliver et al., 2007). Different studies use various distances, using a threshold distance that is easily walkable from home location. The distances used vary from as small as 400 m (Jago et al., 2005), 500 m (Marketta Kyttä et al., 2016), through to as large as 1600 m (Christian et al., 2015). The choice of different distances employed remain arbitrary and often limited empirical data to support the choice of buffer size exists (Hasanzadeh et al., 2017). Furthermore, as Kytta et al. (2016) demonstrate, the buffers are not always inclusive, meaning that in many cases, individuals are exposed to vast areas which do not fall into these distances.

To overcome the limitations of these existing methods, a recent addition is seen in parametrically evaluating residents' neighbourhood perception by using SoftGIS methodology. It employs a

public participation GIS (PPGIS) method that combines internet maps with a traditional questionnaire (Brown & Kyttä, 2014). Thus, defining neighbourhood has evolved with time, and different methods are usually applied depending upon the study's context.

2.3.3. Children and Neighbourhood Relations

Defining 'neighbourhood' could be dynamic, but its profound effect on children shaped by their multi-layered interactions on a day-to-day basis remains constant. As discussed earlier, the research on environmental child-friendliness already underscored the need to develop settings and environmental structures supporting children's rights and interest while encouraging their friendship with place. Advancing on this point, since the last three decades, a child's place of residence or neighbourhood became a central point of interest among multidisciplinary researchers (Minh et al., 2017). One of the first claims in this direction was made from a bio-ecological perspective by Urie Bronfenbrenner's person-process-context time framework for human development (Bronfenbrenner, 1999). It suggested that a child's development change is a product of their sustained interactions with immediate and distal environment over time. In line with this, health literature also indicated that the way neighbourhoods are designed, and build can facilitate a healthier lifestyle and contribute to children's overall well-being (K. Villanueva et al., 2016).

However, the sociological lens took another route and tried to look at children's early development in relation to poverty in their residential areas (Wilson, 1987). This perspective suggested that neighbourhoods generate place-based inequalities in the distribution of social and environmental risks and opportunities for children's developmental health. Gradually, researchers began understanding children's neighbourhood as 'community open spaces and communal facilities that children consider as being especially important to them in terms of psychological, behavioural, and symbolic meanings' (Min & Lee, 2006). A study from South Korea found children living in high rise high-density neighbourhood preferring and using only those outdoor spaces that offered them meaningful experience and psychological benefits (Min & Lee, 2006). Similarly, a rich literature has emerged on the significance of neighbourhood green spaces on children's mental and emotional health (Flouri et al., 2014) as well as their quality of life (McCracken et al., 2016).

Despite these theories and evidence on the neighbourhood's effect on children's developmental health, they have limited to offer that can be translated in policy action (Minh et al., 2017). As a

result, majority of children's spaces and other urban settings are designed and developed without considering children's preferential needs, effecting their emotional connection with place (Oloumi et al., 2012). This work focuses on children's mobility needs in neighbourhoods by investigating the corresponding two fundamental factors of built and social dimensions. Next section will elaborate on their effect on CIM.

2.3.4. CIM and Built Environment

The interest in CIM and neighbourhood built environment research was initially generated by the first study (Vliet, 1983) that explored children's 'fourth dimension' beyond home, school and park. Since then, several studies investigated a range of built environment (BE) variables and assessed its impact on CIM to inform policies. In their meta-analytic review, Sharmin and Kamruzzaman (2017) found a total of 66 such variables, which were repetitive and representing only 13 distinct BE features. These were broadly categorised under two themes of (a) distribution of land-use pattern (proportion of residential land use, proportion of commercial land use, residential location type (urban-suburban), distance to destination, residential density, availability of recreational facilities and land-use mix); and (b) street design pattern (dead-end street, traffic volume, proportion of major road, intersection density, road density and street width). The most positively associated BE variables with CIM were dead-end street and proportion of residential land use. However, these results varied between developed and developing countries. For example, distance to destinations, mixed land use, and intersection density factors were a stronger CIM barrier in developing countries. In contrast, they have little to no effect in the context of a developed country. Apparently, only three studies from developing countries were examined in this review, all of which were from Bangladesh.

Another study (Qiu, 2017) instead of looking at BE variables as separate entities, proposed to examine it across community, housing and community-housing relationship levels. At a community level, it included walkability, residential density, access to public transport, increase in urbanisation, aesthetics and presence of specific local destinations (e.g. recreational venues and retail shops), while at housing level, it included housing type (public or private and apartment or one-family house) and location of housing on a busy road. The last level includes the overall distance to park and school from children's home. This conceptual framework was the first to comment on the lack of research in CIM studies across different housing typologies.

Despite the decades-long investigation in this area, there are statistical inconsistencies between various studies (Sharmin & Kamruzzaman, 2017; Smith et al., 2019). Plausible reasons for such outcome are substantial differences in study locations, study design, sample characteristics and CIM measurements. Nevertheless, the field is advancing, however, with examples being the development of new child-specific walkability measures (Giles-Corti et al., 2011; Karen Villanueva et al., 2013) and destination accessibility (H. Badland et al., 2015). For consistency and comparable outcomes among cities and countries, it is necessary first to standardise research design and measuring tools for different areas having similar built and social context, respectively. A similar issue occurs while examining social environment variables with CIM, as discussed in the next section.

2.3.5. CIM and Social Environment

Multiple definitions and measures of 'social environment' (SE) exists (Lochner et al., 1999; McNeill et al., 2006b). Coleman (1988) suggested that the most crucial dimension of SE for children's travel is the parent's perception of neighbourhood and neighbours, through which their assessment of risk is constructed within the environment. Globally, the impact of parental fear of traffic and stranger is extremely intense that directly affects their neighbourhood perception and in turn their decision on CIM (Christian et al., 2015; Foster et al., 2014; Lin et al., 2017). Traffic accidents are the leading cause of injury for children in developed and developing countries, validating parental concerns regarding traffic safety. However, threats posts by strangers are primarily grounded in the universal 'fear of crime'. Previous studies (Foster et al., 2014) have shown that 'fear of crime' among parents resulted from an emotional response impacted by numerous factors that include negative media reports and perceived vulnerability to crime than actual incidents within neighbourhood. News of child abductions and molestations broadcasted by several media channels attune parents to the extreme examples of child's harm in the outdoor environment (Foster et al., 2014).

There may be several factors that contribute to parental fears and concerns; here, the focus remains on the role of neighbourhood setting in generating such emotions. Evidence suggests that social capital defined as 'all networks and social connections that individuals accumulate throughout their lifetime, through sharing of common values such as social trust and reciprocity' (Porskamp et al., 2019) plays a significant role in encouraging CIM. Neighbourhood places such as local

street, shops, café and recreational activities regarded as important 'third places' foster social interactions and social cohesion among residents that might provide active support for neighbourhood children. This notion of 'social capital' extends to the idea of social cohesion and intergenerational closure or social connection (R. Sampson et al., 1997). While social cohesion refers to the trust, respect, and participation within a community, social connection is the degree of association between the adults and children living in the same neighbourhood(Lin et al., 2017). Thus, social capital is a multi-level active concept characterised as actions within networks by individuals (Lewis, 2010). It is relational, so there is an expectation of reciprocity resulting in trust as the outcome (Love et al., 2019).

Notably, parents with more extensive social networks and greater social integration into their local community, tend to grant higher CIM licenses (Foster et al., 2014; Johansson, 2006; Prezza et al., 2005; Prezza & Pacilli, 2007). There exist a strong association between parent's positive perception of social cohesion and connection within their neighbourhood and higher CIM (Lin et al., 2017; I. Marzi et al., 2018; N. McDonald, 2007; N. C. McDonald et al., 2010), both in urban and rural areas (Porskamp et al., 2019). Besides, benefits, there are certain downsides of social capital. High levels of social capital may place excessive demands on network members (Porskamp et al., 2019). For instance, societal consensus imposes the necessity of constant supervision of children as a result of heightened community perception of safety and crime (Christian et al., 2015). Additionally, it also defines the 'good parenting norms' where chauffeuring children to every place outside home is considered social responsibility resulting in a bubble-wrap generation (Malone, 2007) or back-seat generation (L. Karsten, 2005). Such norms also generate a shift in parental attitude and willingness to send their children independently to local destinations. Parents are more likely to allow their children to practice independent mobility if they have a positive attitude towards CIM (Stephanie Schoeppe, Mitch J. Duncan, et al., 2015).

Several previous studies (Foster et al., 2014; N. C. McDonald et al., 2010) also reports that girls are more likely to be affected by parent's negative or neutral perception of neighbourhood SE than boys. The apparent gender difference may be explained from early childhood, where boys are encouraged to be independent and risk-takers while girls are taught to be cautious (Morrongiello & Dawber, 1999). Thus, stranger danger possesses a greater barrier for girl's independent mobility than boys. In fact, the majority of times, the impact of parental fear of crime overrides the existing

positive social capital due to the global rise of over-protecting and risk-averse parenting styles (Foster et al., 2014).

Presently, several such outcomes and associations between SE and CIM licence or destination remain inconsistent (I. Marzi, Reimers, A. K., 2018). For example, the relationship between CIM licence and parent's perceived fear of crime and traffic were found to be different in different studies based in diverse geographic locations. Overall, it is concluded that SE attributes perceived by parents determine CIM more than neighbourhood BE. A similar result was found in a longitudinal study conducted in United Kingdom (UK) on children's independent walkability to school, where perception of neighbourhood was found to be impacting CIM more than objectively measured BE (A. Carver et al., 2014).

Thus, a need for programs aimed at educating parents about the real and perceived dangers concerning children's safety while travelling within local surroundings is called upon by researchers (Christian et al., 2015). Also, studies acknowledge that influencing social capital in itself is challenging and maybe even impossible from a regulatory standpoint, but with long-term commitment to gradually change the relevant social factors might consequently change the social capital levels itself (Porskamp et al., 2019). Especially in recent times, when virtual interactions among children and young adolescents using social media are projected to substitute face-to-face interactions in future (E. O. D. Waygood et al., 2019).

2.3.6. Methodological Approaches

2.3.6.1. Comparative Case Study

In view of the variations in results related to associations of CIM with BE and SE variables owing to the diverse contextual differences, several studies moved towards adopting a comparative analysis approach. The first attempt was made across varied levels of urbanisations (Sharmin & Kamruzzaman, 2017). Initially, the focus was on the differences between 'urban' and 'rural' areas (A. Carver et al., 2014; Fyhri & Hjorthol, 2009; M. Kyttä, 1997), which later extended by the inclusion of 'suburban'(Loebach & Gilliland, 2014), 'inner-city', 'small-town'(A. Carver et al., 2012; Cordovil et al., 2015a) and 'large-town' areas (M Kyttä et al., 2015; J Rudner & Wickramaarachchi, 2013) in the research design. These studies not only provided empirical

evidence but also emphasised the need to adopt a comparative approach within CIM studies domain.

2.3.6.2. Generational Changes

Hillman and colleagues in their research compared a range of parental mobility licenses to children from 1971 to 1990 in England and Germany. They found a substantial decline, particularly in England, from 86% in 1971 to 54% in 1991 in children's unescorted trips to school. Two subsequent English studies continued this line of enquiry using the same parental licenses in 2000 (O'Brien, 2000) and 2010 (B Shaw et al., 2013). They found a further decline in children's unescorted school trips. Other investigations in developed countries such as Finland (M Kyttä et al., 2015), Netherland (L. Karsten, 2005), Norway (Fyhri et al., 2011), Australia (Stephanie Schoeppe, Paul Tranter, et al., 2015) and New Zealand (Witten et al., 2013) found a similar generational decrease in CIM. Factors such as changes in society-wide policies, community-level social dynamics are attributed to these declines impacting critically on individual-level parenting strategies (Witten et al., 2013).

Notably, all these studies were based on parents' permission levels, while a generational decline in children's geospatial distances and areas remained unclear. Recently, in the absence of data on previous generational spatial boundary limits, existing limits are explored and compared between diverse geographical contexts. For instance, studies found that in England, 35 % of parents would permit children to travel home from school to distances over 1 km, 73 % of Danish parents would allow them to walk or cycle to school up to 1.5 km, while, 62 % of Australian parents would restrict children's independent walking and cycling in public spaces less than 500m from home. Efforts are going on to gather spatial restrictions from the previous generation as well for future comparisons.

2.4. International Initiatives and Policy Frameworks

2.4.1. Child's Rights-based approach

As mentioned earlier, the changing society's perspective to children brought changes both in academics and international platforms, especially the United Nations (UN). The UN played a key role in recognising and establishing the world view on the rights of children (Malone, 2006). The

two most critical steps taken by the UN, which affects CIM are the landmark UNCRC act and child-friendly cities initiative, which are discussed in detail below.

2.4.1.1. UN Convention on Rights of Child (UNCRC) Act

In 1959, the United Nations General Assembly adopted the Declaration of the Rights of the Child (DRC). This original charter was the first human rights document approved by an inter-governmental institution. After 30 years of Rights of Child, the UN General Assembly unanimously adopted the Convention on the Rights of Child (UNCRC). It opened the Convention for signature on 20 November 1989, the 30th anniversary of its Declaration of the Rights of the Child. It was a landmark in human rights legislation as it became the first internationally binding instrument which recognised all the fundamental rights of the child. UNCRC came into force on 2 September 1990, after it was ratified by the required number of nations (Quennerstedt et al., 2018). India ratified UNCRC on 11 December 1992, agreeing in principles all articles except with certain reservations (Rampal, 2008). It gave legal expression to the notion that children have independent human rights and that those rights would be at the heart of all political, economic and social decision making (Freeman, 2009).

2.4.1.2. UNICEF's Child-friendly Cities Initiative

One of the critical projects taken by UNESCO between the years of DRC and UNCRC was the 'Growing Up in Cities' (GUIC) project. It started in the early 1970s under the leadership of Kevin Lynch, a noted Urban planner and designer. It had an overarching aim to explore how children perceive, value use their local environment, to suggest planning policy recommendations. With this background, the United Nations launched the Child-Friendly Cities Initiative (CFCI) at the conference of UN-Habitat II in Istanbul in the year 1996. The conference declared that the well-being of children is the ultimate indicator of a healthy habitat, a democratic society and good governance. This was followed by reviving of GUIC project (1996) and establishment of the International Secretariat of CFCI at the UNICEF Innocenti Research Centre (IRC) in Florence, Italy (2000). Figure 2.2 summarises the timeline in the development of the Rights of Child, leading to UNICEF's 'Child-Friendly Cities'.

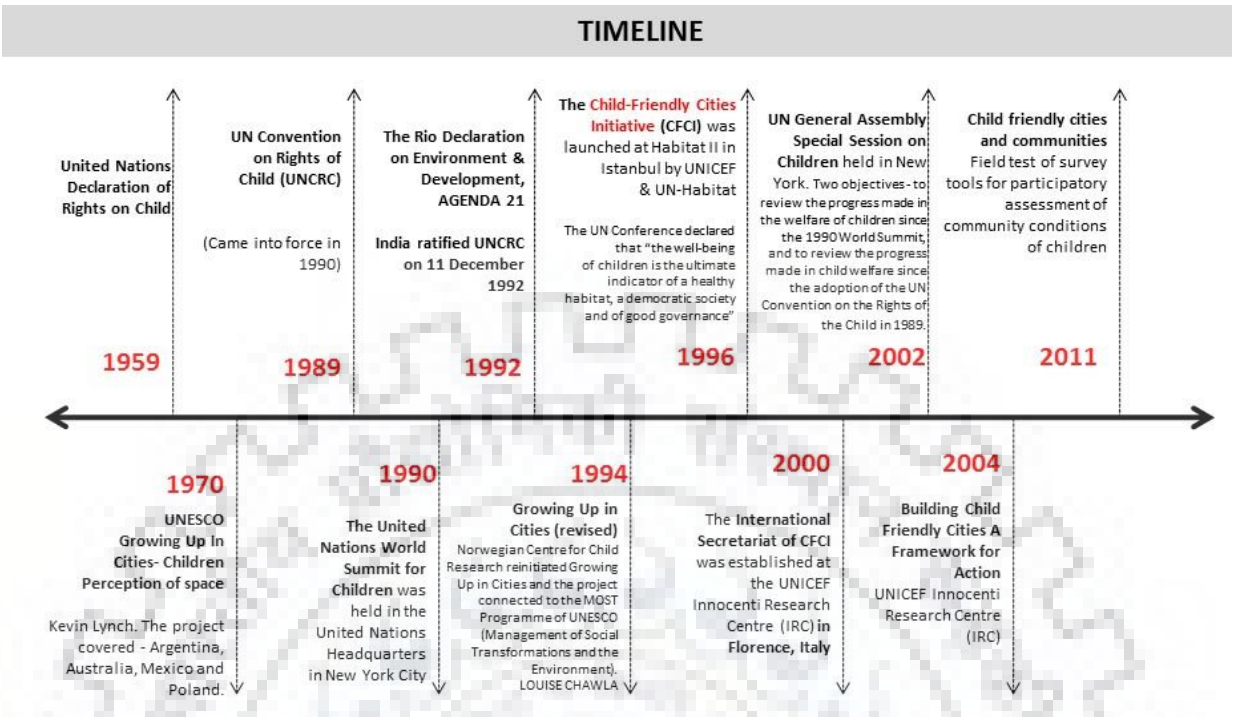


Figure 2.2 Timeline showing initiatives by the UNICEF for the Rights of Child (Source: author)

The extensive work of more than a decade led UNICEF to produce 'Building Child-friendly cities: A framework for Action' in 2004 defining child-friendly cities (CFC) as follows:

"A child-friendly city is a system of good local governance committed to the fullest implementation of the Convention on the Rights of the Child. Large cities, medium-sized towns as well as smaller communities – even in rural settings – are all called to ensure that their governance gives priority to children and involves them in decision-making processes."

The key components of this framework were nine building blocks for guiding cities and communities in the process of becoming child friendly (NIUA, 2016b). These two internationals policies paved the way to give attention to the voices of children, especially while designing urban environments. Consideration of children's need and their meaningful participation was emphasised as an essential goal for creating child-friendly cities. Eventually, several cities across the globe adopted CFCI at multiple levels while progressing in different directions.

2.4.2. Sustainable Development Goals

Children's mobility needs as an agenda also find a place within the 2015 Sustainable Development Goals (SDGs) set by the UN General Assembly. Its principles demand the achievement of

environmental, social and economic goals to meet the needs of a rapidly urbanising world without compromising the needs of future generation (Malone, 2006). The connection between SDGs and children's mobility needs is formulated in SDG 11 (making cities and human settlements inclusive, safe, resilient and sustainable) point 2 that states:

"By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons."

Recognising children as a key user of street and transport facilities, it underscores the significance of mobility as an important dimension for their overall development.

2.4.3. The New Urban Agenda (Habitat III)

Similar to SDGs, the UN set a new vision for cities and municipalities in 2016 by the title 'The New Urban Agenda'. It was adopted in the UN conference on Housing and Sustainable Urban Development (Habitat III) in Quito, Ecuador. It promotes a universal vision of inclusive and sustainable urban settlements. Through the proposal, it is evident that the agenda highlights the significance of people-centred, age and gender-responsive urban development in all cities.

The agenda presses the implementation of civic participation in designing and transforming urban areas which are safe, accessible, inclusive and environmentally friendly. Equal participation of all the stakeholders irrespective of age, gender and socio-economic status is the critical element in implementing the new urban agenda. Another important point is the creation and maintenance of quality public spaces, streets, cycle lanes and green areas in the city with the main focus in proximity factor while strengthening the spatial relationship with rest of the urban fabric. The priority highlighted in the document is also about providing a safe and healthy journey to school for every child in the cities. This was a noteworthy statement since the previous strategies within transport planning policies rarely focused on children's safe school journeys. This statement clearly indicated a shift in the ideology of an international body that might lead to the integration of such strategies into the planning policies of the cities at large.

2.5. CIM in Indian Perspective

2.5.1. Status of Children

2.5.1.1. Demographics

India is home to the largest number of children in the world, significantly larger than the number in China (UNICEF, 2011). Every fifth child in the world lives in India (UNICEF, 2012). Children in the age group 0-18 years constitute 39 % of the country's total population (472 million), out of which 247.5 million (52.4%) are male, and 224.6 million (47.6 %) are female. Figure 2.3 presents the age-wise break up of this population in India. As many as 128.5 million of these children reside in urban areas, constituting 34 % of the urban population (NIUA, 2018). At the national level, the child-sex ratio had declined from 927 girls per 1000 boys in 2001 to 918 in 2011. The decline is observed both in urban and rural areas (NIUA, 2018).

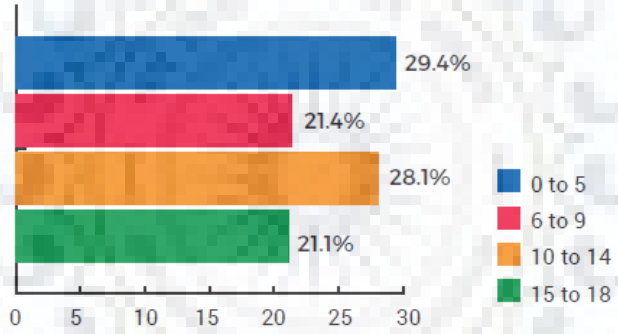


Figure 2.3 Proportion of children's' population in India across various age-groups (Source: Census, 2011)

2.5.1.2. Outdoor Mobility

Children's mobility data to local destinations across several countries have revealed a sharp decline in CIM and active mobility since a few decades. In India, this information exists only for schools within select city locations. The studies conducted in three Indian cities (Hyderabad, Guwahati and Rohtak) involved different organisations, varying sample size and school typologies. Here, the reference to 'school typology' points to the fact that in India, type of school is an indicator of socio-economic status (Tetali et al., 2016). Hence, a government or semi-government funded school will have a majority of children from lower-income group households, while most of the children from middle- or upper-income group households will be attending a private school. Also,

previous studies have already provided enough evidence on the effect of household income on the transport modal choices for children's daily commute (A. Carver et al., 2019; J. Scheiner, 2016). Accordingly, there are inconsistencies in results establishing a need for standardisation of data collection process.

Beginning with the first study conducted in Hyderabad, which had comparatively a larger sample size (approximately 6000) covering 48 schools (government, semi-government and private schools), reported walking (57%) as the most popular mode of transport (Tetali et al., 2016). It further revealed that boys, older children or children from low-income households were more likely to walk or cycle to school. The reason for low-income family children taking active mode of transport lies not only within affordability issues but also within India's policy on providing free education to children but not providing free transportation to school. Additionally, the study also found that those children who were granted independent mobility to school were three times more likely to use an active mode of transport.

Conversely, another study conducted in Guwahati with a sample size of 870 children from one private school reported car (>50%) as the most popular mode of transport (Raoniar et al., 2019). Yet, when the results were investigated in comparison to household income, child's age and gender, the findings reflected a similarity with the previous study. It found that irrespective of distance, as a child's age increases and household income decreases, odds for children's active and independent mobility to school increases. Also, boys were more likely to be granted permission to walk or cycle to school than girls.

The study in Rohtak, on the other hand, was the smallest among the three with a sample size of 430 children across 5 schools (Kush, 2019). In line with the Guwahati study, the findings from this study also revealed that the majority of school trips were motorised, and only 21% of trips were active. On an average in all three cases, more than 60% of children were residing within 5km of school, indicating non-supportive built infrastructure for active transport around schools.

2.5.1.3. Changing Parenting Norms

Attitude towards children changed within Indian families considerably in the last few decades with evolving parenting norms (Isaac et al., 2014). This change varies remarkably among different income groups (D. Sinha, 1982). As the present research examined children belonging to middle-

income households; the change in parenting norms from such households is the focus of the discussion here.

Since ages, parenting norms in India's cultural heritage has its base in the rich values of respect for elders, parents, grandparents, uncles and aunts and strong family ties (Isaac et al., 2014). Even today, with a rise in preference for nuclear family systems over joint families, the presence of strong kingship networks and extended families continues to be an essential component. Generally, parenting choices and child-rearing practices are guided by the spiritual and religious texts, cultural norms and family environment, as well as parents' own beliefs and experiences (Isaac et al., 2014). Research on parenting in India has shown that strict enforcement of family rules often has given rise to autocratic and authoritarian parent-child relationships (Tuli, 2013). Moreover, traditional gender ideals were also found to be prevalent among Indian families with mothers acting as the 'emotional anchor', usually playing a central role in a child's life (Madan, 2018). Further, a lot of stress is given to child's obedience, academic and career achievements. Sports and outdoor physical activities are not given equal importance especially for girls (Swaminathan & Vaz, 2013). Studies show that by determining children's daily routine parents often tend to control their interests, goals and motivations (Madan, 2018). Children also remain less anxious about such parental controls, confirming the societal norms of obeying parents (Isaac et al., 2014).

Currently, as the trend is shifting towards a preference for nuclear family systems, parenting styles is simultaneously evolving. In most urban, educated, and small families, parents, are becoming less authoritative and more child-centred, viewing relationship with their children as symmetric and democratic (Tuli, 2013). Independence and self-reliance are now increasingly encouraged by parents with a prime focus on children's educational and occupational choices for future (Isaac et al., 2014). As a result, it can be concluded that attitude towards children within Indian families resting on the foundation of cultural beliefs, is slowly adopting a liberal approach considering children's developmental needs.

2.5.2. Urban Neighbourhood Characteristics

Over the first half of the 20th century, India's urban population growth remain confined within municipal boundaries of the cities (Annapurna Shaw, 2005). This pattern rapidly changed post-independence owing to the rise in population and gradual congestion of cities resulting in the need

for ‘master plans.’ Initially, the entire planning activity was undertaken following the British Town and Country Planning Act of 1947 (Ahluwalia, 2011). One of the main features of the process was the provision of community facilities by dividing the residential areas into ‘neighbourhood units. However, with no consideration given to the urban economic structure of the country, on-ground enforcement for such regulations did not take place (Das, 1981). The three broad issues identified by researchers to expand this failure were: (i) excessive migration from rural to urban areas; (ii) haphazard and unplanned growth of industries and cities under colonial era and (iii) multiple organisations involved in the implementation of various programs (Das, 1981).

Thus, in contrast to developed countries the spatial structure of Indian cities emerged from the complex interplay of physical, social, economic, cultural and behavioural factors that did not follow the classic ‘urban-suburban’ model (Tiwari, 2002). Tiwari (2002) categorises a typical Indian city into five distinct typologies which include: (i) old core area, which is usually congested, narrow street widths and unregulated land-use pattern; (ii) unplanned area, which is developed organically and consists of informal housing colonies and squatter settlements, (iii) planned residential colonies built by public, private or co-operative sectors for high-income groups, (iv) planned commercial area, having multi-storied buildings and (v) urban fringes, where the urban and rural divide is blurred (Tiwari, 2002). With economic liberalisation supporting market-driven development, a trend towards high-rise gated communities, especially in the city’s peripheral areas, is seen as an added layer over the already dense city fabric (Dupont, 2016). This complex structure does not have clear cut concentric zones for different activities. For instance, central core areas depict not only commercial activity but also high housing concentrations. Likewise, the manufacturing activities are spread not only in the peripheral zone but also in intermediate and inner zones (Tiwari, 2002). Thus, the defining boundaries for urban neighbourhoods in India are complex and often overlaps within the broad built fabric of the city.

2.5.3. National Initiatives and Policy frameworks

As one the signatories of UNCRC act since 1992, India has prioritised children specific issues in their policy frameworks like the National Policy of Action for Children (NPAC), which recognises a child as a person below the age of 18 years. This policy came into been in 2005 as a follow-up to the 2002 Special Session on Children of the UN General Assembly and was revised in 2016 to guide and inform laws, plans and programs affecting children’s health and protection. It is recently

that India has identified children as one of the key users of urban infrastructure by including them in the country's Smart Cities Mission (SCM), launched in 2015. It is an urban renewal and retrofitting program to develop citizen-friendly and sustainable smart cities across the country. Following sub-sections will expand this discussion by introducing guidelines developed under SCM focusing on children and the response of different cities on the same.

2.5.3.1. Child-Friendly Smart Cities (CFSC) Initiative

The National Institute of Urban Affairs (NIUA) under the Ministry of Urban Development (MoUD) launched the Child-friendly Smart Cities (CFSC) initiative in 2016 (NIUA, 2016a). The goal of this ongoing initiative is to mainstream the needs of children in the urban policy and planning framework of Indian cities. Under this initiative, in the absence of an established model of CFC, an exhaustive list was conceived as a starting point to develop indicators that can be used to assess the impact of urban development on children, titled as 'Indicators for Child-Friendly local development" (I-CHILD) (NIUA, 2016c). These indicators recognise 'mobility and safety' as one of the crucial components for creating a child-friendly environment. It focuses on the built environment factors of street connectivity, traffic volume, distance to destination and walkability as vital elements influencing parent's perception of their surroundings and their degree of granting children more freedom to move. In 2019, NIUA also introduced a set of design guidelines for infant, toddler and caregiver-friendly neighbourhood (ITCN), that could assist in designing neighbourhood layout, streets, parks and other urban services (BVLF, 2018). For streets, traffic calming measures, strategies for parking, home zones and shared streets are recommended to promote active and independent mobility among children.

Notably, despite these efforts, such policy and guideline documents are primarily based on literature than field-based evidence from Indian cities. One of the reasons is the adult-centric focus of existing research in active commuting within urban neighbourhoods (Deepti Adlakha et al., 2016; D. Adlakha et al., 2018), while the needs of children and young adolescents are only assessed in reference to play provisions within local surroundings (Bhonsle & Adane, 2016; S. Chatterjee, 2018). Recently, with the launch of 'Nurturing Neighbourhood Challenge' (2020) by the Ministry of Housing and Urban Affairs (MoHUA) and BvLF; an onset of field-based experiments has begun to enhance the built environment for children and their caregivers in India. This initiative planned

for a period of three years, is at a nascent stage and aims to specifically focus on safe and walkable streets for children.

2.5.3.1. Neighbourhood Policies and Guidelines

In India, Urban and Regional Development Plan Formulation and Implementation (URDPFI) guidelines govern the neighbourhood level planning and design. These guidelines were first prepared in 1996, and recently it was updated and revised in 2015 (TCPO, 2015). The guidelines lay stress on having a mixed land-use with medium residential density, commercial activities (employment opportunities) along with supporting retail and services at a neighbourhood scale. It suggests the provision of 10-12 sq. m. of open space per person as desirable for a neighbourhood of 5000-15000 population. Further, there should be a minimum of 3-4 local parks and playgrounds with a park (organised green space) occupying a minimum of 1 hectare and play areas (sports facilities) occupying 1.5 hectares of land in each neighbourhood as shown in Figure 2.4. Additionally, there should be a provision of a local shopping centre occupying 4600 sq. meter of an area that may include informal shopping space, reading room, ATM or bank, weekly market area and convenience shopping zone as well. Acknowledging the role of street vendors as street eyes for safety for women and children, the guidelines also suggest the establishment of a designated area for such services near residential areas. In reference to the transportation facilities, it underscores the need to have local neighbourhood streets pedestrian and cycling-friendly with speed restrictions and limited entry to motorised vehicles. Also, major public transit stations like metro or monorail and bus stop should not be located at a distance more than 800 m and 400 m from neighbourhood respectively. Likewise, the option of intermediate public transport (IPT) also should not be located more than 400m distance from neighbourhood. Besides, URDPFI guidelines, ITCN design guidelines are a new addition to the existing neighbourhood design guideline documents (as mentioned previously).

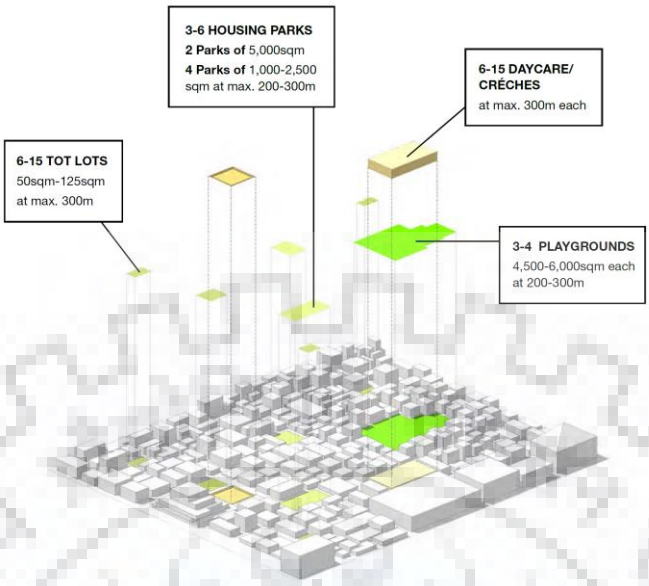


Figure 2.4 Model for infant, toddler and caregiver neighbourhood in line with URDPFI guidelines (Source: ITCN guidelines, Ministry of Urban Affairs, BvLF and BDP. 2019)

2.6. Case Studies

2.6.1. Global Context

Beginning with the Canadian city of Vancouver, which was at the forefront since the 1970s of the planning needs of families with children within inner-city neighbourhoods, providing a spatial solution for the combination of care and work (Punter, 2010; Van Den Berg, 2013). More recently, Toronto has advanced in its approach by addressing children's residence, play and independent mobility needs through design considerations at building, neighbourhood and open space levels (Toronto, 2017). Other cities in North and South America like Boulder (Colorado), Bogotá (Columbia) and Recife (Brazil) also moved forward towards addressing child-friendly components into planning and design guidelines (Derr et al., 2013; ISS, 2019). In Europe, Antwerp (Belgium) as a city prioritizes pedestrians and outdoor play activities over car and traffic. One recent example is the Military hospital residential redevelopment, which began by first reducing the car parking facilities by pushing it to underground garages. The next step included placing larger family residential units on the ground floor to provide direct visibility to the play spaces, enabling families to spill outdoors without the fear of traffic. It further generated the possibility of natural indirect surveillance of children while giving them opportunities to roam around freely (Krysiak, 2019). Another project initiated by the city council was generating a data set for Play Space Web or

Speelweefselplan, which maps commonly used travel routes for child-specific destinations in consultation with children. This data assists the city administration to improve infrastructure, increase the playability of neighbourhoods and add new spaces for a safer commute (Krysiak, 2019). The other European cities leading the CFCI movement by focusing on CIM include Rotterdam, Amsterdam (Netherland), London (United Kingdom), Tirana (Albania) and Tel Aviv (Israel) (L. Karsten, Van Vliet, W., 2006; Van Den Berg, 2013; Vincelot, 2018).

Figure 2.5 Map showing location of cities where child-friendly cities initiatives (CFCI) are currently going on in the world (Source: author)

Among the Asian countries, Japan was the earliest to adopt CFC principles in the area of CIM to school. In Tokyo, it is a common sight on any mass transit to find children troop through train cars, singly or in small groups, looking for seats. Parents in Japan regularly send their kids out into the world at a very young age (Drianda & Kinoshita, 2011). Elementary-aged children had the highest walking rates at 70% in 2010. This is because the majority of children in an elementary school walk to school in Walking School Buses (WSB) (E. Waygood et al., 2017). By definition, a WSB is a "group of children who walk to and from school with one or more adults" (E. Waygood et al., 2015). Besides, Japan offers to its children convenient public transportation with last-mile

connectivity, more surveillance, walkable infrastructure and strong cooperation among schools, local government, parents and local residents. Often street closure timings during school opening or closing time are painted in large text on the street for vehicle owners. Also, pictographs like small feet are painted at crossings, to remind younger children to watch for incoming traffic (Krysiak, 2019).This makes Japan one of the children-friendly countries in the world. Similar efforts are made by Dhaka (Bangladesh), Jakarta (Indonesia) and Singapore on making their mark from Asia. Additionally, cities like Melbourne and Auckland are emerging at par with other global cities working on creating CFC (NIUA, 2019). These cities identify CIM as a critical area that requires improvement for achieving the overarching aim of child-friendliness.

2.6.2. Indian Context

As a result of CFSC initiative at government level in India, children's mobility needs within urban areas gained attention among planners, urban designers and policymakers. Many cities initiated the process of identifying local issues and implementing solutions while collaborating with both children and parents. In order to present a brief picture of the on-field urban challenges regarding the issue, four cities were selected as case studies. The criteria for selecting the cities were based on two clear factors of cities: (i) identifying 'children' as key users of urban infrastructure within their agenda and (ii) working towards 'mobility' as one of the priority areas.

Based on the above criteria, Bhubaneswar, the capital city of the eastern state of Odisha was identified as the first city which is currently working on the child-friendly smart city model using a participatory approach (NIUA, 2014). Child-led tours, neighbourhood mapping, individual interviews and focus group discussions were used as tools for identifying issues. It has also established the Bhubaneshwar Urban Knowledge Center (BUKC) which comprises India's first Child-Friendly Smart City Center (CFSC). The city emphasises on children's mobility to school as a crucial component in a child's daily life. Thus as a part of a solution, it proposes to implement traffic signals, signages and child-friendly crossings near schools (NIUA, 2017). Overall, it aims to have policy level intervention in urban planning documents of the city. On the other hand, Pune, the second-largest city in the state of Maharashtra, has started reclaiming the streets for pedestrian and cyclists, enabling wider footpaths and cycle track. Such attempts, though at small scale, of continuous footpath, organised street parking and more informal seating spaces are already offering tremendous opportunities for children's play area, safe commute and independent travel

(Kush, 2019). While, Ahmedabad, the largest city of the state of Gujarat, believes in bringing a behavioural change among the local people in terms of mobility. A community-based initiative called 'aProaCh' (a protagonist in every child, design for change) supports this thinking by focusing on creating child-friendly zebra crossings near schools and closing down streets for vehicles every month for a single day to promote children's freedom to move, cycle and play (NIUA, 2017). A recent addition in this list is the city of Rohtak in the northern state of Haryana. The city officials in collaboration with international partners undertook a project involving five schools and children (age 10 years and above) to redesign an intersection area, reduce vehicular speed and reallocate spaces on streets for their safer commute to school (Kush, 2019). Besides these four cases, other cities namely Chennai (Tamil Nadu), Udaipur (Rajasthan) and Jorhat (Assam) are also working on implementing solutions for safer mobility of children within local surroundings. Figure 2.6 shows the location of seven cities where the work under CFCIs is currently going on.

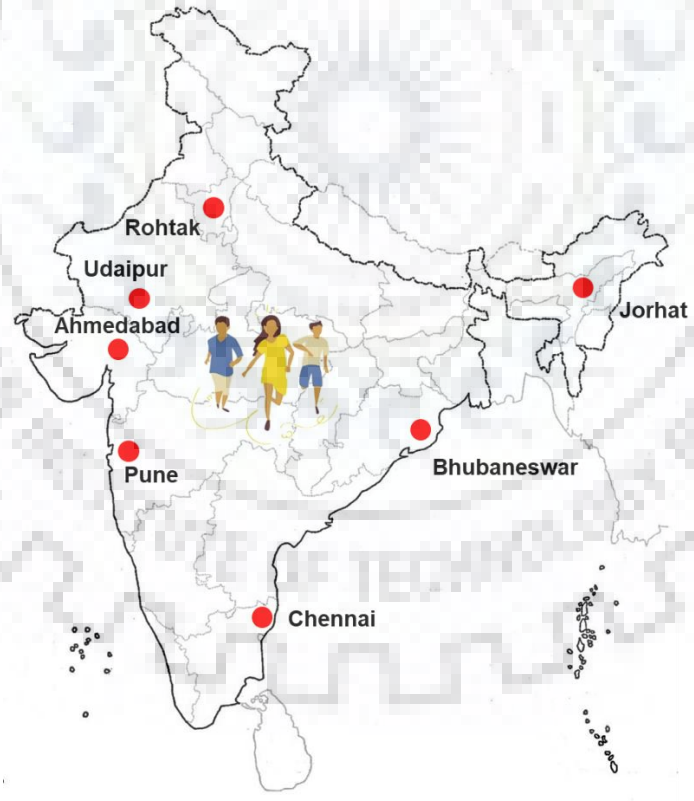


Figure 2.6 Map showing location of cities where child-friendly cities initiatives (CFCI) are currently going on in India (Source: author)

2.7. Chapter Inference: Identified Gaps

Independent mobility is crucial for children's physical and overall developmental needs. Despite its benefits, there is a substantial body of knowledge that indicates a worldwide decline in CIM. Multidisciplinary researchers analyse this issue from two different yet converging approaches of (i) rights-based and (ii) environment-based. The rights-based approach adopted by several international bodies such as UN centres their foundation on the attitudinal shift towards children that no longer view them as 'vulnerable' or 'adults in the making', rather recognising them as 'active' and 'key' users of the built environment. This approach puts government and state bodies responsible for incorporating children's meaningful participation to make their voices heard and respected. It reinforces the need for policy frameworks at both international and national levels while offering a legal notion to the debate of creating inclusive built environment for children.

On the other hand, the environment-based approach directs the attention towards the influencing built, social and individual factors of children's everyday life. It attempts to first look at the external factors that shape children's experience of the outdoor environment. Acknowledging the neighbourhood's role as a 'third teacher' for children, multidisciplinary researchers argue on the actual impact of its various built and social variables on CIM. The argument reveals that instead of any linear relationship, it is the interdependencies of multiple factors that generate a supportive or restrictive environment for CIM. These interdependencies vary across levels of urbanisations, neighbourhood typologies, generations and individual child-care parenting models.

In an overview, the decade long research on CIM has provided a considerable diversity of literature from a multi-point perspective. There is no doubt that childhood is losing its past enjoyed freedom within the local environmental context. The long neglect that the urban designers and planners have done towards the fundamental needs of children have landed our neighbourhood spaces into been inaccessible, unsafe, uncomfortable and clearly non-friendly for children. The research to date has tried to explore and provide possible solutions for the same. However, there exist some inadequacies and unanswered queries that are described below as part of the research gaps:

1. *Limited studies exist investigating CIM within an Indian context*

The global south represents a geographic location that is home to the largest population of children in the world. Yet, few studies on CIM from such countries exist, the majority of which lies under

developing nations' category. As one of these developing countries, India exhibits diversity at multiple levels due to the complex layers of built, socioeconomic, cultural and political aspects, offering a unique and challenging background for CIM. Yet, there exists a clear shortage of studies investigating CIM within the Indian context.

2. Inadequate empirical data on CIM across diverse neighbourhood typologies

Notably, a lot of emphasises is given to the levels of urbanisations, especially in studies from the global north. Investigations on housing typologies, particularly high-rise, high-density gated communities are emerging through individual cases. However, focus on comparative studies across diverse urban neighbourhood typologies remain under-researched.

3. Fewer studies exploring CIM to local destinations beyond school

'School' as a destination has enjoyed immense attention by researchers from various disciplines since long. This interest exists owing to a school's reputation as an important destination in children's everyday life. However, recently researchers agree that local destinations are equally important for children as they provide them far greater exposure to an outdoor environment while simultaneously fostering a sense of place among them. Despite this, studies exploring CIM to several local destinations remain limited.

4. Gaps in development of a contextual methodology for measuring CIM

Several review studies have pointed out that due to the non-existence of any standardised methodology for measuring CIM, study comparisons become challenging and results remain inconsistent across the globe. Such non-uniformity provides semi-picture of the current independent mobility levels among children. To address this challenge, there is a need to contextualize CIM measurements, especially for historically and culturally diverse South Asian cities.

Given the existing status of literature and the identified gaps, this research finds itself at the crossroads, as illustrated in Figure 2.7. On the one hand, there are rising empirical evidences on CIM from the global north reaffirming that children and young people are 'active citizens' and play an essential role as 'agents of change' for our built environment. While on the other hand, there is an increase in pilot-level experiments within Indian cities to create child-friendly

infrastructure indicating a nascent yet appreciating change addressing the global call for human-oriented urbanism.

Figure 2.7 Locating this research diagrammatically within the present context

Chapter 3

Research Approach

Chapter 3 Research Approach

Findings from Chapter 2 provided the platform for developing the empirical chapters of the thesis, including the identification of key constructs, variables, measures and analysis. This chapter describes the research philosophy, theoretical and conceptual framework that informs the research design of the study detailed in the subsequent chapter. First, the theoretical foundations of the research are described and linked with methodology. Next, theoretical elements adopted in the research are outlined. Thereafter, theoretical models adopted by the research and the rationale for their selection is explained in detail. Finally, the conceptual framework that evolved from this theory is described.

3.1. The Philosophy

Research philosophy is a belief about the way in which data about a phenomenon should be gathered, analysed and used. In his landmark work (Crotty, 1998), Michael Crotty identifies four elements to frame the scaffolding of the research process. These four elements include epistemology, theoretical perspective or philosophical stance, methodology and methods. Epistemology refers to "the theory of knowledge embedded in the theoretical perspective and thereby in the methodology"; theoretical perspective means "the philosophical stance informing the methodology and thus providing a context for the process and grounding its logic and criteria"; methodology is defined as "the strategy, plan of action, process or design lying behind the choice and use of particular methods and linking the choice and use of methods to the desired outcomes"; and methods indicate "the techniques or procedures used to gather and analyse data related to some research question or hypothesis (Crotty, 1998). These four elements are all connected and cannot be viewed in isolation, as shown in Figure 3.1.

This thesis includes elements of social science; hence it was imperative to adopt the lens of Crotty for laying the foundation of the research. Interestingly, Crotty does not outline ontology (the nature of existence) as a separate element arguing that ontological and epistemological issues often arise together. Therefore, in the next section, ontological issues are explained by epistemological stance.

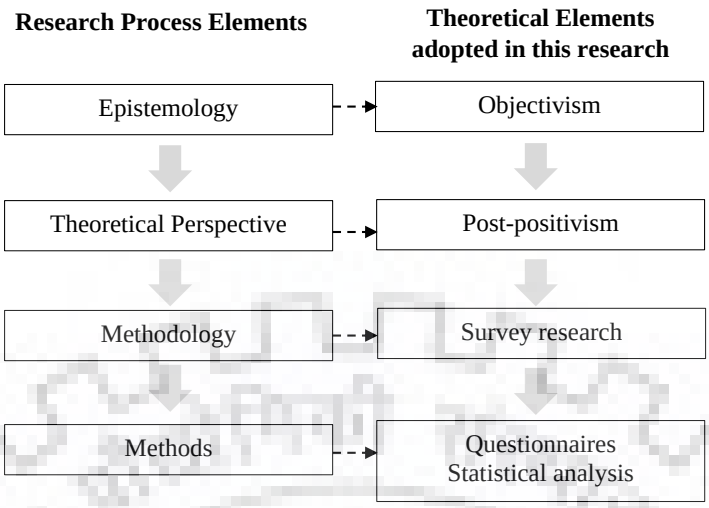


Figure 3.1 Research process structure of the study, adapted from 'The foundation of social research: meaning and perspective in the research process' M. Crotty 1998

3.2. Objectivism and Post-positivism

The epistemology stance of this thesis is 'objectivism' that view things as meaningful entities independent of consciousness for obtaining the objective truth (Peikoff, 1993). This is the epistemological underpinning the positivist stance. Positivism, a term coined by Auguste Comte, grounds on two assumptions. First, knowledge (e.g., facts, evidence) is built on through methodologies, such as evidence-based practice. Second, research is theory-driven and aims to test the theory using the data (i.e., a deductive approach) rather than developing new theory emerged from the data (i.e., an inductive approach), where social reality is assumed to follow pre-existing patterns or order (Sheppard, 2014). Post-positivism advocated by Karl Popper (1959), Thomas Kuhn (1970) and Jacob Bronowski (1950) holds these fundamental positivist assumptions ('the absoluteness of objectivity') but recognises the value of subjective perceptions (Clark, 1998). The current research also follows a deductive approach by developing on-field evidence and relies on participant perception of the neighbourhoods. It is for this reason that the thesis considers post-positivist as an appropriate theoretical perspective. Further, details of the research methodology and methods are provided in Chapter 4.

3.3. CIM and Urban Neighbourhood: Theoretical Models

The post-positivist view of research is deductive and driven by theory (Bryman, 2012). A deductive approach involves the process of identifying theory, defining hypotheses, collecting data, discovering findings, confirming or rejecting hypotheses, and revising theory (Bryman, 2012). As seen from Chapter 2, several theoretical frameworks informing CIM and urban neighbourhood research have been developed across various fields of study. This thesis rests upon the foundation of three such theoretical models that together inform and support the aim of studying the state of CIM and influencing urban neighbourhood environments. These three models and their rationale for selection is illustrated in Figure 3.2 and explained in the following sub-sections.

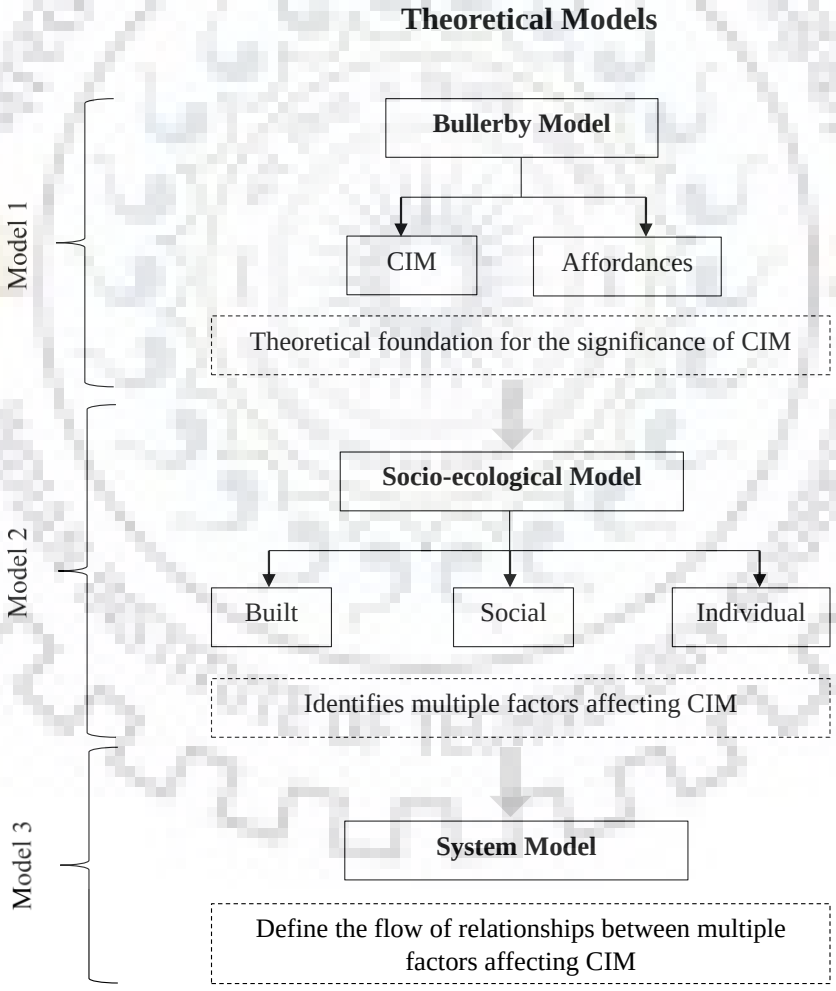


Figure 3.2 Theoretical models adopted by the study

3.3.1. Bullerby Model

The 'Bullerby Model' (as introduced in Chapter 2) developed by M. Kyttä (2004) is a theoretical tool for assessing the child-friendliness of various settings as shown in Figure 3.3. Two aspects determine the central criteria: children's possibilities for independent mobility and their opportunities to actualise environmental affordances (Broberg et al., 2013). The term 'affordances', originally coined by an American Psychologist Dr. James J. Gibson, is a central construct of ecological perceptual psychology (Marketta Kyttä, 2004). It is generally defined as the physical opportunities and dangers which a person perceives while acting in a specific setting (Gibson, 1979; Heft, 1988). As an example, if children perceive a park to be enjoyable and fun offering opportunities for their diverse outdoor activities, it can be said that the park offers a positive affordance for children. Actualisation happens when this positive affordance leads to children actually playing and conducting their various outdoor activities (Marketta Kyttä, 2004). So, according to the Bullerby model, if more children can move around independently within their surroundings, more and richer variety of actualised affordances will be revealed. Thus, it is considered as an imperative model for the research creating a theoretical foundation for the significance of CIM while objectifying child-friendly environment.

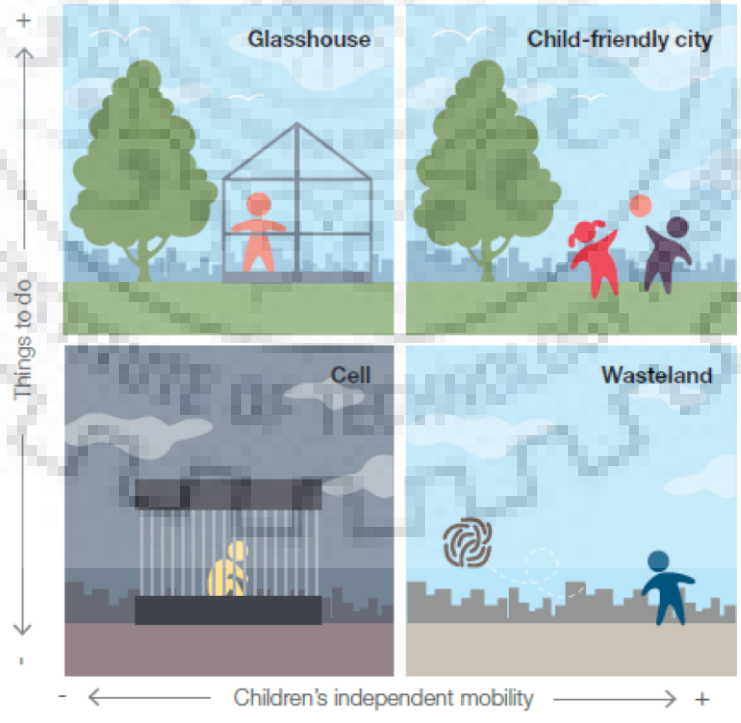


Figure 3.3 Bullerby Model (Source: Cities Alive, Arup, 2017, based on the work of M. Kyttä)

3.3.2. Socio-ecological Model

The review of several CIM studies revealed 'socio-ecological' model as a common foundation. Introduced by Urie Bronfenbrenner in the 1970s (Bronfenbrenner, 1994), it identifies multiple factors forming the ecological system that may have a direct or indirect effect on children's mobility behaviour. Bronfenbrenner further argues that such an ecological system comprises four socially organised subsystems that support children's overall growth. They range from microsystem, which refers to the relationship between children and immediate environment (e.g. family, school etc.) to macrosystem, which refers to distal influencing factors (e.g. culture, policies, laws etc.) (Bronfenbrenner, 1994) as illustrated in Figure 3.4. Notably, this model is also being adopted in the areas of public health, bio-ecology, developmental psychology and urban planning.

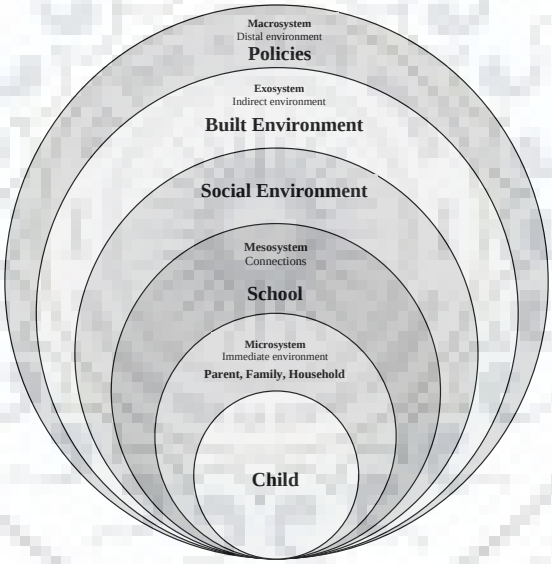


Figure 3.4 Socio-ecological model developed by Bronfenbrenner (1977)

3.3.3. Systems Model

Based on Bronfenbrenner's socio-ecological models, several conceptual frameworks were developed to understand the causal relationship between multiple factors affecting CIM (Martin & Wood, 2014; M. Oliver, Schofield, G. , 2010; Pont et al., 2013). These frameworks mostly showed the relationship unidirectional, while 'systems' model proposed by Badland et al. (2015) advanced further by including the complexities of the factors underpinning CIM. It acknowledged

the potential collinearity, interdependence; and mediating and moderating relationships among factors themselves (Hannah Badland et al., 2015). According to this model, influencing factors vary across five levels: policy and society norms (more distal), neighbourhood, household to individual behaviour (more proximal) as illustrated in Figure 3.5.

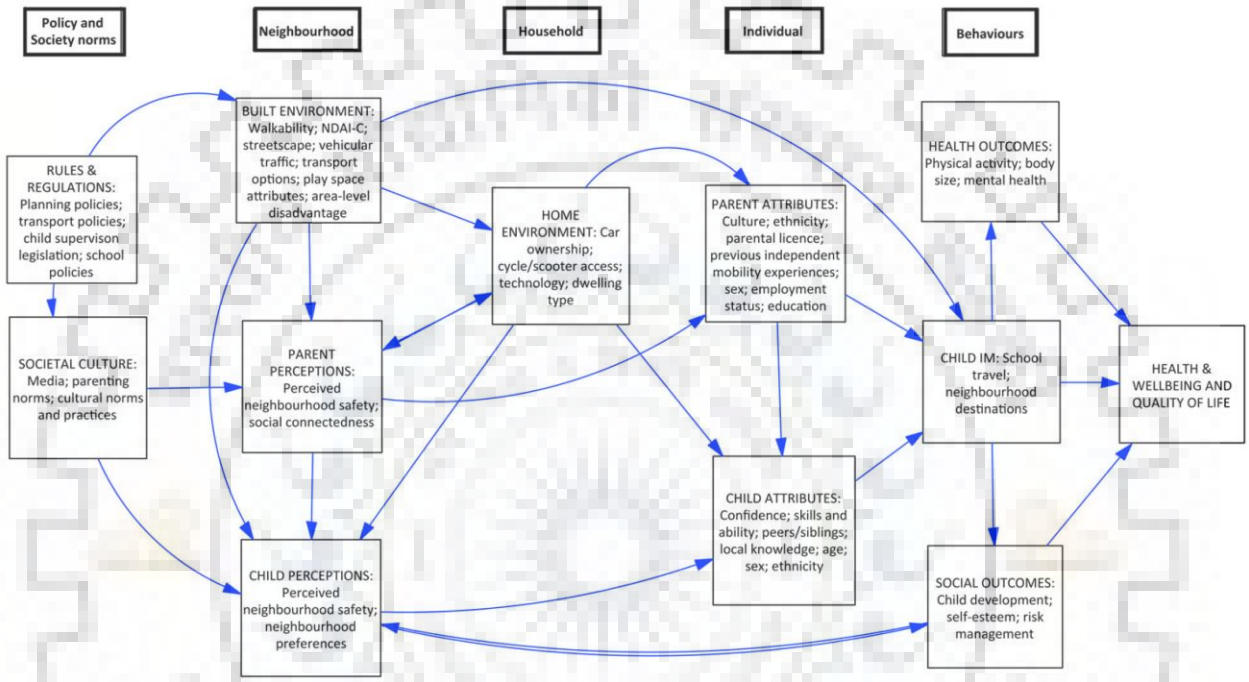


Figure 3.5 System model developed by Badland et al. (2015) to visualise the complexity of CIM

3.4. Conceptual Research Framework

Based on the discussed theoretical models, modifications are done to develop a study-specific conceptual research framework in view of the aim and objectives of the research, as illustrated in Figure 3.6. A conceptual framework assists in theorising relationships between factors in a complex system. These factors are broadly categorised under socio-demographic and neighbourhood environment factors. The socio-demographic factors include child's individual characteristics (age and gender) and the immediate environment (family and household). The neighbourhood environment factors are further bifurcated into built and social factors. The built factors remain influenced by existing governing policies simultaneously affecting the

neighbourhood social environment. Parent's perception is, in turn, is affected by both socio-demographic and environmental factors while playing a significant role in influencing CIM. The state of CIM is an outcome of these multiple factors which is studied by obtaining the permission and actual levels of children's mobility along with their mode of transport.

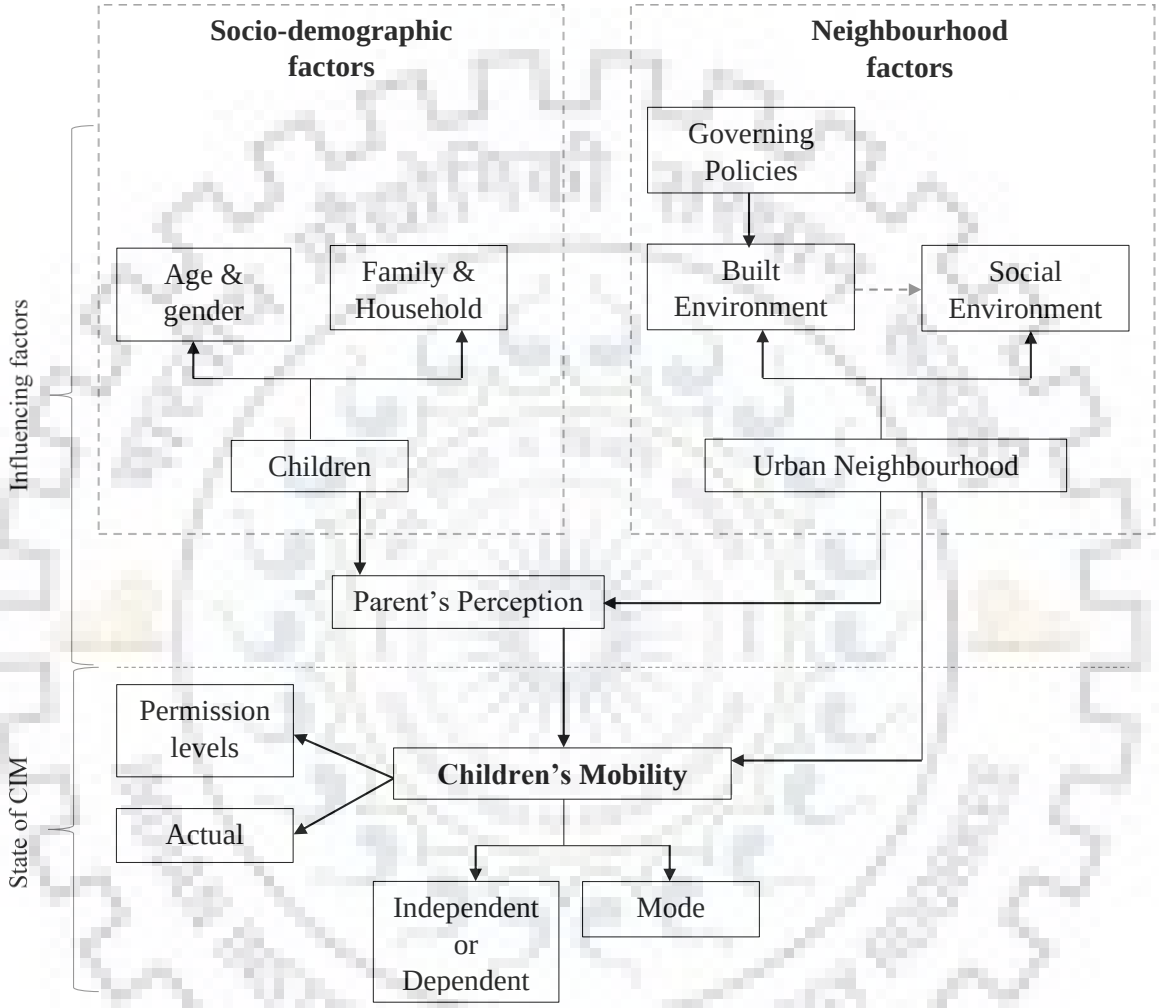


Figure 3.6 Conceptual research framework for the study

3.5. Chapter Summary

By adopting the theoretical perspective of post-positivism, this research follows an evidence-based approach while recognising the value of subjective perceptions. As a foundation, it stands on the conceptual framework of three theoretical models, i.e. 'Bullerby' model, 'socio-ecological' model and 'system' model. These models coming from different disciplines together assist in providing

a base for answering the research question of the thesis while validating the research process. Deviating from the original models, the thesis limits itself to understanding the state of CIM and influencing neighbourhood environment factors without expanding the scope to other behavioural outcomes of health and wellbeing. However, it is assumed that positive and encouraging CIM levels translate into children's overall development. As discussed in the previous chapter, a higher CIM level contributes directly to enhancing children's daily physical activity levels, environmental competence, spatial, cognitive and emotional skills. Besides, it provides children immense opportunities to socially engage with peers and nature while generating a strong sense of place within themselves. Ultimately, this freedom to move and explore around freely without being supervised by adults automatically inculcates the idea in children that their decisions are respected and trusted. They are no longer considered 'adults in the making' and instead treated as active citizens of our built environment.

Therefore, the present research focuses first on understanding existing CIM levels and identifying which influential factors affect CIM at a neighbourhood scale. The conceptual research framework introduced in this chapter categorises these factors as 'neighbourhood' and 'socio-demographic'. The neighbourhood factors include both built and social environment variables, which are considered essential in generating a positive or negative parental perception affecting CIM. While at the same time, children's individual characteristics, such as age and gender, along with their household characteristics, are given equal importance as their role in influencing CIM. Further, to obtain information on existing CIM, two indicators were considered: parental permission levels (CIM license) and children's actual independent mobility levels (CIM destination). By employing appropriate data analysis methods, the complex relationship between the influencing factors and CIM are thus explored.

Concludingly, this chapter acts as a 'blueprint' for the thesis, presenting the logic behind the research design as detailed out in the next chapter.

Chapter 4

Research Design

Chapter 4 Research Design

This chapter explains how the conceptual framework presented in the previous chapter is operationalized to collect empirical evidence to answer the research questions. The chapter is divided into five sections. The first discusses the overall research design and the reason for its adoption, along with the unit of analysis. The second introduces the study context, which is based in the city of Kolkata. Third provides detailed information on the process employed for neighbourhood selection and participant recruitment as well as ethical issues considered while researching with children. This section also provides an introduction to selected neighbourhoods. The fourth section explains the tool development process and the finalized measures for measuring CIM and neighbourhood variables. Lastly, the fifth section deals with the data processing and analysis method employed.

4.1. Overview

The best research strategy is one that maximizes generalizability, increases precision in controlling and measuring variables, and ensures existential realism for the participants (McGrath, 1981). In view of this, the current research follows a comparative case study approach as a methodology. Several scholars within the social sciences and urban studies have written extensively about the importance and purpose of the comparative method (Collier, 1993; George, 1979; Lijphart, 1971; McDonnell et al., 2009). Comparison is the foundation of scientific methodology. In other words, comparison need not be distinguished from other methods but is considered as a foundational methodology itself. Case study, on the other hand, is usually defined as the method of obtaining a case or several cases through an empirical examination of a real-world phenomenon within its naturally occurring context, without directly manipulating either the phenomenon or the context (Kaarbo & Beasley, 1999). The comparative case study is thus a systematic comparison of two or more cases obtained through the use of case study method.

In this research, five cases of urban neighbourhoods were selected across three distinct typologies in Kolkata. Comparison is drawn within and across the typologies for studying the state of CIM and influencing urban neighbourhood environment. Measures for CIM included both the indicators of CIM licence and CIM destination. Social environment variables were obtained from parents

using survey questionnaires, while built environment variables were obtained objectively using ArcGIS software. Relationships between these variables were investigated by statistical analysis. Finally, the established relationships were understood in relation to the valuable insights obtained from conducting a content analysis of post-survey parental interviews.

4.2. Unit of Analysis: Neighbourhood

Each child's neighbourhood was operationalized using the buffer method (as described in Chapter 2, section 2.3.2). The definition of neighbourhood is adopted as the area within an 800 m pedestrian network buffer around each child's home. Buffers are useful for capturing all features of the built environment surrounding a particular location (Thornton et al., 2011). The reason for selecting a scale of 800m is based upon the average distance an adult can cover by walking for 10 minutes within the context of Indian weather (BVLF, 2018). Besides, several international studies related to the investigation of neighbourhood's influence on children's mobility and physical activity has considered 800m as an appropriate scale to define boundaries for a child's local surroundings (A. Carver et al., 2014; M. Oliver et al., 2015; M. Oliver et al., 2011). Further, the research intended to include school as one of the destinations within a child's local surrounding; therefore, only those children and their families were considered who resided within 800m distance from the school.

4.3. Context of the Study

Following the comparative case study approach, the research required the selection of different typologies of neighbourhood. Initially, the idea was to take two or three megacities in India and select similar neighbourhood typologies under distinct categories. However, several considerable factors were found to be challenging. For instance, the study on CIM was being conducted for the first time in India and required a focused understanding of the existing situation. Furthermore, Indian cities, despite having comparable built environment, exhibits enormous social and cultural diversity. Lastly, the researcher was required to spend a minimum of six months in the city, exploring neighbourhoods and engaging with participants. Accordingly, there were time and financial constraints in moving forward with more than one city as primary cases. In view of these points, it was decided to take a single city and conduct in-depth investigation across distinct neighbourhood typologies concerning CIM.

4.3.1. Selection Criteria

Following points were taken into consideration for city selection:

1. Fast-paced urbanising city

   The research adopted the ideology of UNESCO's 'Growing Up in Cities' project led by Kevin Lynch in the early 1970s (Lynch & Banerjee, 1977). According to the study protocols, the focus should be on middle childhood from fast urbanising cities for providing a clear picture of the existing scenario while recommending for future needs of these expanding cities (A Carver et al., 2013; L Chawla, 1997; Toronto, 2017). These protocols were also adopted in numerous international child-focused studies and thus became the base point for selecting a city in India.
2. Diversity in neighbourhood typologies

   Indian cities emerge from a complex layer of socio-cultural, political and economic aspects. Such a multi-layered structure generates diverse neighbourhood typologies in terms of the built and social environment. Since this diversity was an intentional focus of the study, the criterion of the city having distinct neighbourhood typologies was essential.
3. Well-connected public transport

   The thesis looks at children's need from their mobility point of view. Hence, it was necessary to select a city that can offer multiple mobility options with last-mile connectivity, especially in terms of public transport catering to the needs of the residents.
4. Diverse opportunities for children to go outdoors

   This criterion was important for confirming the collection of a diverse set of data on children's mobility to local destinations offered by the city.

The criterions mentioned above led to the selection of Kolkata as a prime case study. The following section will provide a brief introduction to the city's urban and mobility environment.

4.3.2. Kolkata

4.3.2.1. Urban Environment

Kolkata, the erstwhile capital of British India with more than 300-year-old history is presently the capital of the eastern state of West Bengal (Figure 4.1). Popularly known as 'the cultural capital of India' and 'the city of Joy' (Sharma et al., 2015), it is one of India's fast urbanising megacities

(after Delhi and Mumbai). It has grown from a colonial port city to a giant megalopolis with a population of over 14 million and a population density of 24,306 per square kilometre (DCO, 2011).

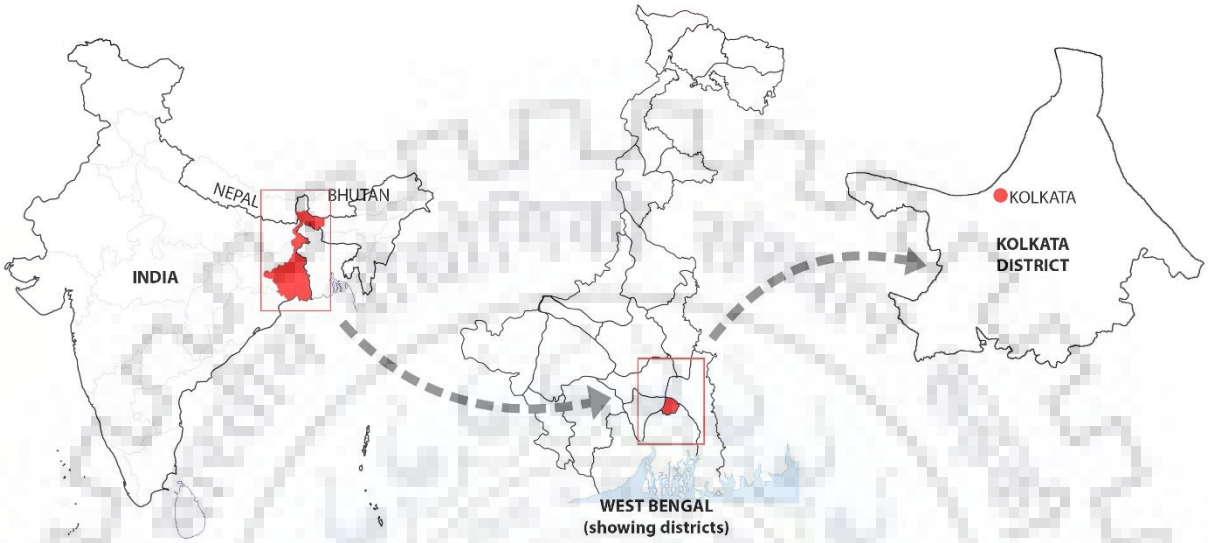


Figure 4.1 Location map of Kolkata in India (source: author)

Kolkata's urban agglomeration (KUA), also identified as Kolkata Metropolitan Area (KMA) is the 3rd largest in India and 8th largest in the world with an aerial coverage of 1851 sq. km. Most of the city area was originally a wetland and has been reclaimed over time to accommodate an increasing population (S. N. Chatterjee, 2008; Haque et al., 2019).

KUA has a well-connected linear urban form along both east and west bank of river Hooghly, which is one the lifelines of southern Bengal (Rahaman et al., 2019) as illustrated in Figure 4.2. It is surrounded by rural hinterland lying as a ring around the metropolitan area and acting as a shielding green belt. It consists of a complex set of administrative entities of 4 important municipal corporations (MC) of South Bengal (Kolkata, Howrah, Chandernagore and Bidhannagar), 38 municipalities, 77 Census towns (CT), 16 outgrowths, 445 rural villages and three satellite townships (Rahaman et al., 2019).

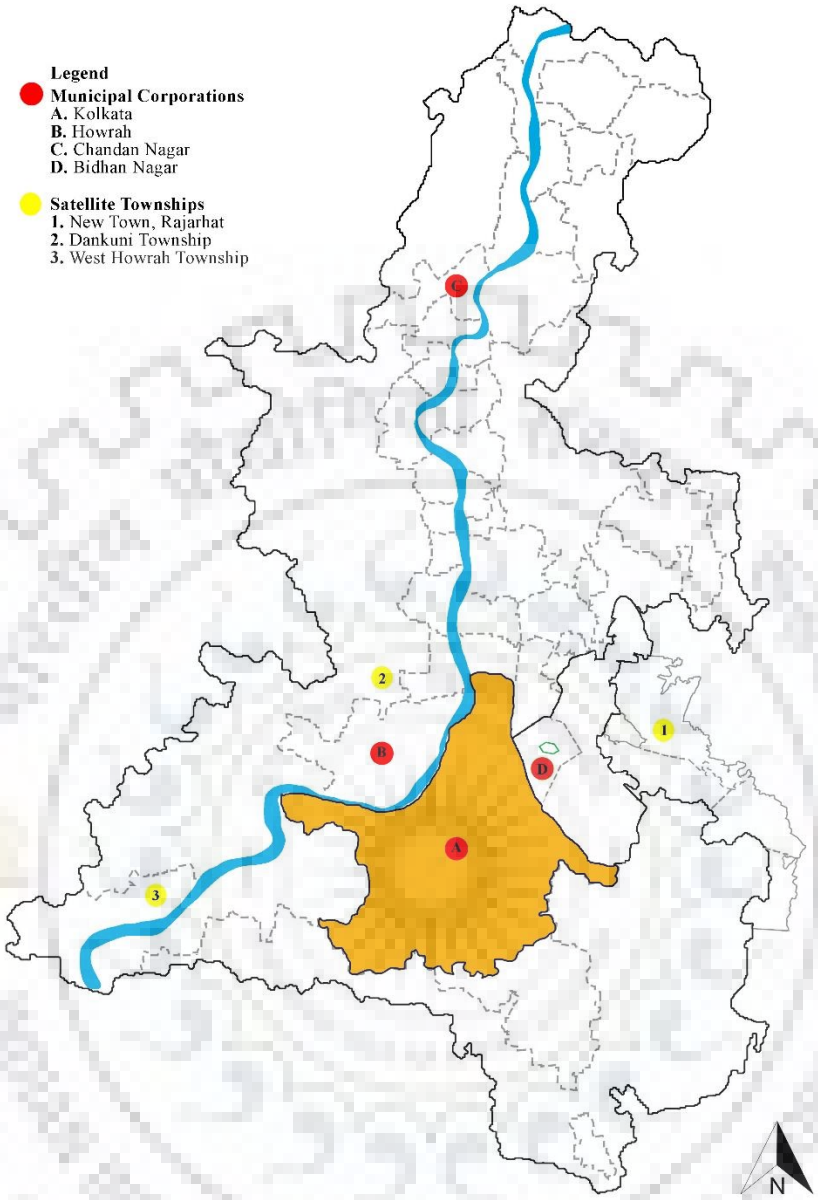


Figure 4.2 Kolkata Urban Agglomeration (KUA) map (source: author)

The present urban form of KUA is a result of complex historical, political, cultural and socio-economical layers. Being the only mega agglomeration hub of economic, political and business activities as well as the educational and cultural pivot of Eastern India, Kolkata has held enormous geopolitical importance since the colonial era. However, despite its significant position, the city planning was majorly characterised as chaotic. One of the reasons was the least priority given to planned settlements by the Britishers. Instead, they viewed the city from a single lens of acquiring

commercial gains in the quickest way possible (M. Chatterjee, 1990). Predictably, it resulted into the issues of urban inequity between the colonial rulers and the natives in terms of their access to open spaces, well-maintained roads and connectivity with the city's central business district. The areas occupied by the natives were termed as 'black towns', while the ones occupied by the ruling class were termed as 'white towns'. Researchers have frequently pointed out that the most striking distinguishing feature of these two 'towns' was the density of the urban fabric- the sparsely distributed buildings of the while town as opposed to the close-knit fabric of the black town (Chattopadhyay, 2000). Geographically, the black towns comprising primarily of the residential and three-tiered commercial network of import-export, wholesale bazaars and retail markets, were located in the northern part of the city. While the white towns primarily comprising the Victoria Memorial, supreme court, critical administrative buildings, and several garden estates were located in the city's southern part.

Interestingly, from the native's point of view, instead of 'black or white towns', the city was divided into a host of *paras*, *tolas* and *tulis*, all terms used to distinguish localities (Chattopadhyay, 2000). The *paras* formed the spatial units similar to a neighbourhood, existing at a liminal space, straddling the dimensions of cultural and spatial demarcation (K. M. Sengupta, 2017). Essentially rural in its origin, the Bengali word *para* denotes to the localities demarcated initially by their inhabitants, belonging to a particular caste or profession. In the later part of the nineteenth century, the caste or profession-based demarcation was replaced by more heterogeneous middle-class neighbourhoods (A. Ray, 1902). At the same time, these native neighbourhoods began expanding out of their core areas, blurring the lines between the white or black towns.

The inhabitants of the *paras* maintained an obligatory, amicable relationship with each other and though occasional feuds and quarrels were common, the sentiments of pride, association and sense of territoriality kept them united. (Dasgupta & Tyagi, 2021). Hence, the paras were essentially territorial in nature with a strong sense of community and attachment ingrained within its inhabitants. This community developed around institutions like libraries, sporting clubs, literary and other cultural associations which were mostly established through the collective voluntary contributions of the inhabitants of the *para* with a substantial donation from the wealthier inhabitants in many cases (Dasgupta & Tyagi, 2021). Such an environment nurtured discussions and reflections on essential issues of the date, leading to several cultural norms and orders which

configured the urban unit. One such practice, quintessentially originating out of the cultural customs of meetings and discussions in a para was *adda* (K. M. Sengupta, 2017).

An *adda* is a form of informal social talk whose content is essentially of intellectual significance. It is done [the Bengali verb is "give"] among friends, neighbours and colleagues, spanning issues of politics, art, literature, music and science and has become synonymous with the urban middle-class Bengali identity and culture (Fruzzetti & Östör, 2003). It is imperative to note that the salient feature of *adda* was its urban setting and its location in the public sphere where the young, middle-class men of Kolkata engaged in the activity on "ro'aks" (elevated platforms outside a dwelling house), markets, parks and playgrounds, canteens and bus stops.

After independence, in the later part of the twentieth century, the culture of *adda* witnessed the advent of indigenous clubs in various neighbourhoods in response to the elitist British clubs (Dasgupta & Tyagi, 2021). These clubs concretized the domain of *adda* in the *paras*, providing a defined space in the neighbourhood to partake in the genre. Many of these local clubs were the strength of the *para*, providing assistance to the residents in times of crisis and serving as the muscle of the community. From providing a platform to position the deliberations and opinions of residents to organising cultural programmes, community religious festivals (like Durga puja, Kali puja, etc.) and contributing to social causes like blood donation camps, disaster relief, etc. At present, these clubs form an integral part of the urban social dimension. The *para* thus, as the point of origin for such institutions and activities, was not only a residential unit but also an urban social unit with strong cohesion in the community (Dasgupta & Tyagi, 2021). It provides a secure territory in the dynamic urban environment imparting a sense of trust and security among its inhabitants, which still exists in many neighbourhoods of the inner-core areas of Kolkata. Figure 4.3 provides a collage of images showing Kolkata's historical, transportation, cultural, social and built environment characteristics.

Eventually, owing to Kolkata's geopolitical position and subsequent years of enormous unchecked internal and cross-border migration from neighbouring states and countries (especially Bangladesh), the city experienced an escalated horizontal and vertical urban expansions. This gave shape to the current land-use of Kolkata, characterised by an extremely dense built-up core along with large scale linear residential development in its adjoining peripheral areas (Haque et al., 2019).

Figure 4.3 Collage of images showing Kolkata's historical, transportation, cultural, social and built environment characteristics. Starting from the top left the image shows (a) pedestrians, trams and city buses moving on the arterial road at Esplanade in the 1960s (source: oldkolkatablogspot.com); (b) the everyday mobility in the city's main shopping district of 'Bara Bazaar' (Source: Shreya Rathi, 'A day's trip to the city of joy & sheer happiness', 2016); (c) a typical Durga puja 'pandal' at Deshapriya Park, 2019 (Source: author); (d) daily morning activities at Hooghly river ghat near Hooghly bridge (Source: Calcutta Riverfront Cultural Heritage & Diasporas, 2020); (e) residents indulging in *Adda* while sitting on a "ro'ak" (Source: Bidisha Banik "10 absolute reasons why you must visit "The City of Joy", 2016); and (f) a typical view of a local street in the city's inner-city core areas (Source: Alex Vadukul "Filthy Gorgeous', 2011).

It is in the early 1960s after independence that such residential development began in the peripheral areas that include the present neighbourhood of Salt Lake. Salt Lake's development was planned with ample green open spaces and broad streets that enabled unhindered vehicular movements and segregated land-use. The buildings are multistoried structures, most being three-storeyed or more with parking space on the ground floor. With the onset of the 21st century, the city started expanding eastward and is currently developing high-rise gated community townships owing to the increase in population. Presently, out of the three townships, New Town, Rajarhat is under development while the other two are either partly developed or remains under proposed state (Roy, 2019).

Evidently, looking at the evolution of Kolkata's urban structure, the neighbourhood typologies can be categorized as inner-city core areas, post-independence planned areas and growing high-rise peripheral areas.

4.3.2.2. Urban Mobility

As a multi-functional and polycentric city, the area under Kolkata Municipal Corporation (KMC) has only six per cent road space, narrow street layout and congested residential layout (especially the old core areas) along with an extensive network of public or intermediate public transport (IPT) (Bardhan et al., 2015). The public transport options include bus, suburban railways, metro, tram, shared auto-rickshaws, hand-pulled rickshaw (only in Kolkata Municipal Corporation), yellow-taxis, other sharing transport modes (bike-taxi, OLA/Uber) and ferries. In fact, Kolkata is the only city in India where tram and hand-pulled rickshaw still exists as an option for the daily commute. The limited amount of road space has favoured a highly permeable walkable system for shorter distances (3-4 km) which amount to 60% of total trips in the city (Bardhan et al., 2015; CSE, 2011). This is reflected in the city's modal share as illustrated in Figure 4.4, where public transport, walking and cycling are revealed as the most preferred transportation modes.

Despite the availability of diverse public transport options and walking systems, a recent trend towards increasing private vehicular ownership is observed. Between 1998 and 2008, car ownership by households increased from a mere 1.73 per cent to 11 per cent, and the ownership of two-wheelers increased from 5.67 per cent to 16.5 per cent. While, the number of households that did not have any vehicle has fallen from 61 per cent to 49.2 per cent (Chakrabartty & Gupta,

2014). Also, the encroachment of a large section of road space by hawkers creates further issues resulting in congestion. Consequently, the lack of any holistic transport planning to deal with these situations leads to a bottleneck situation (Haque et al., 2019).

Studies suggest that Kolkata needs to focus on improving their public transport systems. As despite the increase in private vehicle ownership, it caters to only 6 per cent of the passengers occupying 29 per cent of the road space, while buses serving 76 per cent of the population occupies only 32 per cent of the road space (Chakrabartty & Gupta, 2014).

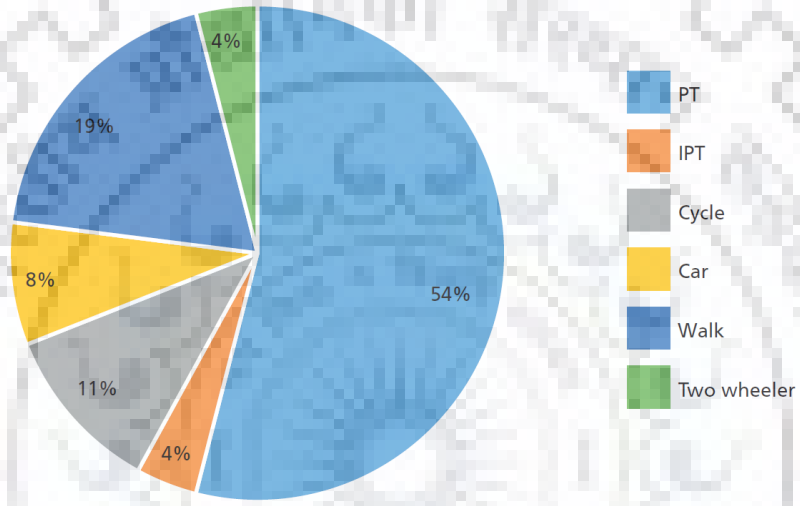


Figure 4.4 Modal share in Kolkata (Source: Study on traffic and transportation policies and strategies in urban areas in India, Ministry of Urban Development (2008) published in reducing footprints: A guidance framework for clean and low carbon transport in Kolkata (2018))

4.4. Sampling Strategy

The cross-sectional data were collected from children aged 7-12 years and their parents belonging to middle-income households, employing a purposive sampling technique. As per environmental psychology (Spencer, 2006), 12-year-olds are generally most physically active and easily navigates within their neighbourhoods; while developmental psychology (Piaget, 1955) confirms age seven years and above as a stage where the representation of physical environment becomes more coordinated. This is supported by the focus on middle childhood under the protocols of several international studies including 'Growing up in Cities' project by UNESCO (Lynch & Banerjee, 1977), Hillman's CIM study (Hillman et al., 1990) and the recent 'Kids in the City' project (M. Oliver et al., 2011). Nationally, the investigation on children's play

provision (Bhonsle & Adane, 2016) and their travel to school (Tetali et al., 2016) also focused on the same age group.

4.4.1. Selection of Schools

A total of thirty-five schools were identified in all three neighbourhood typologies (discussed in the previous section) and were contacted by email or telephone for fixing an appointment with the Principal or head of the institute. The detail of the approach email to school Principals is provided in Appendix III. Twenty-one schools were then individually visited to explain the study objectives and obtain their interest in participating in the research. Only seven schools agreed to participate; rest declined, citing tight academic schedules and issues with obtaining parent's information. Out of these seven, six were private schools, and one was a government school. Except for differences in school fee, there were no significant differences between the private and government schools. This difference automatically translated into a slight disparity between families' household income, sending their children to these schools. Except in neighbourhood 1, the schools selected in other neighbourhoods were all co-educational. Therefore, to balance the gender ration, another school (girls' school) was selected located adjacent to the previous one (boys' school). On the other hand, in neighbourhood 2, the first school selected was smaller in terms of student intake. Therefore, to balance out the participatory rate, another school located in close proximity with overlapping 800m buffer was selected. Thus, a total of seven schools across five neighbourhoods were finalized.

4.4.2. Finalized Neighbourhood Typologies

The five neighbourhoods are broadly categorised under three typologies of low-rise, mid-rise and high-rise neighbourhoods. Figure 4.5 shows the location of selected neighbourhoods on the map. Introduction of the neighbourhoods is provided in the following sections.

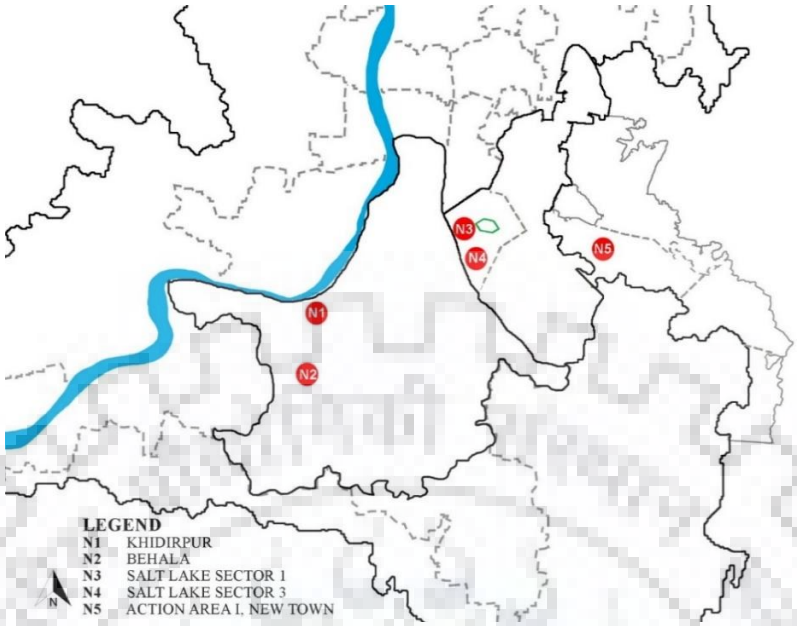


Figure 4.5 Kolkata Map showing selected neighbourhood locations (source: author)

4.4.2.1. Low-rise neighbourhoods

N1: Khidirpur

Khidirpur is one of the oldest neighbourhoods located in South Kolkata about 5 kilometres from the city's Central Business district (CBD) adjacent to river Hooghly, Fort William and Victoria Memorial. It lies under the KMC, where the proportion of children is 27% of the total population. Kolkata Port Trust has one of its major and oldest operating docks located in this area. Figure 4.6 shows the land-use map of Khidirpur. Two schools (one boys' and one girls' school) selected in this neighbourhood share their boundaries with Khidirpur market in the north; Kolkata Armed Police Headquarter campus (with staff residential quarters) in the south; residential areas in the west (across the Diamond Harbour road) and Alipore Zoo in the east. As seen from the map, the neighbourhood has narrow street widths, lack of green open spaces, high population density and proximity to services like hospitals (Calcutta Medical Research Institute (CMRI), Woodland Hospital, Kothari Medical Centre) schools, shopping areas and a National public library. The nearest open space for outdoor activities is at a walking distance of 2.5kms from the neighbourhood called Maidan (city's largest urban park), considered 'lungs of the city' (S. Banerjee & Dey, 2017).

The spatial structure exhibits a compact design with an extensive network of public/intermediate public transport (IPT) within limited road infrastructure (6%) (Bardhan et al., 2015). The public

transport options include bus, suburban railways, metro, tram, shared auto-rickshaws, hand-pulled rickshaw and taxi. Within selected neighbourhood boundary, these all options are available except suburban railways and metro services. Despite these options, walking is the popular mode of transport amounting to 60.0% of total trips for shorter distances (3-4 km) in this neighbourhood (Bardhan et al., 2015; CSE, 2011). The housing typology similar to found in old parts of North Kolkata can be categorised as low-rise with single-family or joint family structures displaying an array of vernacular and hybrid colonial styles (Annapurna Shaw, 2015). Demographically, Khidirpur is home to low, middle and upper-income families. Figure 4.7 shows the residential areas of the neighbourhood.

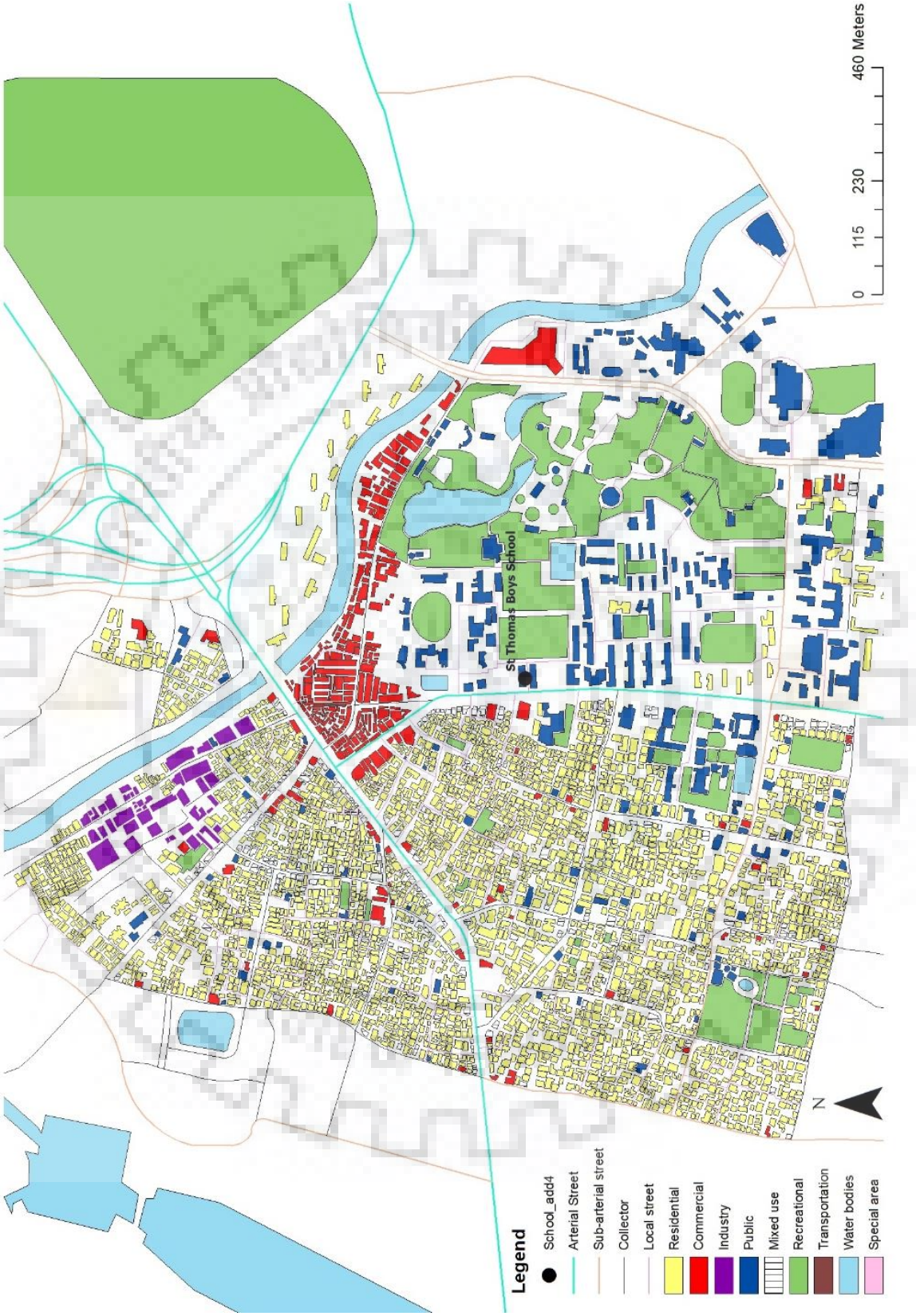


Figure 4.6 Land-use map of Khidirpur (source: author)

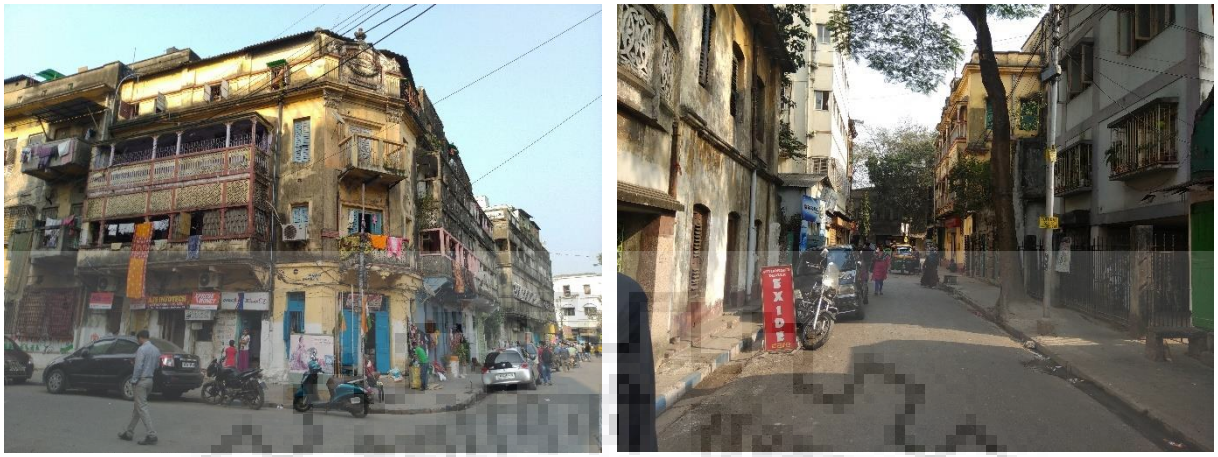


Figure 4.7 Residential areas in Khidirpur (source: author)

N2: Behala

Behala is also one of the oldest residential neighbourhoods under KMC and encompasses one of the city's largest suburban agglomerations. The history of Behala dates back even further than Kolkata when it was called *Bahula,* meaning 'the land of many rivers' or 'dark city'(Chaudhuri, 1990). Originally composed of small villages and home to some of the wealthy and famous *Zamindari*[1] families, today, this neighbourhood is urbanised beyond recognition with high residential density and large-scale migration of working-class (Chaudhuri, 1990). It consists of several small localities and urban villages within its administrative boundaries. It experiences huge population growth, especially since the 1980s due to a large-scale migration of daily wage earners and the working class in this part of the city, resulting in haphazard and unplanned growth of the neighbourhood. Figure 4.8 shows the land-use map of Behala. As seen from the map, the neighbourhood is subdivided into two parts of West Behala and East Behala, on each side of the main Diamond Harbour road (DHR). This is the arterial road which experiences heavy traffic throughout the day despite the availability of parallel James Long Sarani as an option. The two schools (to balance the participatory rate) selected in this neighbourhood is located in the dense residential area of the neighbourhood. Majority of commercial and institutional areas includes shops, hospitals, banks and government offices are located along the DHR. Like Khidirpur, this

[1] *Zamindar* was a term given by the Mughal rulers to the existing categories of landholders and was a blanket term invented for administrative convenience. They usually held an enormous tracts of land and control over peasants, from whom they reserved the right to collect tax on behalf of imperial courts or for military purposes (R. Ray, 1975).

neighbourhood also lacks green open spaces and children are found to play outdoors on neighbourhood streets. Figure 4.9 shows the residential areas of the neighbourhood.

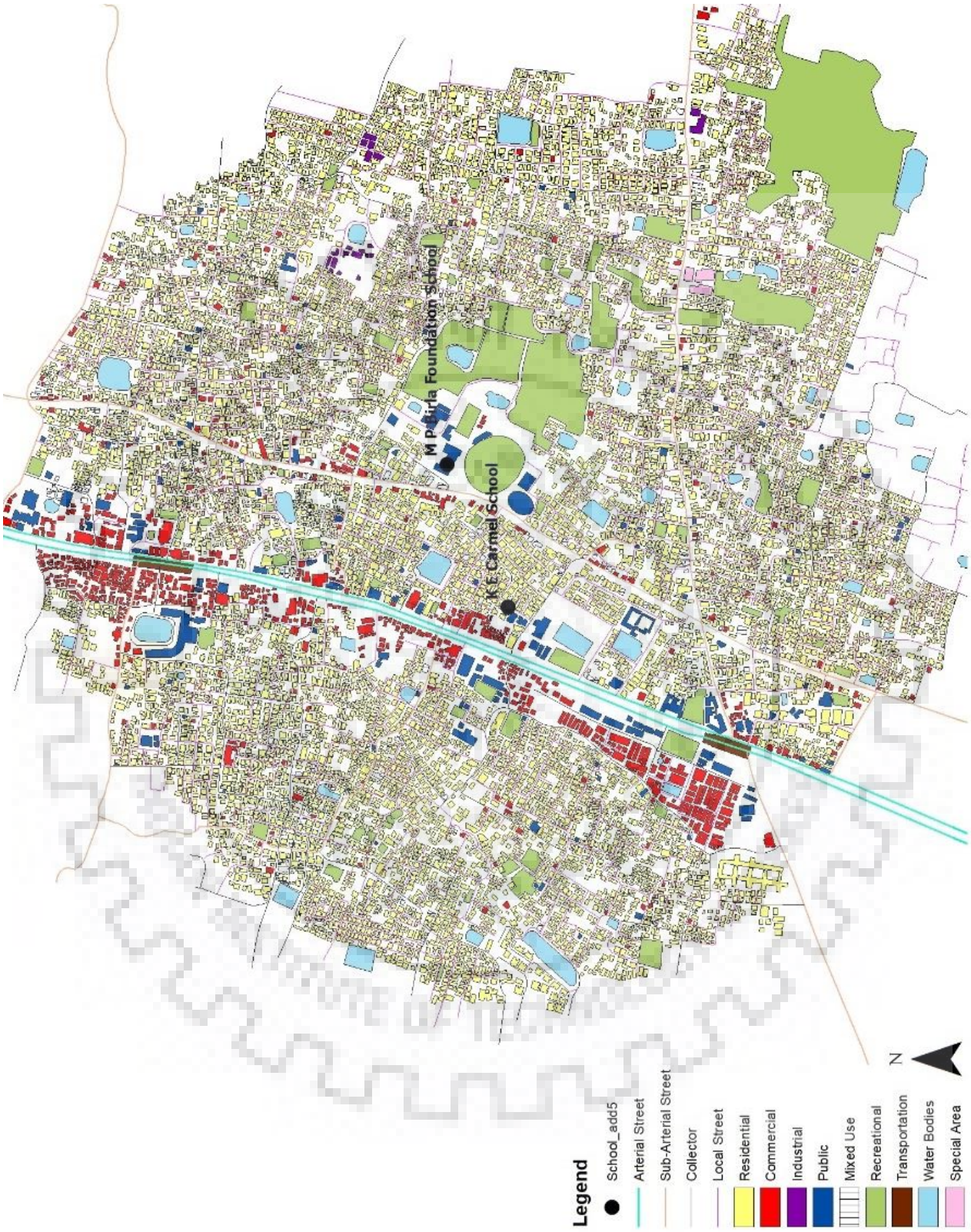


Figure 4.8 Land-use map of Behala (Source: author)

Figure 4.9 Residential areas of Behala (Source: author)

4.4.2.2. Mid-rise neighbourhoods

Two mid-rise neighbourhoods were selected for the research in the Salt Lake area of the city under the Bidhan Nagar Municipal Corporation (BMC) (Figure 4.10). The proportion of children in BMC is 26% of the total population. Salt Lake was envisioned as a planned neighbourhood by the state government in the 1960s to combat the critical shortage of land availability in the city (Rumbach, 2014). Built on land recovered from the wetlands of the city's north-eastern fringes, the neighbourhood's spatial planning is based on a Sector model. It is characterised with gridded blocks, wide streets and equal distribution of green spaces. The influence of the Avant grade visions of modernity and industrialization is hence can be observed in the master plan of Salt Lake City by Yugoslav urban planner Dobrivoje Toskovic.

There are a total of five sectors with Sector 1 to 4 developed as residential areas and Sector 5 as Kolkata's first IT (Information Technology) hub with offices of many governmental and multinational organisations located here. The neighbourhood is connected with the other parts of the city via public bus, e-rickshaws and private taxis. Recently (February 2020), Kolkata metro's east-west line has started operating in Salt Lake between the stadium and Sector 5, which is expected to connect Salt Lake with Howrah in coming years. Presence of government and private office buildings and IT (information technology) hub, has led this neighbourhood to emerge as a new administrative and economic centre of Kolkata, successfully attracting a huge set of educated middle and upper-income urban class (Mukherjee, 2012). Besides this, Salt Lake also attracts a vast national and international crowd to its international football stadium, book fairs, food

festivals, art and craft festivals, music and other cultural programs that happen year-round. This research limits itself within Sector 1 and 3 of the neighbourhood owing to the consent obtained from schools for participation.

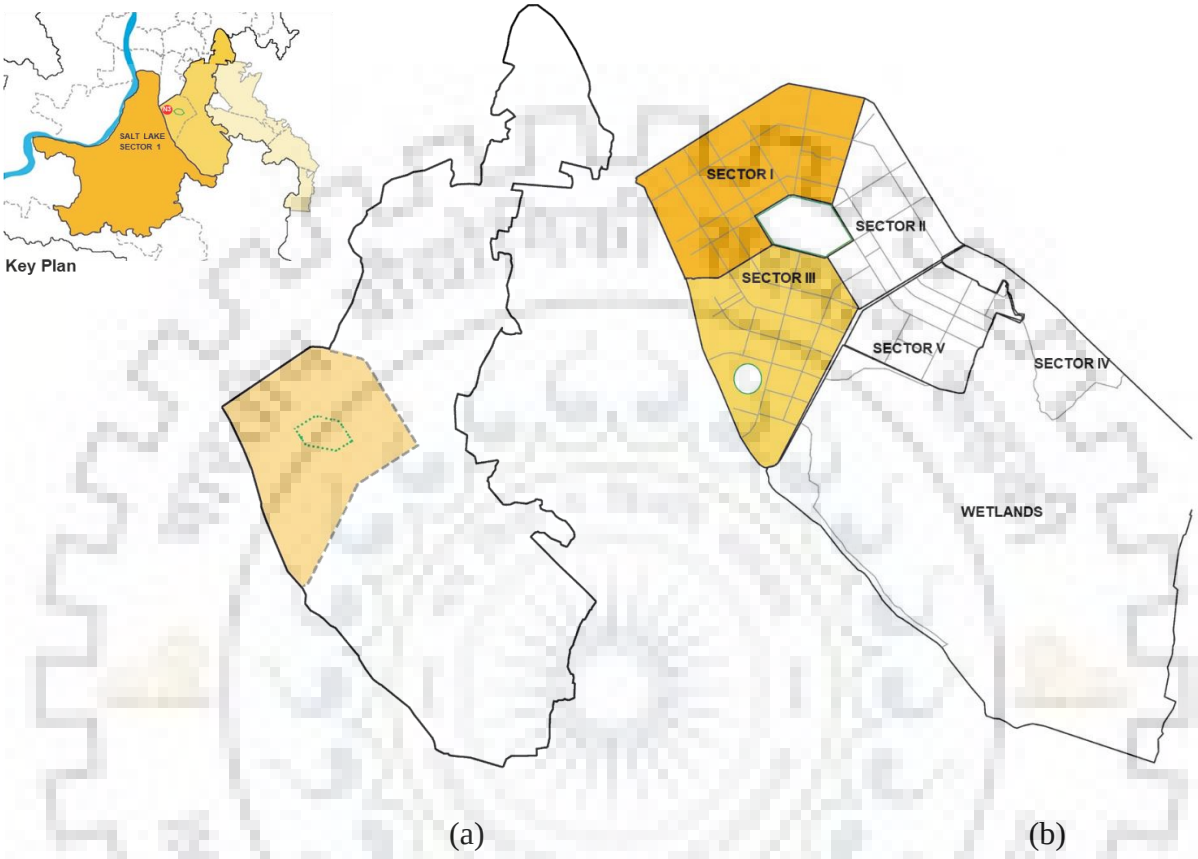


Figure 4.10 Map showing (a) Bidhan Nagar Municipal Corporation boundary and (b) sectoral division of Salt Lake (Source: author)

N3: Salt Lake Sector 1

This sector is the oldest and first among the others to develop in the early 1960s completely. Initially, a two-storey restriction was placed on the buildings, which was later removed (Bhattacharya, 2008). Thus, currently, the housing typology is categorised as mid-rise with single-family or joint family structures. Figure 4.11 shows the land-use map of Salt Lake Sector 1. The school selected for this neighbourhood is government-owned and located within the residential area of the sector. This sector's major landmarks include a shopping mall (City Centre), state government offices, hospitals, and government bank headquarters. Figure 4.12 shows the residential areas in Sector 1.

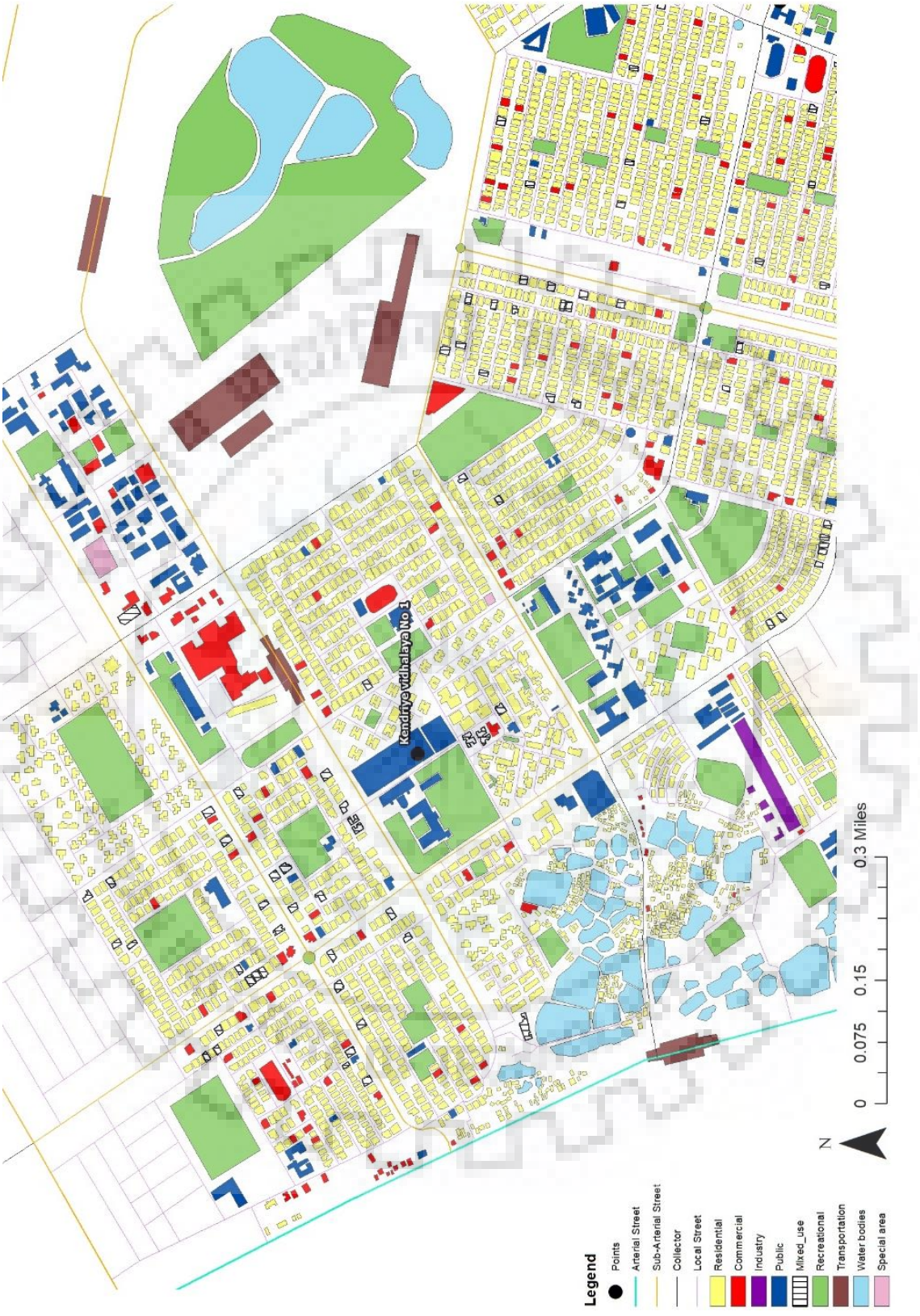


Figure 4.11 Land-use map of Salt Lake Sector 1 (Source: author)

Figure 4.12 Residential area in Salt Lake Sector 1 (Source: author)

N4: Salt Lake Sector 3

This sector shares the boundary with Sector 5 and hence experiences a heavy traffic volume during office hours. It comprises Salt Lake football Stadium, a sports complex of Sports Authority of India (SAI), government offices, government colleges, hospitals and bank headquarters. Figure 4.13 shows the land-use map of the neighbourhood. The school selected in this neighbourhood is located in the residential area and caters to a large population of local children. Figure 4.14 shows the residential areas of the neighbourhood.

Figure 4.13 Land-use map of Salt Lake Sector 3 (Source: author)

Figure 4.14 Residential areas in Salt Lake Sector 3 (source: author)

4.4.2.3. High-rise neighbourhood

N5: Action Area I, New Town, Rajarhat

By the turn of the 21st century, another planned neighbourhood, three times the size of Salt Lake was proposed. This satellite township, named New Town (Rajarhat) covering a total of 67 square kilometres (Biswas & Singh, 2017), was planned to accommodate gated high-rise residential complexes for all income classes, the city's second IT hub, business zones, university campuses, hotel chains and several large-scale shopping malls (D. Mitra & Banerji, 2018). It comes under New Town Development Authority, where 28% of the total population are children. Projected to be the city's eco-friendly neighbourhood, it was designed to develop in four phases or action plans. Action area II occupies the highest amount of total land of the project comprising of the CBD having headquarters of several national and multinational companies located here. Currently, Action Area I, consisting of mostly residential and commercial areas, is complete and work on other phases is under process (Karmakar, 2015). It is for this reason; the neighbourhood is not well-connected with other parts of the city in terms of public transportation. Originating bus routes are few, and buses are sporadic plying only during office hours (Biswas & Singh, 2017). The east-west Kolkata metro proposed has one of its major transit stations for New Town connecting it with the international airport by next two years. Thus, the connectivity issue is projected to improve in the coming decades. Figure 4.15 and 4.16 shows the land-use map and built environment of the neighbourhood respectively.

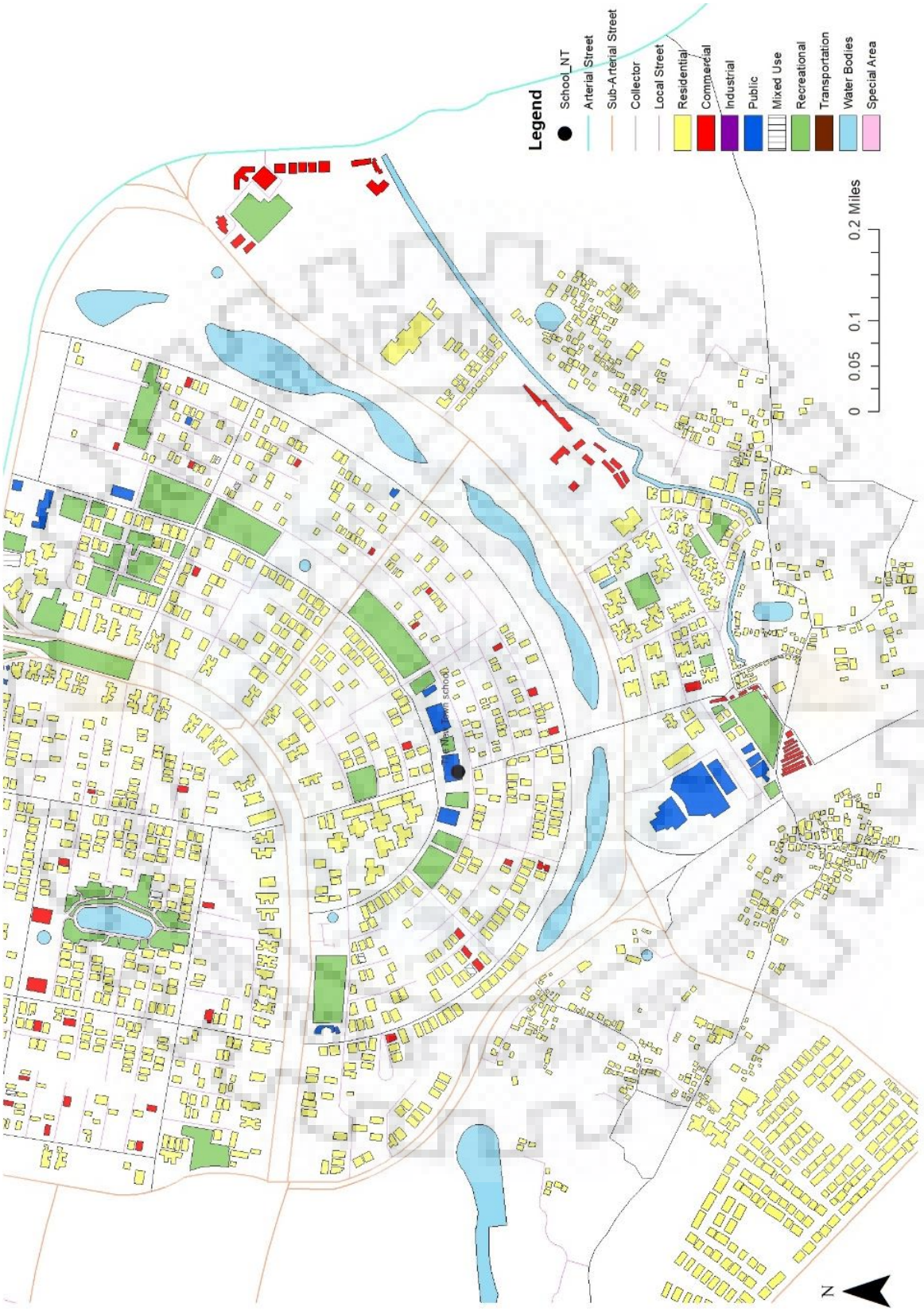
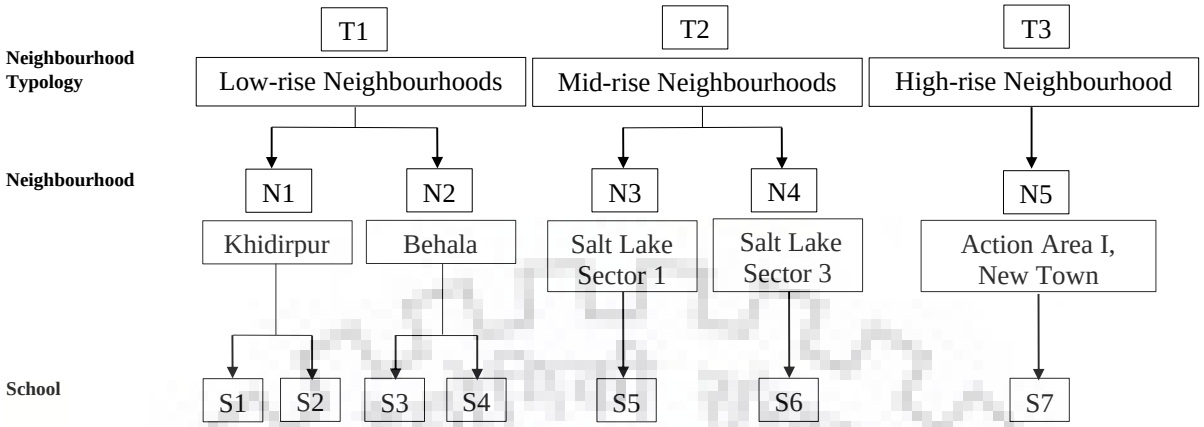


Figure 4.15 Land-use map of Action Area I, New Town (Rajarhat) (source: author)

Figure 4.16 Built environment of Action Area I, New Town (Source: author)

4.4.2.4. Comparative Overview

To summarize, the above-discussed three neighbourhood typologies were distinct from each other not only in terms of verticality but also in terms of location, time-period, road proportion and transportation options. Figure 4.17 illustrates these key differences while providing a comparative overview of the same. From the Figure, it is evident that besides other factors, the difference in proportion of road was substantial. Low-rise neighbourhoods, despite having the minimum road percentage, was catering to diverse mobility options. On the other hand, the high-rise neighbourhood having 50% of its area under road and open spaces was supporting limited public transport.



Location	Inner-city core	Eastern periphery	Satellite township
Building Time-period	Pre-independence	1958-1965	2007-present
Road %	6%	23%	50% (including green open spaces, drains and water bodies)
Transport options	Bus service (government and private funded), suburban railways, metro, tram, shared auto-rickshaw, hand-pulled rickshaw and private taxi	Bus service (government and private funded), e-rickshaw and private taxi	Bus service (government and private funded), and private taxi

Figure 4.17 Comparative overview of five selected neighbourhoods across three typologies

4.4.3. Sample Size Calculations

The sample size calculation was done using the formula for finite population and categorical data, as shown in Equation 1:

$$\text{Sample size (n)} = \frac{Z^2 \times N \times p \times q}{(N-1)e^2 + Z^2 \times p \times q} \qquad (1)$$

Where, z value is 1.96 for 95% confidence level; e value (margin of error) thus is 0.05; p, percentage picking a choice, expressed as a decimal (0.5); q is calculated as 1-p and N is the population size. The total students from seven schools and five classes (class 3to 7), taking an average of 40 students in three sections each comes out as 4200. Assuming that 40 per cent are local students residing in the surrounding neighbourhood, N comes out to be 1680. Thus, the overall sample size of 313 or above will be appropriate for the research.

4.4.4. Participant Recruitment

Participant recruitment was done in four phases. Figure 4.18 summarizes the sequence of data collection with the participants. In phase I, before initiating the survey process, participating school

Principals and teachers were provided with a brief presentation of study protocols (Appendix IV) along with a sample of children's and parent's questionnaire sheet (Appendix IA, IB, IC, II).

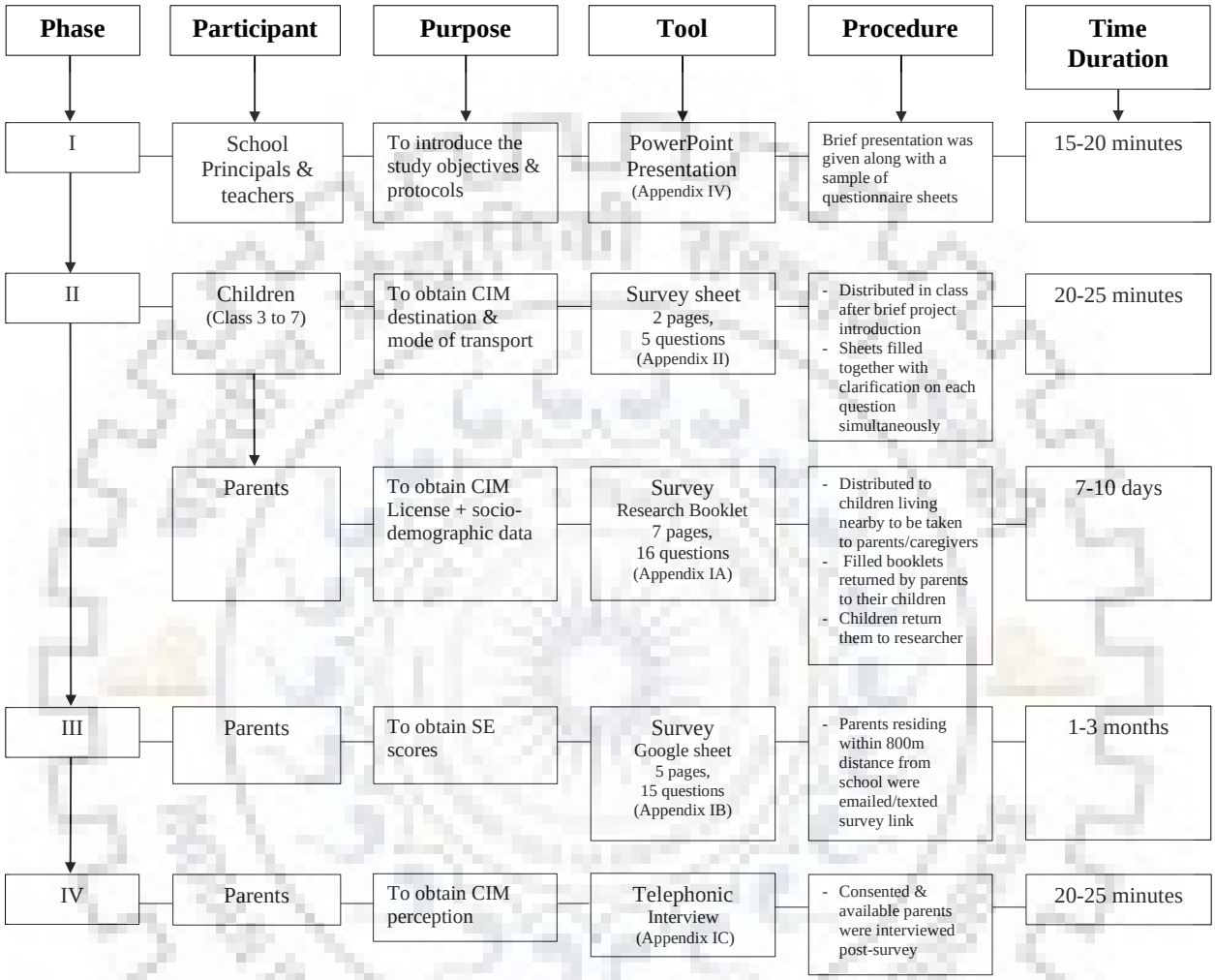


Figure 4.18 Sequence of data collection with children and parents

The data collection survey was conducted in two phases in April 2019 coinciding with the beginning of a new academic session in the majority of the schooling systems in India. In phase II, the researcher visited each section of the class and introduced children with the study objectives using presentation slides (Appendix V) or sketches on a blackboard (whichever feasible with class teacher's permission and schools' infrastructure). Children's questionnaire was then distributed to each child with the help of a class teacher and class monitor (a post usually given to the class's best performing child or a child exhibiting leadership qualities by the teacher for assistantship in

daily administrative and disciplinary duties within Indian education system). Children were asked to report their name, age, gender, class (educational class), section and home address in neat handwriting. Children from younger classes were encouraged to copy their residential addresses from their school diaries (since school diaries are a reliable source of exact residential addresses often filled by the parents or caregivers themselves). Next, children were asked to provide details on their mode of transport and accompaniment status to six local destinations (finalized from the pilot study). The entire exercise was conducted with the researcher reading aloud each question with detailed explanation in children's preferred languages (Hindi or English) and children simultaneously filling in the details as a group. This approach assisted in clarifying children's doubts regarding any question at the same time. Notably, despite many children belonging to native families having Bengali as their mother tongue, they were comfortable in understanding and speaking both Hindi and English. The whole session took 20-25 minutes each, including the children's sheet distribution and collection. In this way, data from a total of 2884 children were collected across all seven schools.

At the end of each session, children residing in the nearby localities or neighbourhoods were identified with the help of the class teachers and cross-checking with their residential addresses from school dairies. These children were provided with parent's questionnaire booklet to be taken home to their parents and return the filled booklet to the class teacher after one week. Parent's questionnaire booklet included an introduction and consent form for participation agreement in the research. Parents were free to self-select (mother or father) among themselves to fill the booklet. In case of parents having more than one child between the selected age-group, they were asked to respond with reference to any one of the children as per their preference. Parents entered the particulars of their full residential address, gender, educational qualification and employment status; child's age and gender; type of family (joint/ nuclear) and vehicular ownership. The booklets were collected after one week, with the second round of collection two days later to account for late responses.

Out of 1026 invites, a total of 739 parents returned the filled booklet, generating a response rate of 72%. Prior to phase III, the parents' addresses thus received were re-checked using Google Earth for inclusion in the study. In phase III, selected and consenting parents were sent an email or phone message with a Google Form obtaining their neighbourhood SE scores. Finally, the data of only

those children and parents were included in the analysis who responded with complete details in both parts (673 out of 739) of the survey process. This number was higher than 313, validating the sample size for the study. In the last phase, a brief semi-structured interview was also conducted on the phone with the consenting and available parents (22) enquiring their perception and concerns regarding CIM.

4.4.5. Ethical Considerations

Research with children involves a number of ethical issues. Consent from both parents and children must be taken before involving children for research. Most recently, the UNCRC added an essential element to consent, which stated that a child has to be competent to understand what is proposed, and the intervention needs to be in his or her best interest. The term 'best interest' implies ensuring children's well-being, which is determined by several individual circumstances such as age, level of maturity, presence or absence of parents, the child's environment, and experiences.

Therefore, this research followed the code of researching with children by introducing the research problem to both children and parents through information sheets. It briefly described the research agenda, point of involvement of children and parents and procedure for the same. Secondly, data of only those children and parents were included who provided their consent to participate in the research. Thirdly, participant names were kept anonymous, and each participant was given a code while analysing or presenting the data. The researcher also provided the contact details to the consenting participants to follow up with the project. This way, trust was built between the participants and the researcher.

4.5. Contextualization of Measures

To collect data on CIM and neighbourhood environmental variables, tools were first contextualized by conducting expert opinion surveys and a pilot study in Delhi. This process was essential to refine and revise the tools in Indian context before employing for the main study in Kolkata.

4.5.1. Expert Opinion and Validation

The literature review provided a set of questionnaires to measure CIM and a list of comprehensive factors influencing CIM. These factors were clustered together in terms of their occurrence, and similar or overlapping factors were eliminated. The factors were then categorized under built, social and individual dimensions accordingly. To obtain opinions about these measures, a panel of six experts from diverse backgrounds were finalized, as presented in Table 4.1. The selection was based on their experience of working in the field of children and built environment within urban Indian context and their consent to participate in the research.

Table 4.1 Details of the expert panel

S. No.	Organisation	Background	Interview date	City
1	National Institute of Urban Affairs (NIUA)	Architect & Urban Planner	30th April 2018	Delhi
2	Bernard van Leer Foundation, India	Psychologist and child right's law specialist	11th May 2018	Bhubaneswar
3	Humara Bachpan Campaign	Sociologist & psychologist	17th May 2018	Bhubaneswar
4	IBI Group	Architect & Urban Designer	13th May 2018	Bhubaneswar
5	National Institute of Urban Affairs (NIUA)	Architect & Urban Designer	14th June 2018	Delhi
6	Action for Children's Environment (ACE)	Architect & Urban Researcher	5th July 2017	Delhi

The opinions were obtained in a two-step process by first conducting individual discussions (conducted in April, May and July 2018) to finalise influencing factors, followed by a short online survey for content validity of CIM measure. These experts were mainly from Delhi and Bhubaneswar working in government, private and non-government organisations at different levels. In each discussion session, experts were asked to rate according to their preference of factors that most affect CIM within the Indian context. This resulted in the selection of seven out of eleven factors to be used for the pilot study. These seven factors under two categories were: (1)

Built-environment (BE) variables: (i) Land-use mix, (ii) Street connectivity, (iii) Traffic exposure (iv) Residential density; and (2) Socio-environment (SE) variables: (i) Social cohesion, (ii) social connection and (iii) neighbourhood safety. The factors under the third category of individual variables included child's age, gender, parent's gender, education and employment status, family type and vehicular ownership.

Next, these same experts were sent an email containing questions for obtaining content validity index (CVI) for revising the CIM and SE variable scales. Content validity concerns the degree to which a sample of items, taken together, constitute an adequate operational definition of a construct. As noted by Lynn (1986), researchers compute two types of CVIs. The first type involves the content validity of individual items (I-CVI), and the second consists of the content validity of the overall scale (S-CVI). Experts were asked to rate each scale item in terms of its relevance to the underlying construct. Lynn (1986) advised a minimum of three experts but indicated that more than ten was probably unnecessary. Thus, a group of five experts (one expert declined to participate in the survey) were sufficient for obtaining CVI.

By tradition, and based on the advice of early writers such as Lynn, as well as Waltz and Bausell (1981), these item ratings are typically on a 4-point ordinal scale to avoid having a neutral and ambivalent midpoint. Total four criteria are used to evaluate the measure (Rubio et al., 2003): (1) Representativeness is demonstrated by an item's ability to represent the content domain as described in the theoretical definition; (2) clarity is evaluated based on how clearly an item is worded; (3) factor structure, categorizing each item under several factors and (4) comprehensiveness, where the experts are asked to consider the entire measure and specify the addition or deletion of any item. Out of the above four, factor structure was eliminated since the scale only consists of one factor. Table 4.2 presents the five experts' representativeness rating on six items (or questions) of CIM licence. From the table, it is evident that I-CVI of only two items are above the acceptable value of 0.83 and above (Lynn, 1986). The overall scale level CVI (S-CVI) is 0.83, which is above the acceptable value of 0.8 (Polit et al., 2006) (The S-CVI value is computed using the average method).

Table 4.2 Expert ratings on the representativeness of the six items of CIM licence

Item description	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Number agreement	I-CVI
1	3	3	3	3	4	5	1
2	3	3	3	2	3	4	0.8
3	4	2	4	4	4	4	0.8
4	2	2	3	4	4	3	0.6
5	4	2	3	4	4	4	0.8
6	4	4	4	4	4	5	1

Table 4.3 presents the clarity rating of experts on six items of CIM licence. From the table, it is again evident that except item 1 and 6, rest item I-CVI values fall below the acceptable range of 0.83 and above. However, the S-CVI value of 0.8 confirms the validity on clarity parameter of the scale.

Table 4.3 Expert rating on the clarity of the six items of CIM licence

Item description	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Number agreement	I-CVI
1	3	4	4	3	3	5	1
2	4	3	3	4	2	4	0.8
3	3	2	4	4	2	3	0.6
4	3	2	2	4	4	3	0.6
5	4	2	4	4	4	4	0.8
6	4	4	4	3	4	5	1

Thus, overall, both the criterion of representativeness and clarity have S-CVI value above the acceptable range of 0.8; indicating CIM licence scale to be valid for the Indian context. However, since the I-CVI values of four items were low, minor revisions are done after individual qualitative discussions with experts. Since the majority of comments received upon the items were in the form of “change in wording” and “elaboration” of the statements, thus the six statements were further revised. The significance of local language in the scale was another point of key suggestion from

experts. Therefore, ‘Hindi’ and ‘Bengali’ translations of these questions were added along with English questions for the survey with parents. Upon asking on the scale's comprehensiveness, experts were satisfied with the items for a beginning within the Indian context. They recommended no further addition or deletion in the same.

A similar process was done for scales of CIM destination and SE variables. Experts were satisfied with the questions and provided a CVI above 0.83, for both scale and individual items. These revised scales were then tested in a pilot study conducted in Delhi. The questionnaires' reliability was later checked with an increased sample size in Kolkata using Cronbach Alpha test (explained in Chapter 5 section 5.1.3).

4.5.2. Pilot Study: Delhi

Urban Context

As India's capital, Delhi is one of the largest megacities in the world, with a population density of 11,297 persons per square kilometres (Ahmad et al., 2013). The city’s current spatial pattern is characterised by a multi-centric layout with no identifiable Central Business District (Ahmad et al., 2013; Sahai & Bishop, 2010). A significant part of Delhi remains unplanned and consists broadly of seven unplanned settlement typologies (Dupont, 2004). Out of these typologies, 567 neighbourhoods come under the category of ‘regularized unauthorized colonies’, which were developed on agricultural land with illegal means but were later regularised by the government in the late 1970s (Ahmad & Choi, 2011). This pilot study situates itself in one such typical example of ‘regularised unauthorised colony’ of ‘Panchwati, Adarsh Nagar’ under North West Municipal Corporation of Delhi (MCD) area. The neighbourhood is located near ‘Azadpur Mandi’ (Asia’s largest wholesale fruit and vegetable market) and thus experiences heavy vehicular traffic, leading to a congested road network throughout. The area is also served by two major public transportation hubs (Delhi Metro station and city bus stop) located within an 800m distance buffer. This gated neighbourhood, which was planned in the early 1960s, comprises of 79 residential plots with a central 2000 sq. m. park, housing a total of 60 families. Figure 4.19 shows the land-use map of the neighbourhood, along with its surrounding areas. The housing typology can be categorized as semi-detached, multiple dwelling, low-rise structures. The plots facing outside, towards the city arterial road have been converted for mixed-use purposes and currently include facilities such as a bank ATM (automated teller machine), a dental clinic, a low-budget hotel and a printing shop,

mainly targeting the non-residents. The access to these converted plots remains outside the neighbourhood gates but adds to the already existing traffic problem of the area.

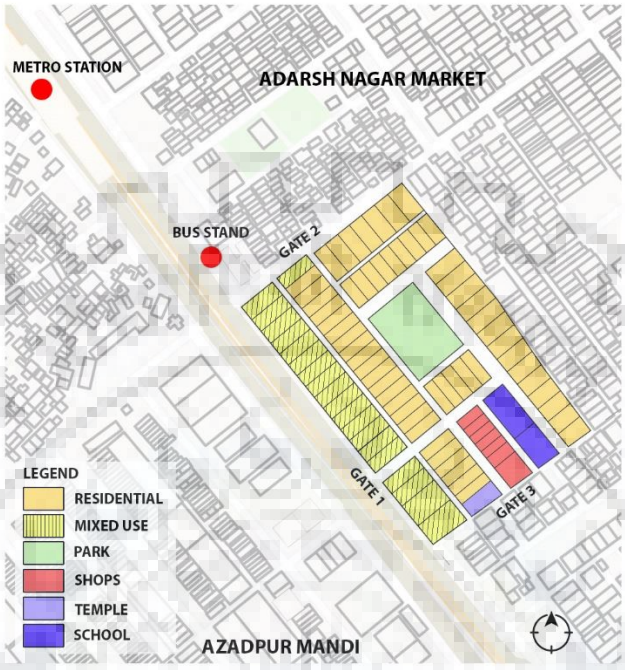


Figure 4.19 Land-use map of the neighbourhood in Delhi showing surrounding areas (Source: author)

Participant Recruitment and Analysis

The inclusion criteria for participants were parents of children aged 7-12 years, who were contacted via phone call or email, obtained through the neighbourhood's resident welfare association (RWA) office. Based on this criterion, a total of 37 families were approached, for the participation of only one parent (mother or father), self-decided by families, in the interview session. Out of 37, fifteen families agreed to participate, and prior appointments were fixed with each participating parent having at least one child in the age group of 7-12 years. Parents having more than one child in this age group were asked to respond on behalf of only one child in order to balance out the independent mobility score ratio.

A semi-structured interview was conducted with every participating parent in their respective homes (in the absence of their children). Parent's personal information related to their educational qualification, profession, family type, their child's age and gender, child's daily activity schedule, as well as vehicular ownership, was already noted at the beginning of the session. Parents were

then asked to provide their CIM licence, social cohesion, social connection and neighbourhood safety scores. Further, since this was a pilot study, qualitative information was also gathered in terms of their child's daily activity schedule, child's mode of transport and accompaniment status to local destinations, including school and the reasons for the same.

The interviews were conducted in the parent's language of preference (Hindi or English), lasting approximately 15-20 minutes each. Their responses were recorded by a voice recorder, which was transcribed verbatim. Content Analysis was conducted for each answer using NVivo 12 pro. Coding categories and sub-categories were identified by reviewing the transcripts. The measure of central tendency based on the percentage method was used to analyse CIM licence and social environment variable scores.

Result

The sample had an almost equal number of male and female children, with a majority in the age group of 10-12 years (53.3%). Out of 15 participating parents, 11 were mothers (73.3%), and 4 were fathers (26.7%), signifying mother's strong authoritative position in children's everyday mobility. Two of the mothers were working, with the rest being homemakers, while all the participating fathers were working majorly in wholesale businesses at nearby 'Azadpur Mandi'. These parents mostly had undergraduate degrees (66.7 %) and were living in a joint family system (66.7 %), having their children, spouse, parents and sometimes a sibling living with their family in the same house. Parents from nuclear families (33.3 %) had only their spouse and children living together. 12 out of 15 families owned both car and motorbike, indicating a strong prevalence of private vehicle ownership despite two public transportation hubs being located nearby. The parental licence score for independent mobility ranged from 0 to 4, with the majority of the scores lying between 3-4 (66.6%). The lowest score '0' was an outlier, given by the parent of a 7-year-old girl, which was still considered for descriptive analysis because of the small sample size.

Additionally, a small sample size limits any conclusive outcome related to the impact of a child's gender or age on individual CIM licenses. However, broadly, it was found that freedom to commute from school or use any public transport was not allowed to children, irrespective of their age or gender. Younger children (7-8-year-old) were not even allowed to go to local destinations independently within neighbourhood gates. Overall, the most liberal mobility licenses were to go out after dark and cycle on main roads alone.

Child's daily activity schedule survey, included within parent's interview sessions, revealed a set of six common outdoor local destinations: (1) park, (2) neighbourhood street, (3) friend's house, (4) structured class (tuition/sports/hobby class), (5) local market and (6) school. These destinations were consistent with previous studies (Egli et al., 2019; Karen Villanueva et al., 2012), except the addition of neighbourhood street, which is an important destination within an Indian context. In terms of neighbourhood social environment, it was found that parents giving higher scores to neighbourhood social cohesion, connection and safety, granted higher CIM licenses to children.

The content analysis also highlighted the significance of constant and indirect supervision of children for parents, leading to a common practice of 'conditional' CIM. Here, the conditions of 'time' and 'location' were important as a parent's confidence in CIM increases when they are sure of their child's location at the predetermined and approved time daily. The explanation of this result was found in 'fear of crime' and 'traffic', ascertaining not only the universality of parental concerns but also of the temporal and spatial restrictions applied by parents on children. The study also suggested the parent's lack of trust in CIM to school and independent use of public transport by children. Factors such as preferred school choices, increased distances and availability of 'private van' to fill the void of school buses and safe public transport were primarily attributed to such outcomes. In conclusion, this small pilot study not only assisted in revising the scales but also provided a glimpse to the on-field issues regarding CIM from a parent's perspective. The following section will give a detailed explanation of the finalized measures.

4.6. Data Collection Measures

4.6.1. CIM Licence

CIM licence refers to the permissions parents give to their children to move freely within their neighbourhoods (Stark et al., 2018). It was operationalised using six items developed by the Policy Studies Institute (Hillman et al., 1990) and used in comparing CIM levels across various countries (A Carver et al., 2013; Ben Shaw et al., 2015; B Shaw et al., 2013). Parents were asked, whether they allow their child to (i) travel home from school and vice-versa alone; (ii) travel to places other than a school within walking distances alone; (iii) to go out (to local destinations) alone after dark; (iv) to cross main roads (near your house) alone; (v) to cycle on neighbourhood roads alone and (vi) to travel on public transport (city bus/autorickshaw/hand-

pulled rickshaw/ tram/metro) alone. The mobility permission levels for cycling depended upon the ownership or accessibility of cycle to children. Parents of those children who did not own any cycle were asked to cross out the question. A mobility licence score was computed by summing the licenses granted to the child (values range 0–6) as adopted by other studies (Cordovil et al., 2015b; Stark et al., 2018). For the purpose of analysis, this score was divided into three categories of 'no licence' (score= 0), 'low licence score' (score= 1-2) or 'high licence score' (score= 3 and above).

4.6.2. CIM Destination

CIM destination was obtained by first asking children to report on their usual mode of transport to six local destinations (school, park, local street, friend's house, local market and structured class) The response options were 'walk, bicycle, school bus/ school van, hand-pulled rickshaw/ autorickshaw, motorcycle, car or public transport' (bus, tram, metro). Next, they were asked to report their accompaniment status to each of these destinations. The response options were alone, with other children (friends/ siblings) or adults (parents/ grandparents/ other caregivers). Children were also provided with an option of 'don't go there' so that locations not visited by children could be identified. For data entry purposes, options, where children indicated their accompaniment as alone or with other children, were coded as '1' and rest as '0'. The code '1' indicated the journey is usually done independently by children. A CIM Destination ratio was computed by dividing the total independent journeys to the total journeys taken by a child as adopted by previous studies (A. Carver et al., 2014; A. Carver et al., 2012). For the purpose of analysis, this ratio was further dichotomized into two categories of 'low ratio' or 'high ratio' based on the median value.

4.6.3. Built-Environment (BE) Variables

In order to obtain the BE variables, a GIS dataset containing street networks and land-use were developed for each neighbourhood separately using ArcGIS 10.7 (ESRI Inc., Redland, CA). The location of schools and children's addresses were geocoded in the form of point shapefile. The street hierarchy and geocoded maps for all five neighbourhoods are provided in Annexure VI. The four BE variables finalized (by expert opinions) were calculated as follows:

4.6.3.1. Land-use mix

It was calculated using the entropy index, which is the most widely accepted and commonly used index for representing land use mix (Bahadure & Kotharkar, 2015; Bordoloi et al., 2013). Entropy is expressed as Equation 1:

$$\text{Entropy} = (-1) \times \sum_j \frac{P_j \times \ln(P_j)}{\ln(J)} \quad \ldots\ldots(1)$$

Where, P_j is the proportion of developed land in the J^{th} land-use type, and J is the total land uses considered in the study. Entropy index varies between 0 and 1, wherein 0 indicate single-use (homogeneous) and one maximum land use mix (heterogeneous)

4.6.3.2. Street Connectivity

It is calculated (using connected node ratio method) by dividing the number of the street intersections (real nodes) by a number of intersections plus cul-de-sacs (the total number of nodes). The maximum value for this variable is 1, with higher numbers indicating that there are few cul-de-sacs and dead ends and higher connectivity (Mecredy et al., 2011).

4.6.3.3. Traffic Exposure

In the absence of data on traffic volumes, 'road function' was used as a proxy and traffic speed exposure is calculated as the ratio of high speed (>50 km/hour) road lengths to low speed (<50km/hour) road lengths within neighbourhood boundary (Ikeda et al., 2019; Smith et al., 2019). The data on the design speed of four urban roads (arterial, sub-arterial, collector and local) was obtained from Indian Road Congress manual IRC:86-1983 (Geometric design standard for urban roads in plains, IRC, 1983).

4.6.3.4. Residential Density

It was calculated as the ratio of residential dwelling units to the total residential area of 800m network buffer around residential addresses (Ikeda et al., 2019).

4.6.4. Social-Environment (SE) Variables

Parent's safety concerns and their neighbourhood perceptions have significant implications on CIM outcome (Lin et al., 2017) as seen in Chapter 2. This influence of neighbourhood context on children's activities was measured using internationally accepted scales (Lin et al., 2017) of 'social cohesion', 'social connection' and 'neighbourhood safety'. Social cohesion refers to the trust, respect, and participation within a community (McNeill et al., 2006a), while social connection is the degree of association between the adults and children living in the same neighbourhood (Lin et al., 2017).

4.6.4.1. Social Cohesion

For social cohesion, a modified five-item scale (R. Sampson et al., 1997) was used, where parents were asked to what extent they agreed with the following five statements on a 5-point Likert scale (1 =strongly disagree and 5 = strongly agree): (i) people are willing to help in my neighbourhood; (ii) mine is a close-knit neighbourhood; (iii) the people in my neighbourhood can be trusted; (iv) the people in my neighbourhood get along well with each other and (v) the people in my neighbourhood share the same norm and values. A sum score for each respondent over the five items was calculated (instead of the individual five items), with higher scores denoting stronger neighbourhood cohesion.

4.6.4.2. Social Connection

For social connection (Lin et al., 2017; R J Sampson et al., 1999) parents were again asked to what extent they agree with the following statements on a 5-point Likert scale (1 =strongly disagree and 5 = strongly agree): (i) parents in my neighbourhood know their children's friends; (ii) parents in my neighbourhood generally know each other; (iii) adults from my neighbourhood can recognise almost all the local children and (iv) I can trust on the people of my neighbourhood to watch out for my children's safety. A sum score for each respondent over the four items was calculated, with higher scores denoting stronger neighbourhood connection.

4.6.4.3. Neighbourhood Safety

For neighbourhood safety (Lin et al., 2017) parents were asked to what extent they agree with the following statements on a 5-point Likert scale (1 =strongly disagree and 5 = strongly agree): (i)

there are safe places for my child to play in the neighbourhood; (ii) it's a good place to bring up children; (iii) I feel safe walking down my street after dark; (iv) I don't worry about the crime rate in my neighbourhood, (v) it's a good place to buy home. A sum score for each respondent over the five items was calculated, for analysis.

All the scales mentioned above were translated into two Indian languages of 'Hindi' and 'Bengali' apart from English.

4.6.5. Parental Perception of CIM

As one of the earliest studies on CIM from India, a comprehensive and contextual understanding of CIM in relation to the neighbourhood was essential, especially from the parental point of view. Therefore, as a supporting narrative to the empirical scores, gaining valuable qualitative insights was deemed essential. It was achieved by conducting semi-structured interviews with consenting and available parents on the phone. The researcher first recalled the meaning of CIM along with its definition already shared with parents in phase II through the research booklet. After the explanation, parents were asked to respond to three key questions on their understanding of CIM and its need; and neighbourhood-level issues with respect to CIM. Appendix IC provides the sample of parent's interview sheet. The total duration of each interview was approximately 20-25 minutes. After obtaining participant's permission, the interview was recorded using a call recorder app and later transcribed verbatim.

4.7. Data Processing and Analysis

4.7.1. Data Processing

The raw data obtained was filtered and then entered into an excel sheet before employing any analysis methods. The first criteria for filtering the data was based on address. As the neighbourhood study boundary limits itself within the 800m pedestrian network buffer around the selected school, the individual residential address of the participating child and parent was cross-checked before finally entering the excel sheet. The residential addresses were checked using Google Earth services. The data sheets with incomplete address or missing entry under address columns were rejected. There were cases with one or no entry under the travel information part; such cases were also rejected. However, spelling mistakes were not taken into account as a

criterion for rejection. For the filled data sheets (by children) with more than four places out of six marked as ‘don’t go there’; digital entry was not done. Similarly, in case of filled data sheets by parents, if there were blank spaces under any one of the six questions of CIM licence, such cases were not considered. Each parent-child dyad was given a similar code for ease of tracking and cross-checking. Once the excel sheets were ready with appropriate coding, the data was transferred to the SPSS software for analysis. Statistical analysis was performed using IBM SPSS Statistics version 25.

4.7.2. Analytical Framework

Figure 4.20 outlines the analytical framework applied in this research to address the research questions and corresponding objectives. The first objective was achieved by conducting an in-depth literature review, which was already discussed in Chapter 2. For the second objective, measure of central tendency based on percentage method was employed (Analysis 1) resulting in the identification of CIM levels across neighbourhood typologies. The third objective was achieved by employing chi-square tests (Analysis 2); Pearson’s correlation (Analysis 3); logistic regression (Analysis 4) and content analysis (Analysis 5). The details of each analysis are provided in the following sections.

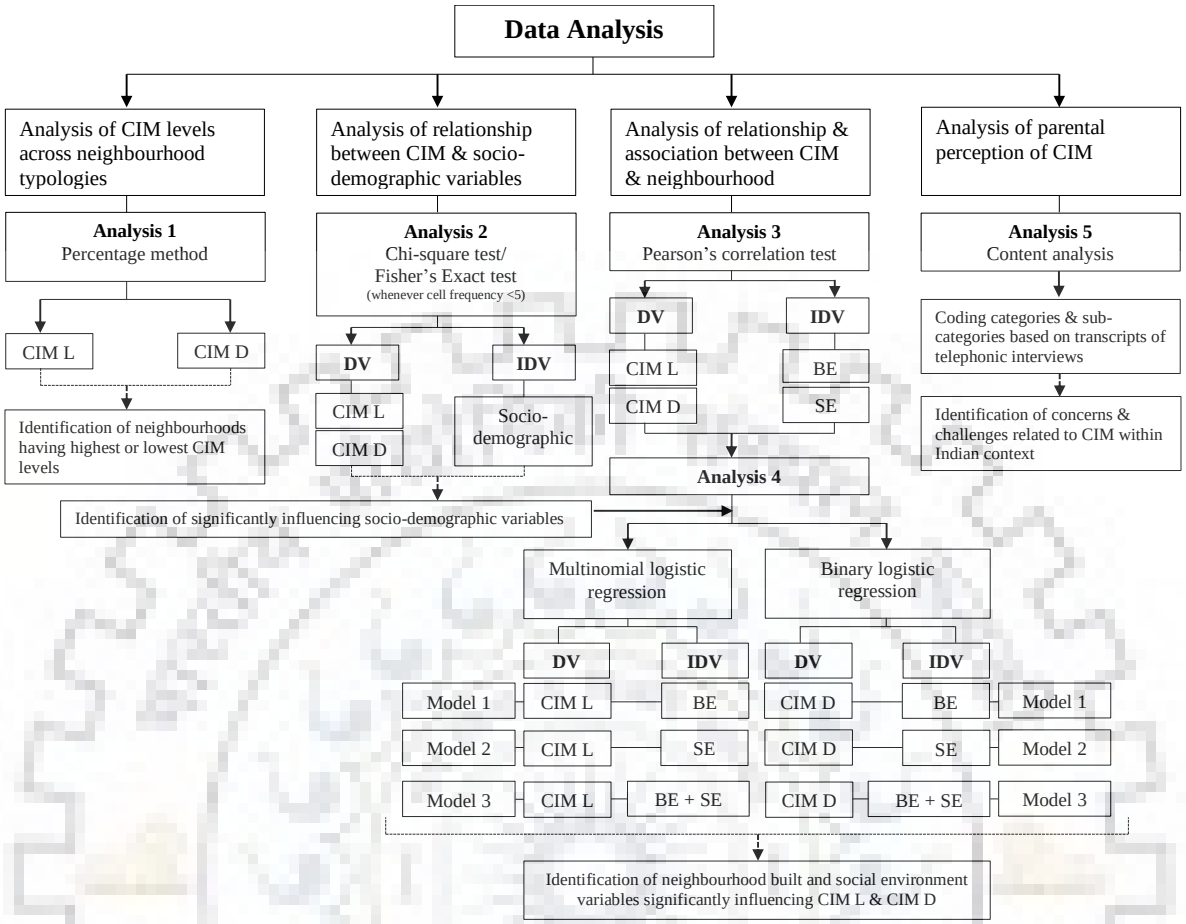


Figure 4.20 Analytical framework applied in this research

4.7.2.1. Chi-square Tests

Chi-square tests were conducted to test the differences between means of mobility licenses and destination scores across all neighbourhoods by child's gender and age, parent's gender, qualification and employment status, family type and vehicular ownership. In case the cell was below 5, Fisher's Exact test was checked.

4.7.2.2. Pearson's Correlation Tests

Before conducting the regression analysis, it was necessary to check the correlation between the dependent variable (CIM L and CIM D) and seven independent variables (BE and SE). This was achieved by employing Pearson's correlation tests for each independent variable. A p-value threshold of 0.05 was used to determine statistical significance.

4.7.2.3. Logistic Regression Analysis

Logistics regression analysis was employed to study the association between one categorical dependent variable (CIM L/ CIM D) and seven continuous independent variables (BE and SE) or predictors. This analysis was applied in previously published several CIM studies (A. Carver et al., 2014; A. Carver et al., 2012; Lam & Loo, 2014; Rodrigues et al., 2018; Karen Villanueva et al., 2012) investigating the impact of neighbourhood environment on parental independent mobility licence or children's actual mobility.

Multinomial logistic regression was used in case of CIM licence scores, keeping 'no licence' as the reference category. While binary logistic regression was used to study the same association with CIM destination with two categories of 'low ratio' and 'high ratio'. The analysis was controlled using socio-demographic variables that significantly impacted CIM values in each neighbourhood. To standardize the differences in units within BE variables, z-score values were calculated and used in regression models. Before conducting any regression analysis, a correlation between all BE and SE variables with CIM were also checked using Pearson's Correlation test. Additionally, all the assumptions for logistic regressions were checked as mentioned below:

1. To test the linearity of the logit model, logistic regression was conducted between variables and interaction with their respective log-transformed values. Any interaction between log values that is significant indicates that the main effect has violated the assumption of linearity of the logit.
2. To check the multicollinearity between neighbourhood environment variables, linear regression is conducted, and tolerance values, as well as VIF (variance inflation factor) values, were checked.
3. To check the model fit, case summaries were prepared of the residuals for identifying any influential cases having an effect on the model. Cook's distance (should be <1), leverage value (should lie between 0 and 1), standard residual, normalized residual, deviance value (should be <3; only 5% should lie outside +1.96 and -1.96 and only 1% should lie outside +2.58 and -2.58) and DFBeta values (should be <1) were checked against standards.

Finally, three regression models were undertaken for each neighbourhood. First two models examined the association of BE (model 1) and SE variables (model 2) with CIM separately, and the third model included both sets of variables (model 3) simultaneously (as illustrated in Figure

4.19). Interaction effects between variables were also included in the analysis in step 1. The results were finalized by checking the goodness of fit (Pearson and Deviance statistics in case of multi-nominal regression), likelihood ratio (in case of multi-nominal logistic regression) and omnibus (in case of binary logistic regression) tests for all the models. This study used the enter selection method in case binary regression and stepwise forward entry method in case of multi-nominal regression to create a final model, which contains only significant CIM predictors. A p-value threshold of 0.05 was used to determine statistical significance.

4.7.2.4. Content Analysis

The content analysis of the transcribed data obtained from telephonic the interviews was conducted using NVivo 12 Pro. The codebook was generated following the international protocols (Fonteyn et al., 2008) generating codes and categories from meaning units and condensed meaning units. The generated codes were then divided into categories and sub-categories by reviewing the transcripts based on the aim of the analysis.

4.8. Chapter Summary

In order to achieve the aim and objectives, the present research adopts the comparative case study approach as a methodology. Neighbourhood was selected as the unit of analysis and defined as the area within 800m pedestrian network buffer around each child's home. For the purpose of comparisons and considering data collection constraints, it was decided to take a single city and conduct in-depth investigations across distinct neighbourhood typologies. Reconnaissance surveys were carried out in the eastern city of Kolkata to finalize participating schools eventually leading to the selection of neighbourhoods. A total of seven schools agreed to participate across five neighbourhoods in the city. These neighbourhoods were broadly categorised into three typologies based on their verticality: low-rise, mid-rise and high-rise neighbourhoods.

Purposive sampling technique was employed to collect data from children aged 7-12 years and their parents, following the global ethical practices. The data collection measures were validated and contextualized within Indian context by conducting a pilot study in Delhi and obtaining expert opinions on the same. Parents provided data on their perception of neighbourhood (SE variables) and their CIM License scores. While children provided data for calculating CIM Destination ratios. The BE variables were obtained using GIS dataset developed for the research.

Recalling the conceptual research framework from the previous chapter, the analysis was approached from the two-point perspective of 'neighbourhood' and 'socio-demographic' factors influencing CIM. A total of five analyses were carried out beginning with the identification of CIM levels across all neighbourhoods using the percentage method. It provided answer to the second research objective of 'identifying CIM levels within distinct typologies in an urban Indian context'. Further, before moving forward with the third research objective, it was necessary to check the influence of socio-demographic variables on CIM, to rule out all possible biasness in the result. Chi-square tests were therefore conducted and significant socio-demographic variables, thus identified, were treated as control variables for the succeeding analyses.

Once the control variables were identified, investigations were carried out to analyze the influence of BE and SE variables on CIM levels across neighbourhoods using logistic regression. But before conducting regression analysis, it was essential to establish the correlation between the variables. Therefore, Pearson's correlation tests were employed first and then logistic regressions were done. This analytical process aligns with the previously published CIM studies and therefore is robust and appropriate for the current research problem.

In the later part of the research, a need for a supporting narrative to the empirical scores was deemed essential. It resulted in semi-structured interviews with consenting and available parents on their perception of CIM. The qualitative data thus obtained, was analysed using content analysis leading to the identification of valuable insights and on-ground challenges related to CIM. Concludingly, this chapter presents a detailed discussion on the research design while explaining explicitly the rationale for each step adopted by the research.

Chapter 5

CIM and Urban Neighbourhood: Identifying Interrelationships

'Giving children more everyday freedoms -where they can gain confidence and a sense that they have control over their lives, where they can learn to respond to challenging situations and discover what intrinsically motivates them-will ultimately help them prosper in the future.'

- Tim Gill,
In 'Designing Child-Friendly High Density Neighbourhoods' by Natalia Krysiak (2017)

Chapter 5 CIM and Urban Neighbourhood: Identifying Interrelationships

This chapter explores the relationships obtained by employing the research methods explained in the previous chapter. The above relationships have been classified in four broad sections; a) descriptive overview; b) CIM License; c) CIM Destination; and d) parental perception of CIM. The first section provides information about the sample, objectively measured BE and subjectively measured SE variables of neighbourhoods. The second and third sections focus on the existing levels of CIM licence scores and CIM destination ratios across five neighbourhoods. Empirical evidence on their association with the socio-demographic and neighbourhood environment variables are also discussed in relation to the previous studies. The last section provides details to the themes generated on parental perception of CIM. Towards the end, this chapter concludes by summarising the critical findings and themes that emerged from the investigation.

5.1 Descriptive Overview

5.1.1. Sample

The sample reflects that a majority of children and parents were from the low-rise neighbourhoods of Khidirpur and Behala, respectively, as shown in Figure 5.1. Whereas the lowest share of children and their parents were from New Town.

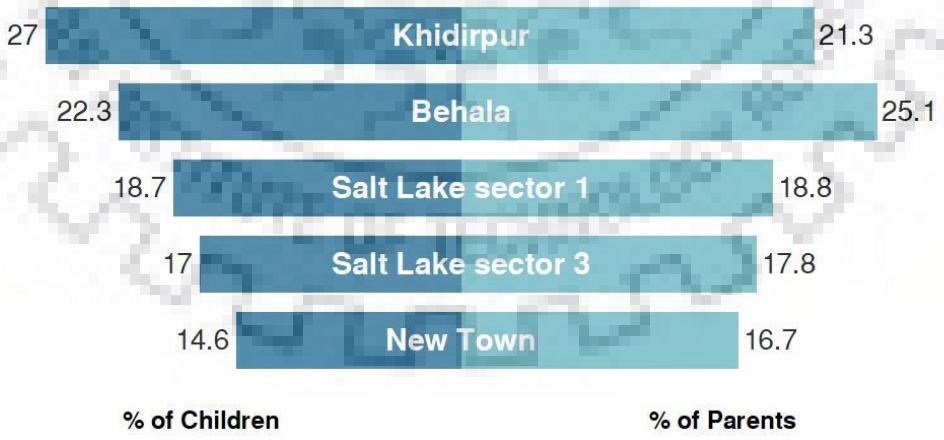


Figure 5.1 Children and parents' distribution (%) across neighbourhoods

In terms of gender, the overall proportion of girls were higher than that of boys, while among responding parents, the proportion of fathers were higher than of mothers, as shown in Figure 5.2.

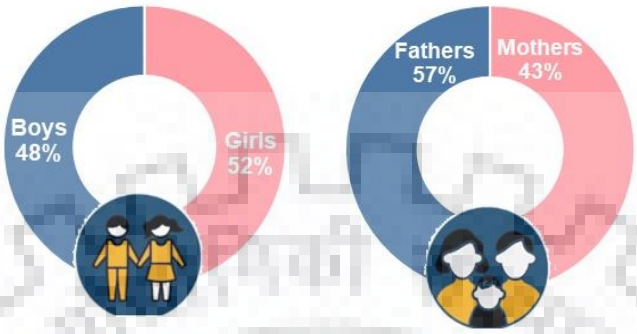


Figure 5.2 Children and parents' gender distribution (%) in the sample

Looking at this data across neighbourhoods, a similar pattern was observed, as seen from Figure 5.3 and 5.4. The share of girls was higher than that of boys except in case of Behala and Salt Lake Sector 3, where there was an equal participation from both genders. Similarly, share of fathers was higher than mothers in all cases except in Behala and Salt Lake Sector 1, where an equal participation was observed.

Figure 5.3 Children's gender distribution (%) across neighbourhoods

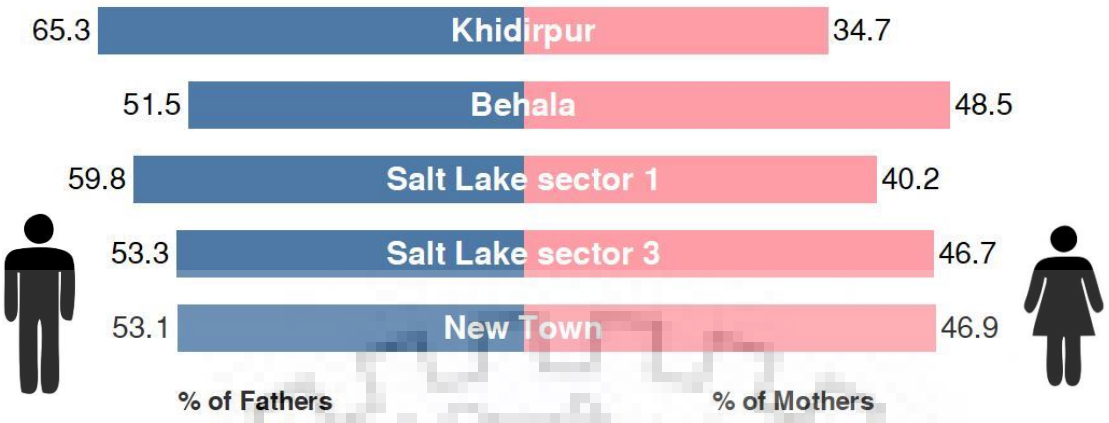


Figure 5.4 Parent's gender distribution (%) across neighbourhoods

In terms of age distribution, children were mostly in the age-group of 9-10 years, as seen from Figure 5.5. Salt Lake Sector 3 had the highest share of youngest children aged 7 years, while Khidirpur and Salt Lake Sector 1 had the highest share of oldest children aged 12 years. Overall, the age-wise distribution was more or less comparable across all five cases.

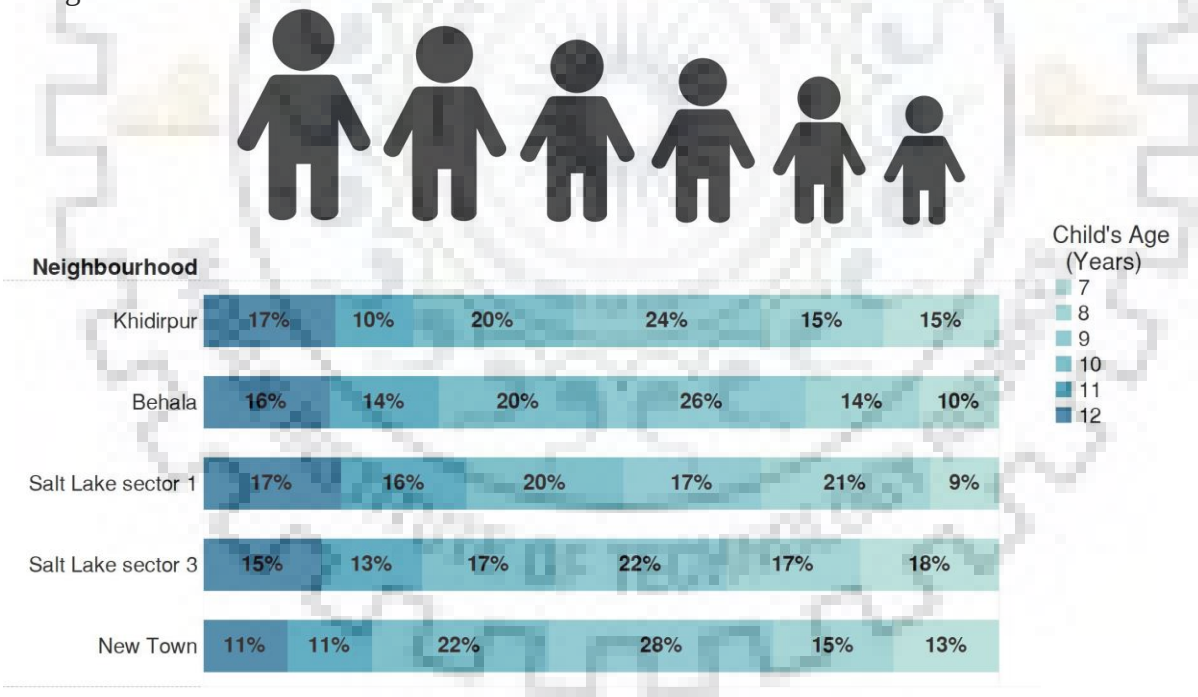


Figure 5.5 Children's age-wise distribution (%) across neighbourhoods

In terms of parent's qualification, 65% had an undergraduate degree followed by 23% having a post-graduate degree and rest 12% cleared the senior secondary examination or high school. Across neighbourhoods, parents from Behala had the highest share in all three categories reflecting a mix group in reference to 'educational qualification', as shown in Figure 5.6.

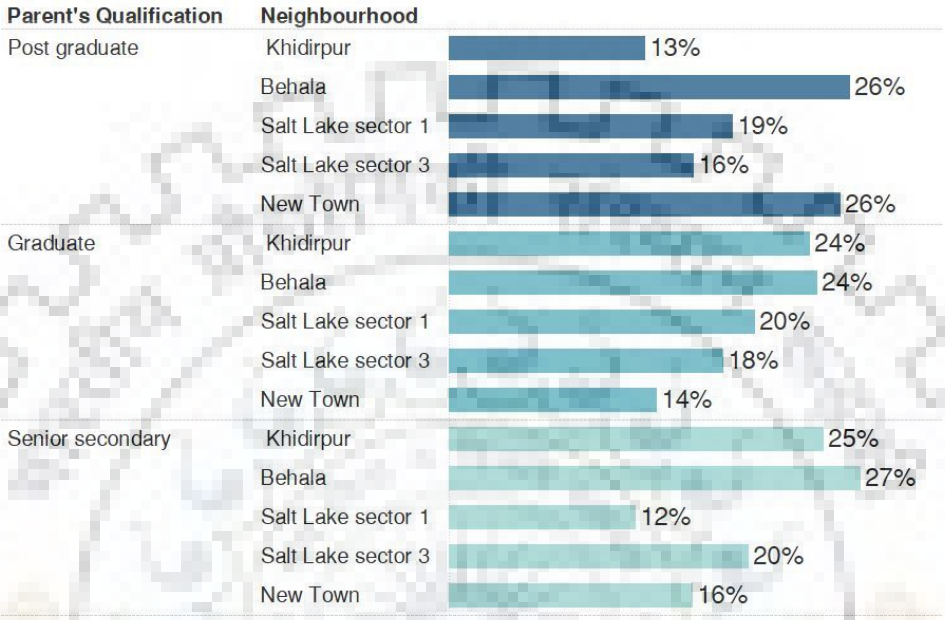


Figure 5.6 Parent's educational qualification distribution (%) across neighbourhoods

However, when the data on parent's employment status was studied across neighbourhoods (Figure 5.7), Behala was seen to have the highest proportion of homemakers despite a decent share of graduate and post-graduate degree holders. This can be understood from the point that majority of responding mothers in the sample were from Behala (in reference to Figure 5.4) and all the homemaker parents were mothers (29.5%). In short, although a majority of parents were full-time working (70.5%), only 19.7% of them were mothers.

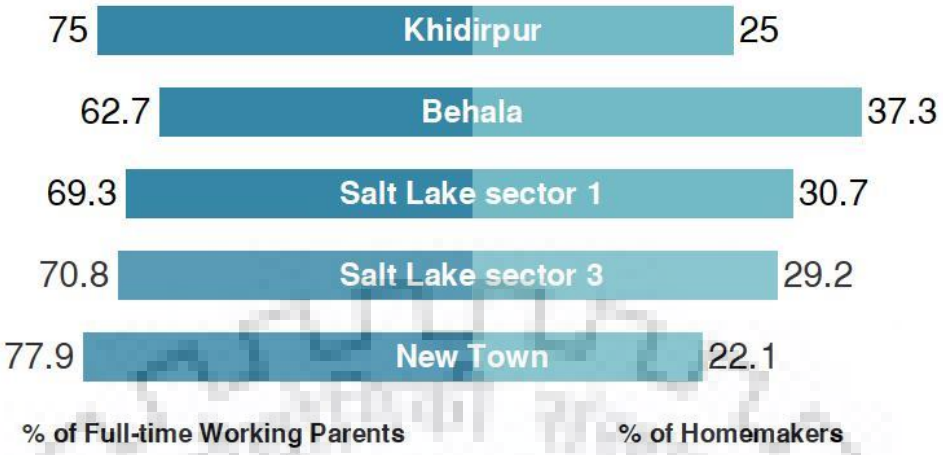


Figure 5.7 Parent's employment status distribution (%) across neighbourhoods

In terms of family type, 68% of parents were living in a nuclear family system as opposed to 32% who were living in a joint family system. Across neighbourhoods, Khidirpur had the highest share of joint family households in comparison to Salt Lake Sector 1 which had the lowest, as evident from Figure 5.8. Interestingly, the joint and nuclear family household ratio was quite comparable between Behala and New Town, despite the differences in their built environment, and demographics.

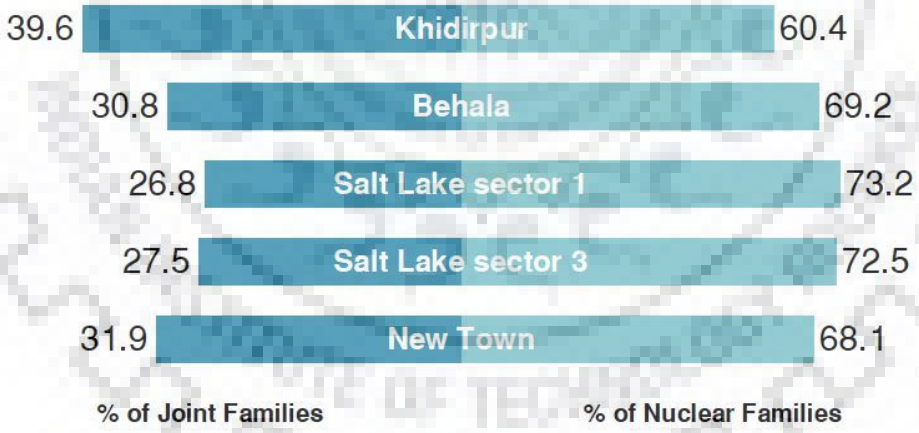


Figure 5.8 Parent's family type distribution (%) across neighbourhoods

In terms of vehicular ownership, similar to the city level statistics, the overall share of households having no vehicle was the highest, as seen from Figure 5.9. However, examining the same data across neighbourhoods, a trend towards a rise in private vehicle ownership was observed in case

of mid and high-rise neighbourhoods. For instance, high-rise neighbourhood households have the highest car ownership, while the lowest was among low-rise neighbourhood households, as seen from Figure 5.10. This is also evidenced through the difference in public transport connectivity between the two, with low-rise neighbourhoods having comparatively better and diverse mobility options for last-mile connectivity. Additionally, the share of both scooter and car ownerships was highest in New Town, suggesting dual earner households here.

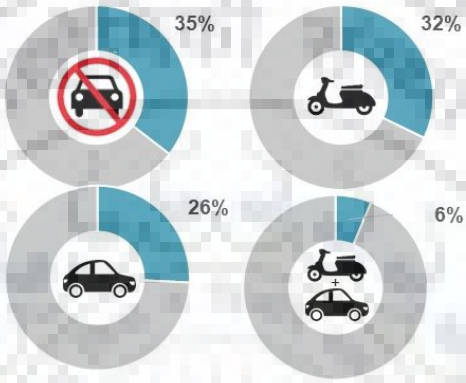


Figure 5.9 Overall percentage of vehicular ownership in the sample

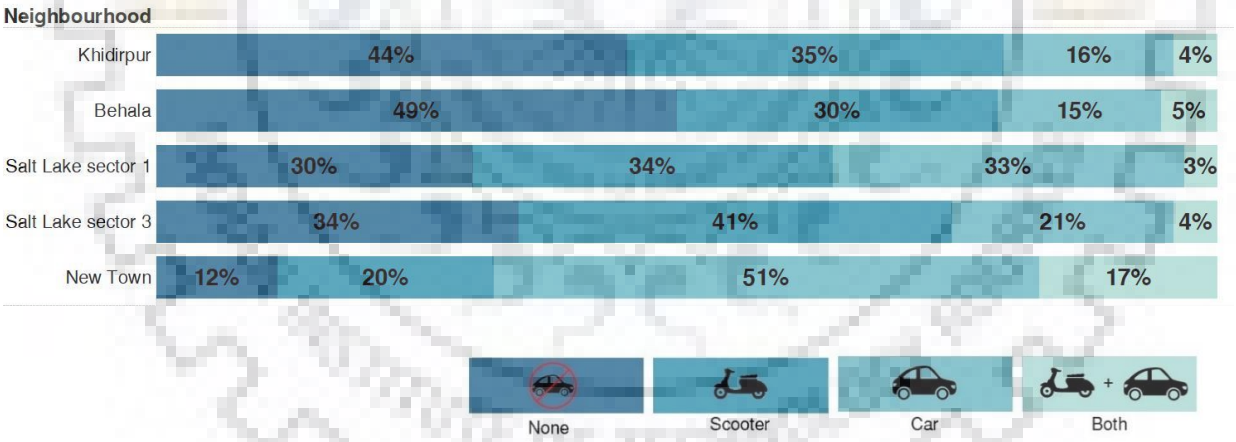


Figure 5.10 Vehicular ownership distribution (%) across neighbourhoods

5.1.2. Neighbourhood BE variables

The descriptive information of objectively measured BE variables across neighbourhoods is provided in Table 5.1. It can be seen from the table, as expected, Khidirpur had the highest land-use mix and traffic exposure values. This results from the dense built-up with commercial, institutional and residential areas in close proximity along with heavy dock activities within the

neighbourhood. Behala, on the other hand, had the highest values for street connectivity and residential density. It results from the presence of several small localities and urban villages within the neighbourhood that generates a dense fabric of core residential built environment. The lowest values for almost all BE variables (except traffic) were seen in the case of New Town. Its current developing status and high-rise residential towers can be one of the reasons for such an outcome. Traffic remains an issue owing to the presence of Kolkata's second and largest IT hub close to New Town neighbourhood boundary (as adopted by the research) and low public transport connectivity. On the other hand, Salt Lake neighbourhoods experiences moderate traffic due to the presence of planned streets not allowing passing traffic to go through the local streets.

Table 5.1 Descriptive information for the objectively measured BE variables

S. No.	Built Environment Variable	Neighbourhood				
		Khidirpur	**Behala**	**Salt Lake Sector 1**	**Salt Lake Sector 3**	**New Town**
		Mean (SD)	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**
1	Land-use mix	**0.75** (0.09)	0.39 (0.08)	0.50 (0.16)	0.55 (0.12)	0.29 (0.09)
2	Street connectivity	0.78 (0.09)	**0.79** (0.13)	0.70 (0.08)	0.67 (0.10)	0.66 (0.09)
3	Traffic exposure	**1.08** (0.09)	0.36 (0.09)	0.50 (0.09)	0.46 (0.13)	0.96 (0.10)
4	Residential density	0.34 (0.11)	**0.47** (0.09)	0.28 (0.10)	0.23 (0.12)	0.22 (0.10)

5.1.3. Neighbourhood SE variables

The responses received from parents on SE variable scales provided critical insights into their overall neighbourhood perceptions. The line plots showing parents' response on individual questions across three categories (social cohesion, social connection and neighbourhood safety) of SE variables, are illustrated in Figures 5.11 to 5.13. Starting with the positive side of 'strongly agree' and 'agree', the plots reveal that parents, in general, had a positive perception of their neighbours and considered property investments within their neighbourhood as a valuable proposition. Social cohesion with majority of responses on the positive end of 'strongly agree' and 'agree', seems to be stronger in comparison to neighbourhood safety.

Looking at the ‘neutral’ responses, it was observed that when the dimension of child’s safety was added with respect to neighbourhood and neighbours, there were mix reactions along with apprehensions. Parents remain hesitant to confirm that the neighbourhood adults could recognize almost all local children or there were safe places to play for their child within their neighbourhoods. This may point to a direction of trust issues among parents with regard to their child’s safety in their neighbourhood. It further extends to the issues of safety after dark and perceived crime rate within neighbourhood. Approximately, 30% of parents disagreed that they feel safe while walking down the street after dark. Whereas, not worrying about the crime rate in the neighbourhood was the most ‘strongly’ disagreed statement by the parents. Notably, it is evident that neighbourhood safety was a matter of concern among parents irrespective of neighbourhood typologies.

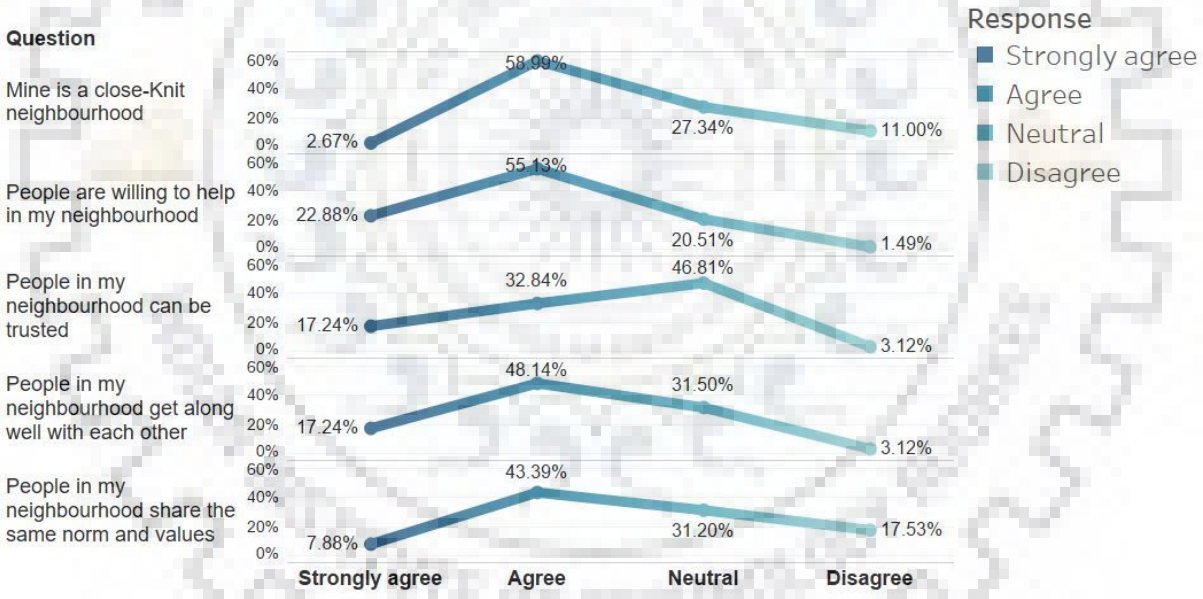


Figure 5.11 Social cohesion line plots

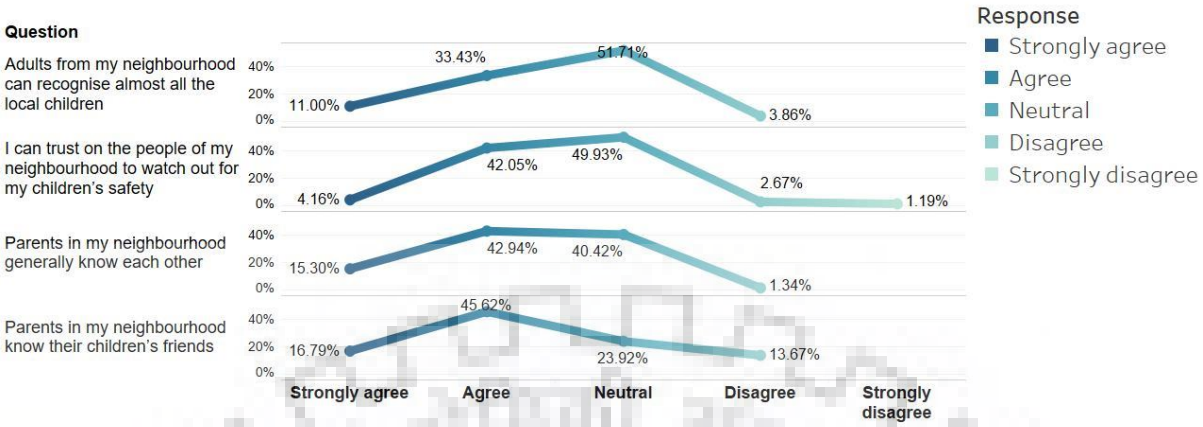


Figure 5.12 Social connection line plots

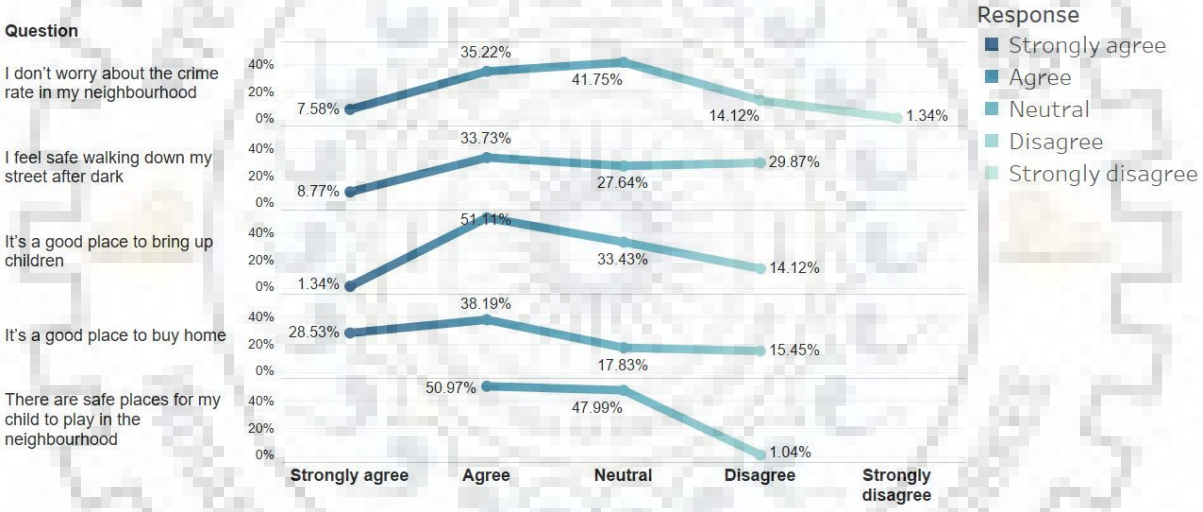


Figure 5.13 Neighbourhood safety line plots

However, looking at the same data across neighbourhoods in Table 5.2, the picture gets more refined. Parents from low-rise neighbourhoods of Khidirpur and Behala seems to have comparatively fewer safety concerns and a higher share of helping neighbours and parental acquaintances. The only areas where these neighbourhoods perform poorly were 'mutual trust' and 'close-knit' bonding among residents. One reason could be explained with the neighbourhood's heterogeneous demographics, having different income households living together in the same localities. On the other hand, there were lesser concerns regarding 'mutual trust' and 'close-knit' bonding in case of mid-rise neighbourhoods (Salt Lake Sector 1 and 3).

Here, the problem persists in the neighbourhood safety category with parents providing least scores to the statement on feeling safe while walking down the street after dark. A similar observation was seen in the case of high-rise neighbourhood of New Town. It exhibits low scores of safety and parental acquaintance, while the highest scores were given to the statement on people getting along well with each other. On a similar line with the previous cases, one explanation to this outcome can lie within the homogeneous demographics of high-rise gated communities. Usually, the same income group households are clustered together within such community housings.

Table 5.2 Mean scores provided by parents to individual SE questions across neighbourhoods

Sno.	Question	Mean scores provided by parents across neighbourhoods				
		Khidirpur	**Behala**	**Salt Lake Sector 1**	**Salt Lake Sector 3**	**New Town**
1	People are willing to help in my neighbourhood	4.14	**4.23**	3.59	4.24	3.65
2	Mine is a close-Knit neighbourhood	3.53	3.89	3.91	3.38	2.73
3	People in my neighbourhood can be trusted	4.44	3.32	**4.10**	3.33	2.91
4	People in my neighbourhood get along well with each other	3.77	4.07	3.68	3.61	**3.74**
5	People in my neighbourhood share the same norm and values	3.91	3.64	3.67	3.22	2.37
6	Parents in my neighbourhood know their children's friends	4.77	4.01	3.72	3.13	2.19
7	Parents in my neighbourhood generally know each other	**4.88**	3.51	3.53	4.00	3.00
8	Adults from my neighbourhood can recognise almost all the local children	3.80	3.86	3.06	3.28	3.41
9	I can trust on the people of my neighbourhood to watch out for my children's safety	3.56	3.82	3.09	3.81	2.80
10	There are safe places for my child to play in the neighbourhood	3.81	3.48	3.57	3.08	3.50
11	It's a good place to bring up children	3.87	3.40	3.65	3.48	2.42

12	I feel safe walking down my street after dark	4.12	4.09	2.31	2.70	2.32
13	I don't worry about the crime rate in my neighbourhood	4.03	4.02	2.53	2.84	2.86
14	It's a good place to buy home	4.72	3.78	3.87	**4.27**	2.08

To understand the range of total scores in these three categories across neighbourhoods, descriptive information of the mean scores is provided in Table 5.3. The Cronbach's alpha value higher than 0.70 shows the reliability of the questionnaire (Santos & Reynaldo, 1999). From the table, it is evident that questionnaire for SE variables were reliable across all neighbourhoods except in few cases where the values less than 0.7 are not far away from the standard and hence can be considered as reliable. Looking at the data across neighbourhoods, parents from Khidirpur reported the highest average scores on all SE variables, whereas the lowest average scores were given by parents from New Town. This could be in result of lower individual question scores as seen in the previous table.

Table 5.3 Descriptive information for the subjectively measured SE variable total scores

Social Environment variable	**Neighbourhood**									
	Khidirpur		**Behala**		**Salt Lake Sector 1**		**Salt Lake Sector 3**		**New Town**	
	Mean (SD)	**Cronbach's Alpha**	**Mean (SD)**	**Cronbach's Alpha**	**Mean (SD)**	**Cronbach's Alpha**	**Mean (SD)**	**Cronbach's Alpha**	**Mean (SD)**	**Cronbach's Alpha**
Social Cohesion	**19.8** (2.50)	0.70	19.1 (2.15)	0.76	18.55 (2.41)	0.72	17.7 (1.98)	0.65	15.4 (2.51)	0.83
Social Connection	**16.6** (1.72)	0.79	15.2 (1.79)	0.69	13.20 (1.43)	0.73	14.2 (1.50)	0.68	11.3 (1.32)	0.65
Neighbourhood safety	**20.5** (1.52)	0.65	18.7 (2.74)	0.78	16.03 (1.90)	0.75	16.3 (1.52)	0.78	13.1 (2.07)	0.84

5.2 CIM Licence & Urban Neighbourhood

5.2.1. Scores

The maximum CIM licence score was '4' in New Town, while it was '5' for the rest of the neighbourhoods. This is one of the first studies to include the data from parents providing '0' or 'no licence' to their children. The study intentionally did not remove this category from analysis (treating it as outliers) since the share of such parents were comparable with other categories. It

opened new enquiries of looking at the influence of neighbourhood on such parents giving no freedom to their children for moving independently (discussed in the next chapter).

The percentage of mobility licence scores under three different categories of 'no licence' 'low licence' and 'high licence' across neighbourhoods are presented in Table 5.4. From the table, it is evident that the highest share of 'high licence' scores was given by parents from low-rise neighbourhoods (Behala 47.3 % followed by Khidirpur 38.2 %), while the lowest was given by parents of high-rise neighbourhood (New Town 8%). A similar reverse trend was seen when considering the share of 'no licence' scores, where the highest percentage were in case of high-rise (New Town 35.4 %) and mid-rise neighbourhoods (Salt Lake Sector 1 26.8 % and Sector 3 23.3%), in comparison to low-rise neighbourhoods (Khidirpur 13.2 % and Behala 16.6%). This outcome suggests that comparatively, parents from the low-rise neighbourhoods were more likely to give some kind of mobility licence to their children than no licence at all.

The previous studies (Lopes et al., 2014; J Rudner & Wickramaarachchi, 2013) investigating CIM across the levels of urbanisations suggests a lower degree of urbanisation allows more children to travel independently. Additionally, research on children living in high-rise residential buildings or gated communities (Whitzman & Mizrachi, 2009) also suggests that they tend to have extremely limited freedom to move independently outside the boundaries of their buildings. The outcome of this research tends to align with these studies at neighbourhood typology level.

Table 5.4 CIM licence scores (%) across different neighbourhood typologies

S. No.	**CIM Licence score**	**Neighbourhood**				
		Khidirpur	**Behala**	**Salt Lake Sector 1**	**Salt Lake Sector 3**	**New Town**
1	No Licence	13.2	16.6	26.8	23.3	**35.4**
2	Low Licence	48.6	36.1	38.6	45.8	**56.6**
3	High Licence	38.2	**47.3**	34.6	30.8	8.0

5.2.2. Individual Mobility Licenses

CIM licence score is a tool that provides information on the overall permission levels across different neighbourhoods. However, to critically understand and evaluate parental mobility

permissions, it is necessary to look at the data on individual mobility licence, as shown in Table 5.5. Interestingly, the most liberal independent mobility licenses were found for '*going out alone after dark*' and '*going to places within walking distances other than school*'. This is most prevalent in low-rise neighbourhoods (Khidirpur and Behala) with more than half children granted this permission. Children from mid and high-rise neighbourhoods also enjoy these licenses more in comparison to other licenses. The least liberal licence across all neighbourhoods was for using public transport alone. It reflects a strong negative perception among parents with respect to public transport for children.

Table 5.5 Percentage of children who were granted different mobility licenses across neighbourhoods

Sno.	Mobility licence	Children (%) granted licenses across neighbourhoods				
		Khidirpur	**Behala**	**Salt Lake Sector 1**	**Salt Lake Sector 3**	**New Town**
1	Do you allow your child to travel home from school and vice-versa alone?	23.6	34.9	34.6	12.5	0
2	When going to places other than school that are within walking distance, is your child allowed to go alone?	48.6	**45.6**	**46.5**	**50**	**27.4**
3	Is your child usually allowed to go out (to local destinations) alone after dark?	**52.1**	**45.6**	13.4	41.7	30
4	Is your child allowed to cross main roads (near your house) alone?	43.8	40.8	38.6	36.7	24.8
5	Is your child allowed to cycle on neighbourhood roads alone?	34	35.5	43.3	35.8	**27.4**
6	Is your child allowed to travel on public transport (city bus/autorickshaw/hand-pulled rickshaw/ tram/metro) alone?	12.5	27.2	7.1	10.8	0

Conversely, the most withheld independent mobility licence across Portugal (Lopes et al., 2014), Vienna (Stark et al., 2018) and other international countries (Ben Shaw et al., 2015) is '*going out after dark*'. Only a handful of countries such as Finland, Sweden, Japan and Denmark have a majority of children allowed to do the same independently (Ben Shaw et al., 2015). Additionally, independent commute to school is also quite prevalent in these developed countries. In terms of urbanisation levels, a study has found that more children from moderately urbanised (30.6 %) or

non-urban neighbourhood (23.8%) travel independently to a school than from highly urbanised neighbourhoods (14.8%) (Lopes et al., 2014). This is relatively similar to these study findings, where more children from low-rise neighbourhoods were found to travel independently to school than high-rise neighbourhoods. Another similarity is found with the licence to go to places within walking distances alone. Children from several developed countries (Ben Shaw et al., 2015) enjoy this licence the most, in line with the study findings.

5.2.3. Association with Socio-demographic Variables

The results from Chi-square tests reveals a similarity with previous studies (Bhuyan & Zhang, 2020; Cordovil et al., 2015b; M Kyttä et al., 2015; Stark et al., 2018) in case of the relationship between 'child's age' and CIM. 'Child's age' is an important variable as with an increase in age; parents tend to grant them more licenses of independent mobility. Chi-square statistics for all neighbourhoods, as shown in Table 5.6, suggests the same outcome. Besides age, child's gender was surprisingly found to have no association with CIM Licence. This outcome was similar to studies done in Finland (M Kyttä et al., 2015) and Portugal (Lopes et al., 2014) but in contrast with several other studies conducted across the globe (Alparone & Pacilli, 2012; Bhuyan & Zhang, 2020; Ghekiere et al., 2017). Interestingly, family type and parent's gender also had an impact on CIM licence in case of Khidirpur and Behala, respectively.

Table 5.6 Association of CIM Licence with socio-demographic variables

S.No.	Socio-demographic variables	CIM Licence				
		Khidirpur	Behala	Salt Lake Sector 1	Salt Lake Sector 3	New Town
1	Child's Gender	0.950	0.535	0.747	0.407	1.911**
2	Child's Age	**68.770***	**96.129***	**44.145***	**48.961***	**25.778***
3	Parent's Gender	0.044	**7.468***	0.403	1.918	1.212**
4	Parent's Qualification	2.102**	3.410**	0.519**	2.030**	2.857**
5	Parent's Profession	1.700**	5.561	0.043	2.166	1.215**
6	Family Type	**6.305***	0.554	0.562	0.680	0.858**
7	Vehicular Ownership	11.097**	7.058**	1.756**	8.314**	7.643**

*variable is significantly associated with CIM ($p < 0.05$)
**result from Fisher's Exact Test (cell frequency < 5)

Since out of the seven socio-demographic variables, only the 'child's age' was significantly associated, its impact on different independent mobility licenses is presented in Table 5.7. Looking at the data across each mobility licenses, it is evident that fewer younger children aged 7-9 years were allowed to commute to school (17.1 %) or use public transport (5.9 %) independently. The most liberal independent mobility licence across all age groups was 'going to places within walking distances other than school' as noted in previous section. Notably, among the younger age group (7-9 years), the other liberal licence was 'go out alone after dark'. While among older age group (10-12 years), it is 'crossing main roads alone'. In line with the previous section, the least liberal licence across all age -groups was using public transport alone. This finding was in contrast with many European countries (Fyhri et al., 2011; M Kyttä et al., 2015; Lopes et al., 2014) where a majority of older children, aged 11-16 years, use public transport for daily commute to school.

Table 5.7 Percentage of children who were granted different mobility licenses according to age (n= 673)

Sno.	Mobility licence	Children (%) granted licenses by age group					
		7 yrs.	**8 yrs.**	**9 yrs.**	**10 yrs.**	**11 yrs.**	**12 yrs.**
1	Do you allow your child to travel home from school and vice-versa alone?	1.2	4.5	11.4	20.3	47.3	59.2
2	When going to places other than school that are within walking distance, is your child allowed to go alone?	10.6	**23.6**	**32.9**	**55.9**	**67.9**	76.7
3	Is your child usually allowed to go out (to local destinations) alone after dark?	**18.8**	18.2	28.5	45.1	50	68
4	Is your child allowed to cross main roads (near your house) alone?	4.7	11.8	28.5	41.4	65.5	**78.6**
5	Is your child allowed to cycle on neighbourhood roads alone?	7.1	20.9	23.4	41.4	51.2	71.8
6	Is your child allowed to travel on public transport (city bus/autorickshaw/hand-pulled rickshaw/ tram/metro) alone?	0	2.7	3.2	9	27.4	41.7

Other socio-demographic characteristics like 'parent's gender', 'qualification' or 'employment status', 'family type' and 'vehicular ownership' had no significant association with CIM licenses. However, when looking at the relationship across neighbourhoods, (besides child's age) 'family

type' and 'parent's gender' were also found to be significantly associated with CIM licence in case of Khidirpur (χ^2 = 6.305, p<0.05) and Behala (χ^2 = 7.468, p<0.05) respectively.

Thus, the regression analysis was controlled for 'child's age' and 'family type' in case of Khidirpur and in case of Behala, it is controlled for 'child's age' and 'parent's gender'. For the remaining neighbourhoods, the analysis was controlled only for 'child's age'.

5.2.4. Model 1: Association with BE Variables

The results from multi-nominal logistic regression model 1 for different neighbourhoods are presented in Table 5.8. The data reveals that the two most significantly associated BE variables with CIM are land-use mix and traffic exposure. In the case of mid-rise neighbourhoods (Salt Lake Sector 1, OR= 5.47, p<0.05 and Sector 3, OR= 5.77, p<0.05) this association is positive and only applies to land-use mix. While in the case of Khidirpur (OR= 0.17, p<0.05), this association is negative and only applies to traffic exposure. For Behala and New Town, the direction of relationship remains the same for both these variables. Notably, no significant association was found between street connectivity and residential density with CIM across any neighbourhood.

Table 5.8 The association between CIM licence and built environment variables

Neighbourhood Built-Environment Variables	**CIM Licence**				
	Khidirpur[a] (n=144)	Behala[b] (n = 169)	Salt Lake Sector 1[c] (n =127)	Salt Lake Sector 3[d] (n=120)	New Town[e] (n = 113)
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Land-use mix		**8.00**(3.91, 16.36)*	**5.47** (2.87, 10.40)*	**5.77** (2.74, 12.14)*	**5.53** (1.35, 22.63)*
Street connectivity	1.88(0.99, 3.58)				
Traffic exposure	**0.17**(0.07, 0.36)*	**0.33**(0.17, 0.64)*		0.62 (0.33, 1.15)	**0.13** (0.37, 0.50)*
Residential density		1.63(0.87, 3.05)		1.85 (0.96, 3.55)	

[a] R^2= 0.364 (Cox & Snell), 0.423 (Nagelkerke). Model chi-square (4) = 65.233, p<0.001, analysis controlled for child's age and family
[b] R^2= 0.403 (Cox & Snell), 0.464 (Nagelkerke). Model chi-square (4) = 87.264, p<0.001, analysis controlled for child's age and parent's gender
[c] R^2= 0.262 (Cox & Snell), 0.295 (Nagelkerke). Model chi-square (2) = 38.548, p<0.001, analysis controlled for child's age
[d] R^2= 0.360 (Cox & Snell), 0.409 (Nagelkerke). Model chi-square (2) = 53.590, p<0.001, analysis controlled for child's age
[e] R^2= 0.282 (Cox & Snell), 0.339 (Nagelkerke). Model chi-square (2) = 37.400, p<0.001, analysis controlled for child's age
* the variables are significantly associated with CIM licence (p <0.05)

These results are in line with other studies (M Z Islam et al., 2014; Lam & Loo, 2014; J Rudner & Wickramaarachchi, 2013) confirming a negative relationship between CIM licence and traffic. But

contrary to developing countries (Sharmin & Kamruzzaman, 2017), land-use mix has emerged, in this research, as a supportive element to CIM. This outcome upholds previous research in India that found high land-use mix supporting sustainable adult's travel behaviour (Bahadure & Kotharkar, 2015). Moreover, a higher land-use mix is found to promote natural surveillance or 'eyes on the street' aspect (Jacobs, 1961) for children's freedom to explore local surroundings.

5.2.5. Model 2: Association with SE Variables

The results from multi-nominal logistic regression model 2 for different neighbourhoods are presented in Table 5.9. The data reveals that the two most significantly associated SE variables with CIM are social cohesion and neighbourhood safety. There was no significant association found with social connection across any neighbourhood. This indicates that for parents, mutual trust and respect among neighbours along with neighbourhood safety perceptions against crime are more essential components in view of granting independent mobility licenses to their children.

Table 5.9 The association between CIM licence and social environment variables

Neighbourhood Social-Environment Variables	**CIM Licence**				
	Khidirpur[a] (n=144)	Behala[b] (n = 169)	Salt Lake Sector 1[c] (n =127)	Salt Lake Sector 3[d] (n=120)	New Town[e] (n = 113)
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Social Cohesion	**5.27** (2.92, 9.50)*	**2.34**(1.68, 3.26)*			
Social Connection					
Neighbourhood Safety			**3.67** (2.39, 5.65)*	**4.02** (2.37, 6.80)*	**5.53** (2.46, 12.43)*

[a] R^2= 0.538 (Cox & Snell), 0.625 (Nagelkerke). Model chi-square (4) = 111.146, p<0.001, analysis controlled for child's age and family
[b] R^2= 0.327 (Cox & Snell), 0.376 (Nagelkerke). Model chi-square (4) = 66.886, p<0.001, analysis controlled for child's age and parent's gender
[c] R^2= 0.394 (Cox & Snell), 0.444 (Nagelkerke). Model chi-square (2) = 63.584, p<0.001, analysis controlled for child's age
[d] R^2= 0.320 (Cox & Snell), 0.363 (Nagelkerke). Model chi-square (2) = 46.227, p<0.001, analysis controlled for child's age
[e] R^2= 0.329 (Cox & Snell), 0.396 (Nagelkerke). Model chi-square (2) = 45.084, p<0.001, analysis controlled for child's age
* the variables are significantly associated with CIM licence (p <0.05)

When looking at the data across neighbourhoods, interestingly 'neighbourhood safety' was seen as a dominant variable for mid (Salt Lake Sector 1, OR= 3.67, p<0.05 and Sector 3, OR= 4.02, p<0.05) and high-rise neighbourhoods (New Town OR = 5.53, p<0.05). On the other hand, 'social cohesion' was revealed as significant in the case of low-rise neighbourhoods (Khidirpur OR =

5.27, p<0.01, Behala OR = 2.34, p< 0.01). The directions for all these associations were positive signifying a crucial position of neighbourhood SE in relation to parent's decision on CIM licenses.

The outcome supports previous studies (A. Carver et al., 2014; Lin et al., 2017; S. Schoeppe et al., 2015) which found parents with a higher perception of social cohesion as more likely to permit their children greater distances for independent mobility and outdoor play. However, in contrast with studies conducted in developed countries (Lin et al., 2017) neighbourhood safety was revealed as an important variable impacting CIM licenses.

5.2.6. Model 3: Association with BE and SE Variables

The results from multi-nominal logistic regression model 3 for different neighbourhoods are presented in Table 5.10. From the data, it is evident that when all the neighbourhood variables (BE and SE) were taken together, four variables of land-use mix, traffic exposure, social cohesion and neighbourhood safety were seen as significantly impacting CIM licence. This outcome is in line with the previous individual models for BE and SE variables (model 1 and 2).

Table 5.10 The association between CIM licence with built and social environment variables

Neighbourhood Variables	**CIM Licence**				
	Khidirpur[a] (n=144)	Behala[b] (n = 169)	Salt Lake Sector 1[c] (n =127)	Salt Lake Sector 3[d] (n=120)	New Town[e] (n = 113)
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Land-use mix		**7.83**(3.63, 16.91)*	**2.36** (1.12, 5.00)*	**4.39** (1.97, 9.80)*	
Street connectivity			1.72 (0.87, 3.39)		
Traffic exposure		**0.43**(0.22, 0.86)*		0.61 (0.30, 1.25)	
Residential Density					
Social Cohesion	**5.27**(2.92, 9.50)*	**1.96**(1.38, 2.80)*			
Social Connection					
Neighbourhood Safety			**3.01** (1.92, 4.71)*	**3.45** (1.95, 6.12)*	**5.53** (2.46, 12.43)*

[a] R^2= 0.538 (Cox & Snell), 0.625 (Nagelkerke). Model chi-square (4) = 111.146, p<0.001, analysis controlled for child's age and family
[b] R^2= 0.477 (Cox & Snell), 0.549 (Nagelkerke). Model chi-square (4) = 109.631, p<0.001, analysis controlled for child's age and parent's gender
[c] R^2= 0.458 (Cox & Snell), 0.517 (Nagelkerke). Model chi-square (2) = 77.860, p<0.001, analysis controlled for child's age
[d] R^2= 0.454 (Cox & Snell), 0.516 (Nagelkerke). Model chi-square (2) = 72.662, p<0.001, analysis controlled for child's age
[e] R^2= 0.329 (Cox & Snell), 0.396 (Nagelkerke). Model chi-square (2) = 45.084, p<0.001, analysis controlled for child's age
* the variables are significantly associated with CIM licence (p <0.05)

Upon comparing the result across neighbourhoods, several interesting and notable observations emerge. For instance, land-use mix was seen as the most significant variable impacting CIM licence in the majority of neighbourhoods (Behala, Salt Lake Sector 1 and 3). This is especially evident in case of Behala, where a one-unit increase in land-use mix, increases the odds of a high licence than no licence by 7.83 times. Yet, this is the only neighbourhood where traffic exposure was also found to have a significant relationship with CIM (OR = 0.43, $p<0.01$). Focusing on SE variables, neighbourhood safety tends to be a strong influential variable on CIM in case of mid (Salt Lake Sector 1, OR= 3.01, $p<0.01$ and Sector 3, OR= 3.45, $p<0.05$) and high-rise neighbourhoods (New Town OR = 5.53, $p<0.05$). Broadly, it is the impact of built environment than social environment that seems to affect parent's CIM permission related decisions across neighbourhoods (except Khidirpur and New Town).

5.3 CIM Destination & Urban Neighbourhood

5.3.1. Ratios

The percentage of CIM destination ratios across neighbourhoods are presented in Table 5.11. The result is similar to the one obtained from parents through CIM licence scores. The share of 'high ratio' is highest among children from Behala (46.2%) and lowest for children from New Town (22.1 %). Clearly, it can be assumed that the independent mobility permissions granted by parents matches with the actual mobility of children.

This outcome aligns with several international studies investigating children's actual mobility across different levels of urbanisation settings. Two such studies conducted in Portugal found that actual independent and active mobility of children to home-school trajectory and weekend leisure time activities was more in non-urbanised than highly urbanised environment (Lopes et al., 2014; Rodrigues et al., 2018). In Hong Kong, a study revealed that children aged 6-12 years from urban core areas showed the lowest level of independent mobility when compared to rural and government planned new town environments (Lam & Loo, 2014). Conversely, an opposite finding was obtained among Australian children aged 7-10 years, where urban children showed higher independent and active mobility to school than rural children (A. Carver et al., 2012).

Table 5.11 CIM Destination ratio (%) across different neighbourhood typologies

S. No.	CIM Destination ratio	Neighbourhood				
		Khidirpur	**Behala**	**Salt Lake Sector 1**	**Salt Lake Sector 3**	**New Town**
1	Low ratio	63.9	53.8	65.4	70.8	77.9
2	High ratio	36.1	46.2	34.6	29.2	22.1

5.3.2. Mobility Type

The overall distribution of children's mobility type for each of the six local destinations is illustrated in Figure 5.14. Clearly, only 17% of children were daily commuting to school without any adult companion. The highest percentage of independent mobility trips was for parks or playgrounds (40%), followed by the local street (36%). After school, the highest dependent mobility of children was seen for 'local market' (44%) and 'structured class' (43%) across all neighbourhoods. Notably, 'structured class' was the least visited local destination across neighbourhoods, with approximately 40% children marking it as 'don't go there' place.

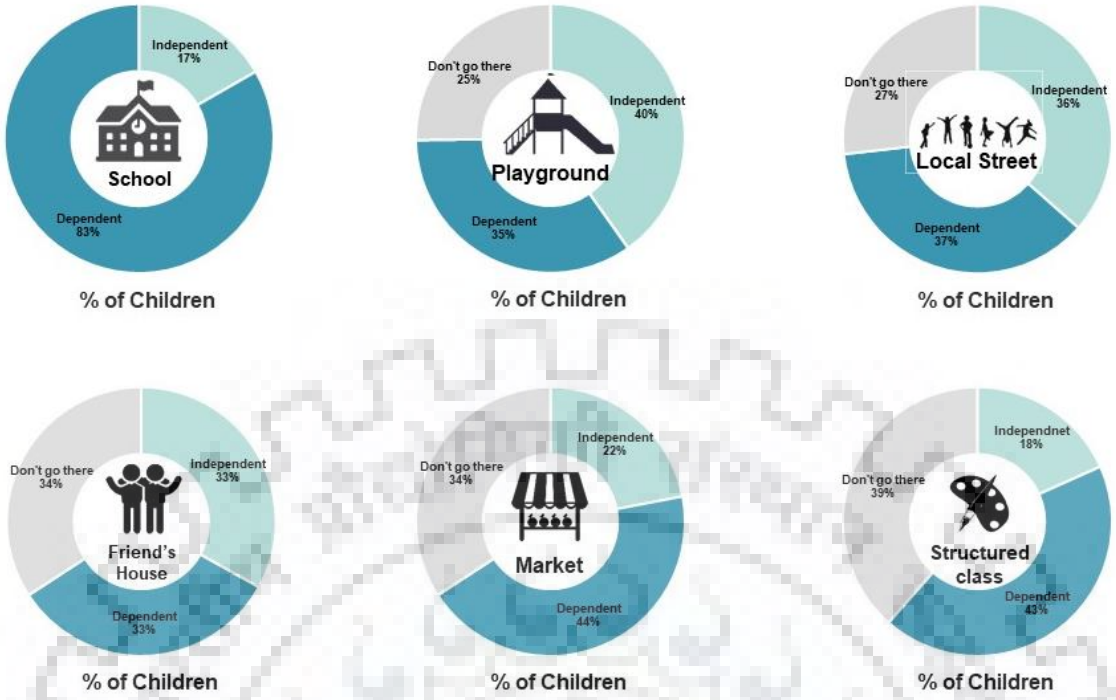


Figure 5.14 Overall percentage distribution of children's mobility type for local destinations

To further advance the understanding on children's mobility type, the same data is looked at across neighbourhoods individually, as illustrated in Figure 5.15. The actual CIM to school and local street was highest among children from low-rise neighbourhoods of Khidirpur and Behala. While CIM to park and friend's house was highest among children from mid and high-rise neighbourhoods. It was observed that a large section of children from low-rise neighbourhoods do not go to park. An explanation could be found in the neighbourhood spatial structure, which in this case, is characterised as dense with less open spaces. These neighbourhoods offer limited opportunities for children's play in designated parks or playgrounds. Instead, an immediate local street near residences was more accessible for children's outdoor activities. Thus, actual CIM to local streets was highest among children from low-rise neighbourhoods. Looking at the case of mid-rise neighbourhoods, this scenario was reversed, as there is an equal distribution of parks and playgrounds within each residential sector. Thus, independent mobility to parks is higher than to local street among children from these neighbourhoods. Moreover, a higher CIM to friend's house was also noted here. The data further reveals a similar case for high-rise neighbourhood, where CIM to park and friend's house was the highest. Notably, this is the only neighbourhood where none of the children were commuting to school independently.

On comparison, the proportion of children independently travelling to school was in line with findings from Bangladesh (Bhuyan & Zhang, 2020). Still, it was lower than reported in studies conducted in other countries. For example, in Western Australia, 71.8% of children travelled independently (Karen Villanueva et al., 2013), while in New Zealand, 44.3% of children were allowed to go to school without adult's supervision (Mitchell et al., 2007), in Spain, 57.2% of children indicated independent commuting to school both ways (Ayllón et al., 2020), in the UK, 53% of children walked or cycled to school independently (A. Carver et al., 2014) and in Finland, 69% of children in inner-city travelled independently in their school journeys (M Kyttä et al., 2015). Considering the mobility to park, friend's house and local market (among children going to these destinations), the average share of independently mobile children was in comparison to Australian children from Perth (Christian et al., 2015).

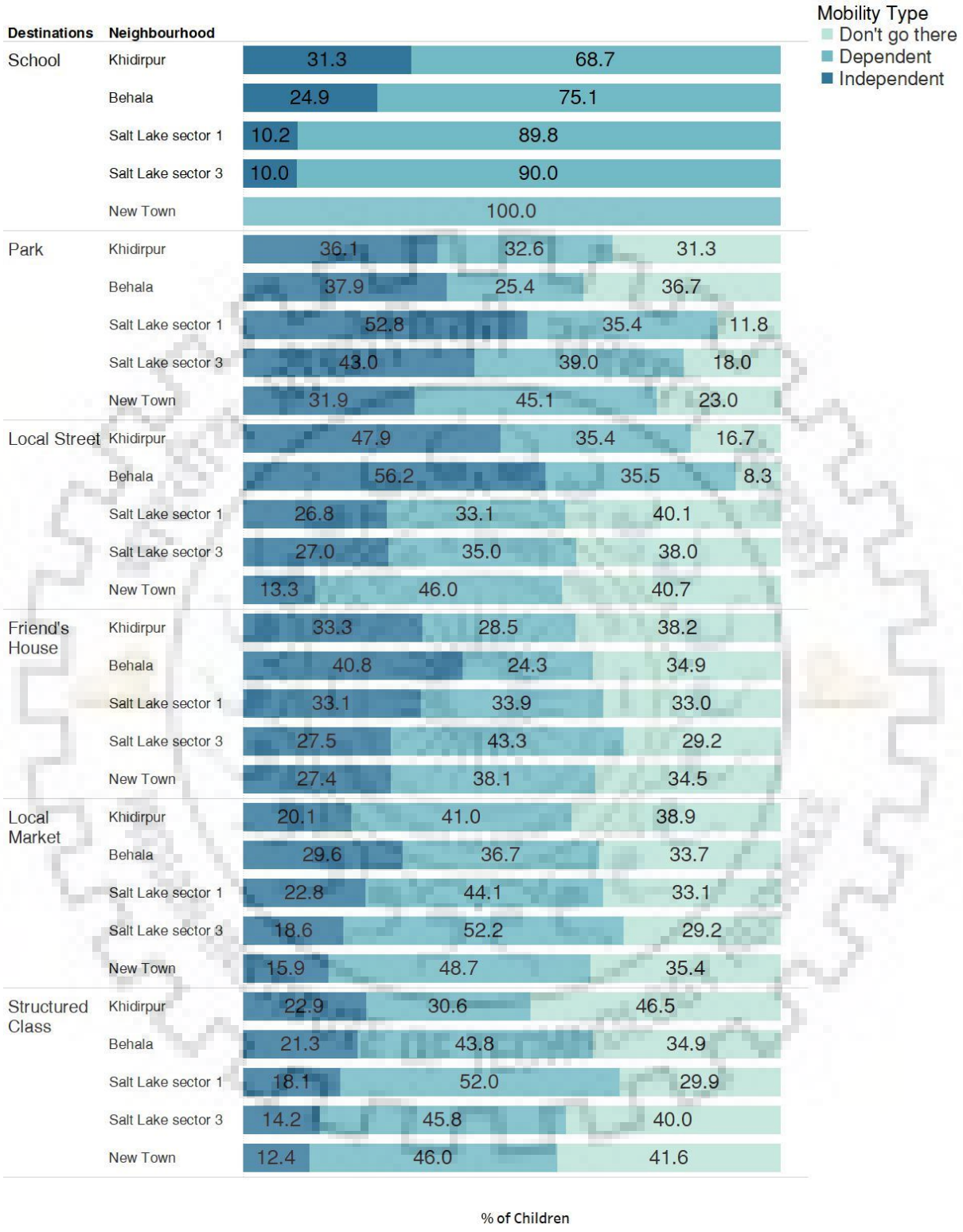


Figure 5.15 Percentage distribution of children's mobility type for local destinations across neighbourhood

5.3.3. Modal Share

The overall distribution of children's mode of transport to local destinations is illustrated in Figure 5.16. Evidently, walking was the most popular mode of transport. Majority of children walked (40%) to school followed by school bus (23%). Interestingly, the highest proportion of walking (60%) and cycling (14%) was for playground or parks. If we combine the data obtained earlier, it clearly indicates that a large proportion of children going to park alone were actively mobile.

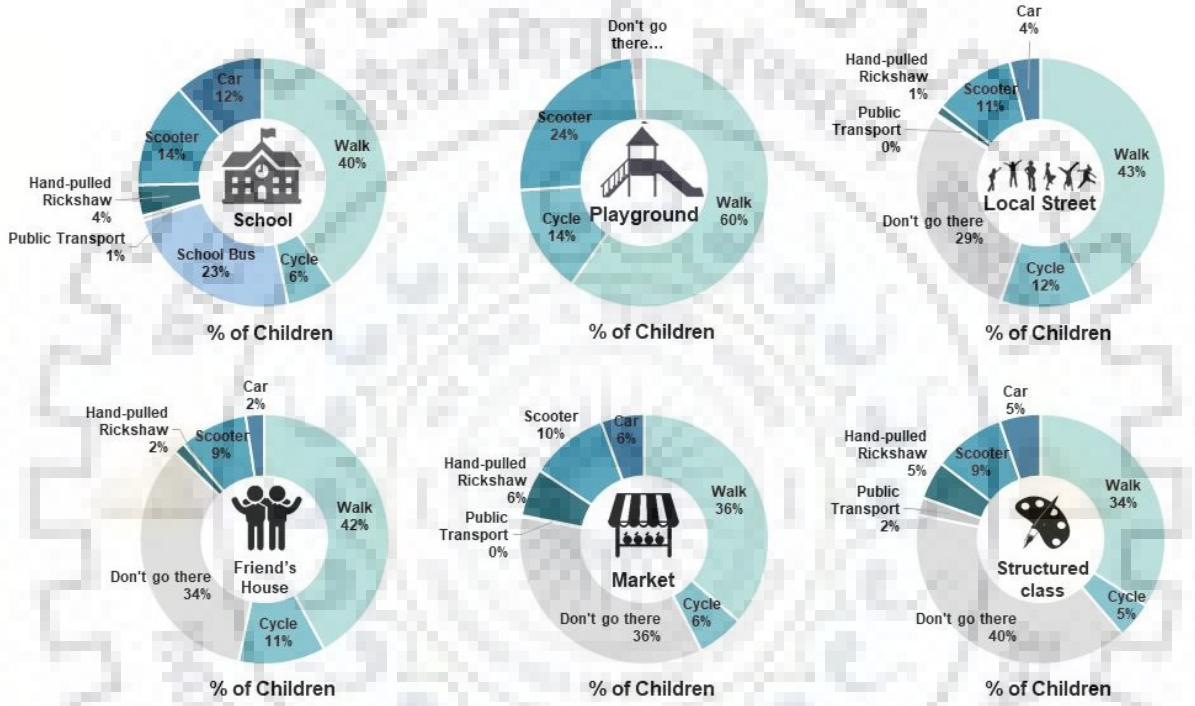


Figure 5.16 Overall percentage distribution of children's mode of transport to local destinations

Now if we look at the same data across individual neighbourhoods as illustrated in Figure 5.17, several key insights were obtained. Beginning with the mobility to school, majority of children (>50%) walked in all neighbourhoods except in Salt Lake Sector 3 and New Town, where most children commuted by school bus. This is attributed to the fact that the schools in these neighbourhoods provided a well-managed bus service plying on several routes across the city (including nearby neighbourhoods), unlike in other cases. Interestingly, the share of 'car' as the mode of transport to school was seen to increase from low-rise neighbourhoods to high-rise neighbourhood, in line with the increase of dependent mobility share as discussed in the previous section.

Besides park, the proportion of cycling as a mode of transport, remains the same in case of mobility to local street and friend's house among low-rise neighbourhood children. While most children from mid and high-rise neighbourhoods were either walking or driven by scooter or car to the same locations. Interestingly, walking and hand-pulled rickshaw were seen as the prevalent mode of transport for mobility to local market and structured class among low-rise neighbourhood children. However, with no availability of hand-pulled rickshaw or frequent public transport in mid and high rise neighbourhoods, children were mostly walking or driven to the same locations.

The results on mode of transport to school, corroborate with a study conducted in the Indian city of Hyderabad, where 57% of children were found to be walking daily to school and only 5 % using public transport (Tetali et al., 2016). Similarly, 40% of Norwegian children aged 6-12 years were also found daily walking to school, while only 17% were using public transport (Fyhri & Hjorthol, 2009). Also, more than half German children aged 6-10 years walked or cycled to school, and only 46% used public transport or driven to school by parents (Kobel et al., 2019). Further, 67% of Canadian children also walk to school daily (Rothman et al., 2014).

In contrast, (as mentioned in chapter 2, section 2.5.1.2), the results contradict findings from studies done in two Indian cities of Guwahati and Rohtak (Kush, 2019; Raoniar et al., 2019), where more than 50% of children were found to be driven to school. This variation is mainly due to varying sample size and school typology selection. Furthermore, the results also go against the findings from the Global North where public transport share to school was high among children (Fyhri et al., 2011; M Kyttä et al., 2015; Lopes et al., 2014). However, for non-school destinations, the study result aligns with the previous studies. Most Australian and Norwegian children were using an active mode of transport (walk or cycle) for mobility to friend's (or extended family) house and park, whereas a majority were driven to destinations like local market and structured classes (Christian et al., 2015; Fyhri & Hjorthol, 2009).

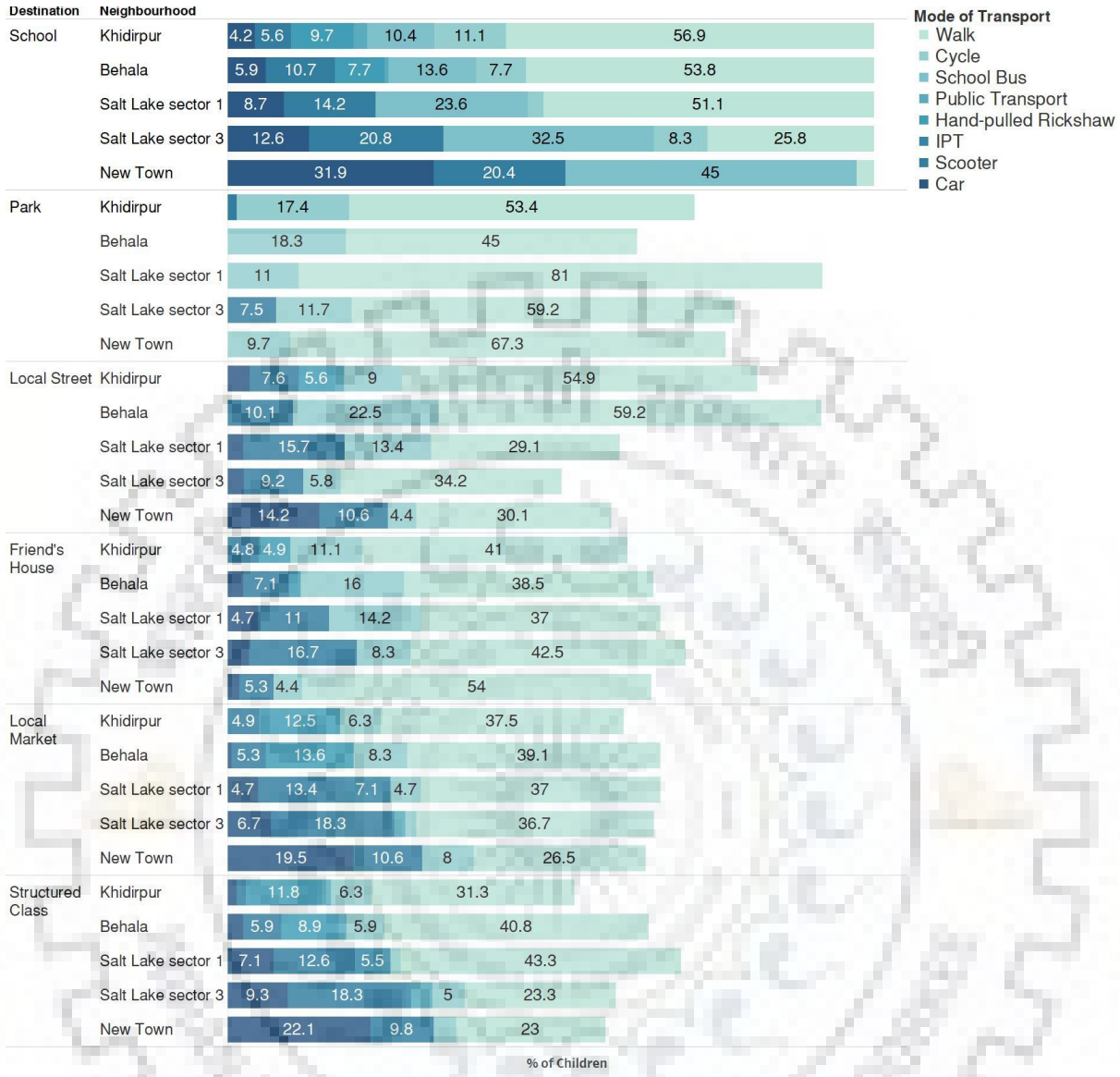


Figure 5.17 Percentage distribution of children's mode of transport (excluding % of '*don't go there*') to local destinations across neighbourhoods

5.3.4. Association with Socio-demographic Variables

The results from chi-square statistics reveal a similarity with the one from CIM licence, as shown in Table 5.12. Among all socio-demographic variables (child's gender, parent's gender and education, employment status, family type and vehicular ownership) child's age was found to be the most significantly associated with CIM destination across all neighbourhoods. It is only in

Khidirpur, where child's gender was also found to be significantly impacting CIM destination (χ^2 = 13.175, p<0.01), indicating that boys were more independently mobile than girls.

Table 5.12 Association of CIM Destination with socio-demographic variables

S. No.	Socio-demographic variables	CIM Destination				
		Khidirpur	Behala	Salt Lake Sector 1	Salt Lake Sector 3	New Town
1	Child's Gender	**15.175***	1.768	1.541	1.008	3.019
2	Child's Age	**38.357***	**25.090***	**26.523***	**29.995***	**10.720***
3	Parent's Gender	0.00	0.068	0.065	0.882	1.067
4	Parent's Qualification	0.30	1.202	0.285**	1.503**	0.306
5	Parent's Profession	1.445	1.567	0.362	0.285	0.643
6	Family Type	0.43	1.788	0.009	0.534	0.254
7	Vehicular Ownership	4.031**	3.891**	0.363**	6.016**	1.881**

*variable is significantly associated with CIM (p< 0.05)
**result from Fisher's Exact Test (cell frequency < 5)

To understand the variance across neighbourhoods in all age-groups, data is presented in the form of a bar chart in Figure 5.18. Visibly, the share of 'high ratio' destination scores increase with an increase in child's age. A remarkable shift can be seen from age 9 to 10 years onwards, indicating the importance of this age-group. It is similar to the finding from Bangladesh, where the mean CIM age from home to school was 9.05 years (Bhuyan & Zhang, 2020). Across neighbourhoods, similar to previously observed trend (from CIM licence scores) low-rise neighbourhood children enjoy higher actual independent mobility than the ones from high-rise neighbourhood.

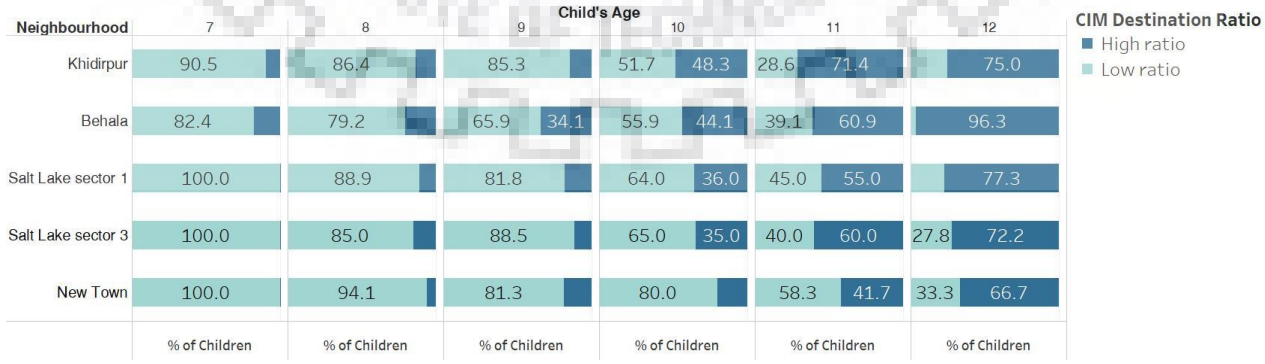


Figure 5.18 CIM destination ratio distribution across children's age in different neighbourhoods

5.3.5. Model 1: Association with BE Variables

The results from the binary logistic regression model 1 for different neighbourhoods are presented in Table 5.13. The final model showed a significant improvement over the null model with -2 Log-likelihood chi-square as highly significant ($p<0.001$) for all neighbourhoods. Looking at the individual variables, only significant variables (land-use mix and traffic exposure for Khidirpur, land-use mix and residential density for Salt Lake Sector 3, only land-use mix for rest of the neighbourhoods) were retained in the final model. The variable interaction effect was found to be not significant and thus, not included in the final step. Hosmer and Lemeshow test suggested that there was no significant difference between observed and expected ($p >0.05$, null hypothesis is accepted), which was the desired result. Overall prediction percentage was 71.5%, 68.6%, 64.6%, 75% and 80.5% for each neighbourhood model, respectively.

The data evidently suggests that land-use mix is the only variable having a strong positive association with CIM destination across all neighbourhoods (Khidirpur OR= 1.49, $p<0.05$; Behala OR = 2.65, $P<0.01$; Salt Lake Sector 1 OR = 2.01, $p<0.01$, Salt Lake Sector 3 OR = 2.13, $p<0.01$, New Town OR = 2.81, $p<0.01$). This outcome corroborates with the previous results from CIM licence scores. At individual neighbourhood level, the additional variables of traffic exposure and residential density were also found to have significant association on CIM in case of Khidirpur and Salt Lake Sector 3, respectively. Street connectivity was not found to have any relationship with CIM destination.

Table 5.13 The association between CIM destination and built environment variables

Neighbourhood Built-Environment Variables	CIM Destination				
	Khidirpur[a] (n=144)	Behala[b] (n = 169)	Salt Lake Sector 1[c] (n =127)	Salt Lake Sector 3[d] (n=120)	New Town[e] (n = 113)
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Land-use mix	**1.49**(1.00,2.21)*	**2.65**(1.79, 3.92)*	**2.01** (1.34, 3.02)*	**2.13** (1.34, 3.39)*	**2.81** (1.54, 5.11)*
Street connectivity					
Traffic exposure	**0.40**(0.26, 0.62)*				
Residential density				**1.83** (1.14, 2.92)*	

[a] R^2= 0.11 (Cox & Snell), 0.259 (Nagelkerke). Model chi-square = 19.721, $p<0.001$, analysis controlled for child's age and gender
[b] R^2= 0.166 (Cox & Snell), 0.222 (Nagelkerke). Model chi-square = 30.693, $p<0.001$, analysis controlled for child's age
[c] R^2= 0.095(Cox & Snell), 0.131 (Nagelkerke). Model chi-square = 12.634, $p<0.001$, analysis controlled for child's age
[d] R^2= 0.149 (Cox & Snell), 0.213 (Nagelkerke). Model chi-square = 19.410, $p<0.001$, analysis controlled for child's age
[e] R^2= 0.124 (Cox & Snell), 0.190 (Nagelkerke). Model chi-square = 14.962, $p<0.001$, analysis controlled for child's age

* the variables are significantly associated with CIM destination (p <0.05)

5.3.6. Model 2: Association with SE Variables

The results from binary logistic regression model 2 for different neighbourhoods are presented in Table 5.14. The final model showed a significant improvement over the null model with -2 Log-likelihood chi-square as highly significant (p<0.001) for all neighbourhoods. Looking at the individual variables, only significant variables (neighbourhood cohesion for Khidirpur and Behala; all three variables for the rest of the neighbourhoods) were retained in the final model. The variable interaction effect was found to be not significant and thus, not included in the final step. Hosmer and Lemeshow test suggested that there was no significant difference between observed and expected (p >0.05, null hypothesis is accepted), which was a desirable result. Overall prediction percentage was 76.7%, 67.5%, 73.2%, 72.5% and 82.3% for each neighbourhood model respectively.

The data findings were comparable with CIM licence, which revealed that the two most significant SE variables were social cohesion and neighbourhood safety. For low-rise neighbourhoods, the relationship is positive and applicable to social cohesion only. While for mid and high-rise neighbourhoods, the association is positive and applicable to neighbourhood safety only. It is in line with the Australian study where parent's negative perception about neighbourhood safety has resulted in reduced odds of CIM to school, park and local shop (Christian et al., 2015).

Table 5.14 The association between CIM destination and social environment variables

Neighbourhood Social-Environment Variables	CIM Destination				
	Khidirpur[a] (n=144)	Behala[b] (n = 169)	Salt Lake Sector 1[c] (n =127)	Salt Lake Sector 3[d] (n=120)	New Town[e] (n = 113)
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Social Cohesion	**1.61** (1.36, 1.92)*	**1.50** (1.27, 1.77)*	1.08 (0.91, 1.30)	1.14 (0.90, 1.43)	0.72(0.49, 1.07)
Social Connection			1.31(1.01, 1.78)	1.04 (0.75, 1.44)	1.58(0.83, 3.02)
Neighbourhood Safety			**1.49** (1.14, 1.94)*	**1.77** (1.24, 2.55)*	**1.69**(1.09, 2.62)*

[a] R^2= 0.206 (Cox & Snell), 0.324 (Nagelkerke). Model chi-square = 38.854, p<0.001, analysis controlled for child's age and gender
[b] R^2= 0.150 (Cox & Snell), 0.200 (Nagelkerke). Model chi-square = 27.473, p<0.001, analysis controlled for child's age
[c] R^2= 0.188 (Cox & Snell), 0.259 (Nagelkerke). Model chi-square = 26.384, p<0.001, analysis controlled for child's age
[d] R^2= 0.152 (Cox & Snell), 0.216 (Nagelkerke). Model chi-square = 19.742, p<0.001, analysis controlled for child's age
[e] R^2= 0.134 (Cox & Snell), 0.205 (Nagelkerke). Model chi-square = 16.225, p<0.001, analysis controlled for child's age
* the variables are significantly associated with CIM destination (p <0.05)

5.3.7. Model 3: Association with BE and SE Variables

The results from binary logistic regression model 3 for different neighbourhoods are presented in Table 5.15. The final model showed a significant improvement over the null model with -2 Log-likelihood chi-square as highly significant ($p<0.001$) for all neighbourhoods. Only significant variables (land-use mix, traffic exposure and cohesion for Khidirpur, land-use mix and cohesion for Behala, land-use mix, connection and safety for Salt Lake Sector 1, land-use mix, residential density and neighbourhood safety for Salt Lake Sector 3 and only land-use mix for New Town) were retained in the final model. The variable interaction effect was not significant and thus, not included in the final step. Hosmer and Lemeshow test suggested that there was no significant difference between observed and expected ($p >0.05$, null hypothesis is accepted), which was the desired result. Overall prediction percentage was 72.2%, 67.5%, 72.4%, 72.5% and 80.5% for each neighbourhood model respectively.

When all the neighbourhood variables (BE and SE) were taken together in a model, three variables of land-use mix, social cohesion and neighbourhood safety were seen as significantly impacting the actual CIM. This outcome is in line with the previous individual models for BE and SE variables (model 1 and 2). Upon comparing the results across neighbourhoods, several interesting and notable observations emerge. For example, land-use mix was found to be significantly associated in case of Behala and New Town. No association with other BE variables were found to be impacting CIM destination. Looking at SE variables, the positive association with social cohesion was found only within low-rise neighbourhoods, while a similar association with neighbourhood safety was found within mid-rise neighbourhoods. Broadly, it can be assumed that social environment seems to override any effect of built environment on children's actual independent mobility across majority of neighbourhoods. This outcome aligns with the review study (I. Marzi et al., 2018), which suggests that unlike physical activity or active travel, CIM tends to be more determined by the social environment than physical environment.

Table 5.15 The association between CIM destination with built and social environment variables

Neighbourhood Variables	CIM Destination				
	Khidirpur[a] (n=144)	Behala[b] (n = 169)	Salt Lake Sector 1[c] (n =127)	Salt Lake Sector 3[d] (n=120)	New Town[e] (n = 113)
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Land-use mix	1.28(0.82, 1.97)	**2.11**(1.40, 3.19)*	1.24 (0.75, 2.07)	1.64 (0.99, 2.70)	**2.81** (1.54, 5.11)*
Street connectivity					
Traffic exposure	0.71(0.41, 1.25)				
Residential Density				1.61 (0.98, 2.64)	
Social Cohesion	**1.43**(1.15, 1.79)*	**1.34**(1.12, 1.61)*			
Social Connection			1.28 (0.93, 1.75)		
Neighbourhood Safety			**1.46** (1.10, 1.94)*	**1.57** (1.09, 2.25)*	

[a] R^2= 0.071 (Cox & Snell), 0.343 (Nagelkerke). Model chi-square = 41.424, p<0.001, analysis controlled for child's age and gender
[b] R^2= 0.271 (Cox & Snell), 0.290 (Nagelkerke). Model chi-square = 41.391, p<0.001, analysis controlled for child's age
[c] R^2= 0.187 (Cox & Snell), 0.258 (Nagelkerke). Model chi-square = 26.271, p<0.001, analysis controlled for child's age
[d] R^2= 0.192 (Cox & Snell), 0.275 (Nagelkerke). Model chi-square = 25.652, p<0.001, analysis controlled for child's age
[e] R^2= 0.124 (Cox & Snell), 0.190 (Nagelkerke). Model chi-square = 14.962, p<0.001, analysis controlled for child's age
* the variables are significantly associated with CIM destination (p <0.05)

5.4 Parental Perception of CIM

The relationship between CIM and neighbourhood is further understood from a three-lens parental perspective of concept, concern and challenges. The content analysis of telephonic interviews generated valuable insights that are divided into the following key themes, as detailed below:

Theme 1: 'Conceptual' understanding and 'concerns' related to CIM

A high proportion of parents (90%) reported a collective agreement that children should be granted permission to move freely within local surroundings. Father of a 12-year-old girl further added that independence as a skill from an early age assists in building confidence among children. In fact, many (60%) even recalled their childhood and the freedom they enjoyed to move around their neighbourhood in Kolkata without any adult supervision.

"*There was a time when I used to walk every day to school, playground or any other nearby places in my para [neighbourhood]. My parents never restricted me to go anywhere within the para. Although they were strict about the timings, they were less worried since there was a sense of social security and trust among neighbouring families. I feel a little sad that my kid does not enjoy the same kind of freedom today*." (Mother of a 10-year-old boy from a low-rise neighbourhood)

In most cases (82%), a similar sentiment on the difference of freedom enjoyed by two generations was expressed while citing reasons of 'these times' referring to the perceived negative societal changes. Consequently, several parents (68%) believed that fixed mobility range and indirect adult supervision should be essential components of CIM.

"*She is free to go out and plan. She knows which streets to play on and which ones need to be avoided. I have memorised her since an early age the play and cycling boundaries. Besides, people here know our family, and even the shopkeepers know my husband since his childhood…so I don't have to accompany her [for play]*." (Mother of a 12-year-old girl from a low-rise neighbourhood)

However, for parents from mid and high-rise neighbourhoods, indirect supervision was not sufficient. They stated that accompanying their children to local destinations is essential as a duty towards 'responsible parenting'. As on the one hand, streets in mid-rise neighbourhoods remain largely inactive and unsafe for most of the day. While on the other hand, streets in high-rise neighbourhood primarily prioritise vehicular traffic over pedestrians.

"*It's a vicious cycle here. Since people usually prefer staying indoors than socialising on terraces or front porches- we see fewer people walking on our streets even in daylight. Also, unlike older parts of Kolkata, we don't have those street vendors on wheeled carts coming here regularly. There is always somebody new every month. Such an atmosphere has become a boon for petty thieves breaking into homes or cars without anyone noticing. It is for this reason people have invested heavily on CCTV cameras and window grills*." (Father of an 8-year-old girl from a mid-rise neighbourhood)

"*I cannot imagine anyone walking or cycling safely on those streets, let alone the point of allowing our kids to do the same. The (vehicular) traffic is hideous, especially during office rush hours. We don't have any other option than literally driving our kids everywhere*". (Mother of a 7-year-old girl from a high-rise neighbourhood)

Conversely, the issues raised by parents from low-rise neighbourhoods centred around the perceived 'fear of crime' owing to the proximity of families from low-income households. There was an outward migration of old families reported by parents from inner-city core areas to new neighbourhoods. This was accompanied by the inward migration of new families from low-income households. Perhaps, more than 'fear of crime', it was the company of children from low-income families that parents considered unsuitable leading to demarcations of children's mobility routes and on-street play areas. Parents are seen to apply such social rules in previous studies (Pinkster & Fortuijn, 2009; Witten et al., 2013) where they allow their child to hang out with particular friends, only after meeting or knowing about the children's parents.

Theme 2: Urban policy-level 'challenges' of neighbourhood and surrounding areas related to CIM

Three main urban policy-level challenges impacted parent's decision on children's mobility within neighbourhoods. Firstly, there was lack of nearby child-specific destinations. A majority of parents (64%), especially from mid and high-rise neighbourhoods, reported driving their children for small errands daily. They believed such a situation could have been avoided if child-centred facilities were made available at a walking distance from their home.

"*I drive my son daily to school. I have no other choice. While coming back, there is always some stationary or sports-related shopping that needs to be done too. Since there are no such shops here, we do our shopping from Sector 1 near the city center mall. It gets exhausting sometimes*" (Father of an 11-year-old boy from a mid-rise neighbourhood)

Interestingly it was further revealed that there was also an issue of decision-making powers on selecting managing bodies and types of neighbourhood services. The existing policy did not give the local residents any authority to decide the type of services to be made available within their neighbourhood. Accordingly, parents were compelled to travel larger distances for daily shopping needs, and there were trust issues with the people managing the neighbourhood shops.

Secondly, parents (65%) even criticised the lack of safe and accessible public transportation within neighbourhoods. Despite an extensive network of transit options within low-rise neighbourhoods, parents felt that they did not cater to the needs of children and their caregivers. For instance, one parent informed that although there are several bus stops at a walkable distance within the neighbourhood, the bus waiting infrastructure remains nonexistent. Additionally, the absence of designated parking for hand-pulled or auto-rickshaws, further creates unsafe mobility environment for both adults and children. On similar lines, parents from mid and high-rise neighbourhoods expressed disappointment over the limited public transport infrastructure and lack of last-mile connectivity.

"*How can I send her on that city bus alone? It's unimaginable! She is not yet matured enough to navigate through the crowd or understand the bus route system independently. Besides, if there were hand-pulled rickshaws here, I would have given it a thought since they are safer and more reliable*." (Mother of a 9-year-old girl from a mid-rise neighbourhood)

Thirdly, there was a commonly raised issue of sidewalks. Majority of parents (88%) across all neighbourhoods saw sidewalks as a necessary element for a safer commute of children within local surroundings. They reported that existing sidewalks were discontinuous, unmaintained and unprotected. On several occasions during peak traffic hours, there was a tendency among people on motorised bikes to use the sidewalk as a shortcut, creating a dangerous situation for pedestrians.

On other occasions, there was a problem of parking on sidewalks too, minimising the sidewalks' already insufficient width.

Overall, parents valued and encouraged CIM as an essential requirement for children's well-being but believed in granting conditionally to children. This conditioning emerged out of the urban-level challenges of neighbourhood varying across distinct typologies.

5.5 Chapter Summary

The independent mobility of children depends upon multi-layered built, social and individual factors. This research by employing participatory approach across five neighbourhoods resulted in some key findings that provide an in-depth view of CIM within the Indian context. The result reveals that the share of girls was higher than boys in the majority of the sample. Children were majorly in age-group of 9-10 years. The responding parents were majorly fathers, living in nuclear family systems. CIM licence scores obtained from parents and CIM destination ratios obtained from children were comparable as seen from Figure 5.19. Children who were granted higher CIM licenses by their parents tend to have higher actual independent mobility for local destinations.

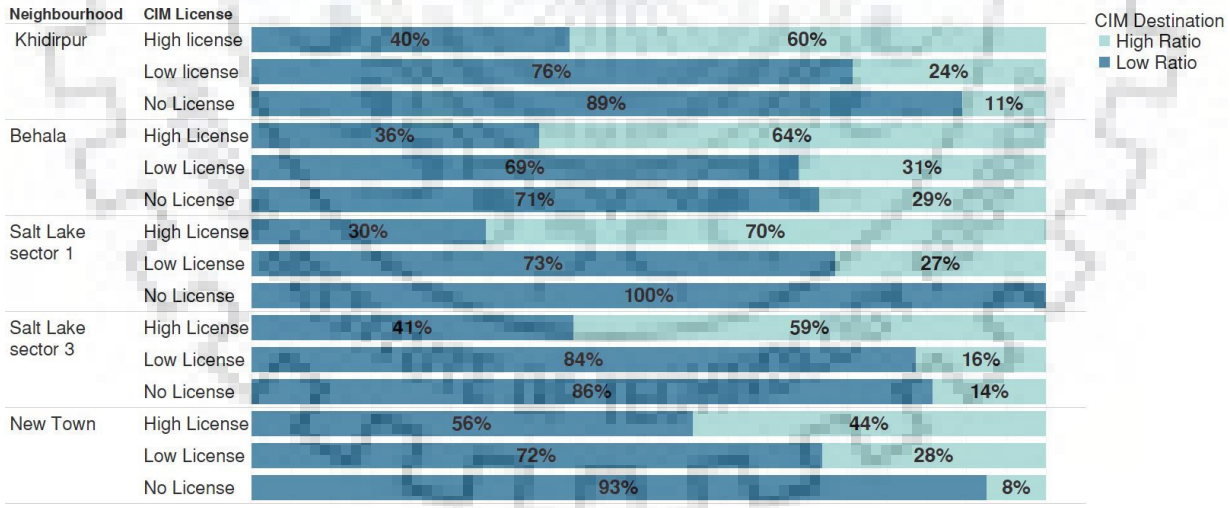


Figure 5.19 Percentage distribution of children's CIM licence score and CIM destination ratios across neighbourhoods

Child's age was uniformly and significantly associated with both CIM licence and destination. Other socio-demographic variables that were found (in few cases) to be impacting CIM were child's gender, parent's gender and family type. 'Park' was revealed as the most independently

mobile location across all neighbourhoods. On average, 30% of children were travelling alone to school within low-rise neighbourhoods (Khidirpur and Behala). None of the children were allowed to travel independently to school in New Town. 'Local market' and 'structured class' were the least independently mobile locations. Walking was the most common mode of transport for all locations across neighbourhoods irrespective of presence or absence of adult supervision. Looking at the data on individual mobility licenses, the most liberal licence was going to places within walking distances alone. While, the least liberal mobility licence was using public transport alone, indicating a negative parents' perception of this mode for a safer and independent commute of their children.

Notably, several relationships emerge between CIM and neighbourhood built and social environment across neighbourhoods. Land-use mix was revealed as an influential variable impacting CIM positively. It was further supported by parental interviews, which revealed a positive relationship between walkable child-specific destinations and higher CIM. On the other hand, traffic exposure was found to be negatively impacting CIM, especially within low-rise neighbourhoods. Social cohesion and neighbourhood safety were the only SE variables having a significant effect on CIM within all neighbourhoods, respectively. Overall, parental CIM licence tends to be more affected by the neighbourhood BE while children's actual independent mobility tends to be affected by neighbourhood SE. Understanding the correlational nature of both CIM licence and destination, the research thus provides strong empirical evidence on the significance of neighbourhood in creating barrier or support for CIM.

Chapter 6

Neighbourhood Matters: Interpretations and Discussions

'Our buildings, places and spaces have an indelible impact on the wellbeing of the young people of our society. We must shape the built environment with children and youth at the very heart of our considerations'

-Building Spaces and Places for
Children and Young People (2011)

Chapter 6 Neighbourhood Matters: Interpretations and Discussions

This chapter critically evaluates and discusses the findings obtained from the previous section. It logically interprets the relationships between observations and uncovers the underlying patterns. The existing scenario of CIM is understood in-depth for each individual neighbourhood, and the findings are related to the literature review and theoretical and conceptual frameworks of the research. A comparative analysis is provided across three neighbourhood typologies as an overview. Further, this chapter expands by discussing the discrepancies obtained from study results and ends with a summary highlighting the overall significance of the findings.

6.1. Overview

The thesis sought to understand the current status of CIM and its association with neighbourhood built and social environment in the Indian context. A comparative case study approach was used to gain valuable insights from diverse yet representative neighbourhood typologies on children's mobility scenario. This body of work draws evidence and background information from an in-depth literature review presented in Chapter 2. The findings from this chapter informed about the methodological, design-based and geographical research gaps. Building on these findings, Chapter 3 introduced the theoretical foundation and conceptual frameworks in relation to research methodology. It assisted in providing a rationale for the research design explained in detail in Chapter 4. These foundational chapters shaped the flow of empirical information provided in Chapter 5. This chapter presented the evidence on the actual status of CIM across neighbourhoods. To further elaborate on the findings, the present chapter combines the outcome across the generated themes to present a clear and more refined picture for each neighbourhood. For ease of reference, thesis objectives are restated below:

5. To understand the theoretical and empirical relationship between CIM and urban neighbourhoods.
6. To identify the CIM levels to local destinations within distinct typologies in an urban Indian context.
7. To analyse and compare the influence of objectively measured built environment (BE) and perceived social environment (SE) on CIM levels across distinct neighbourhood typologies.

8. To propose strategies and guidelines for the design and planning of urban neighbourhoods that support CIM.

Objective 1, 2 and 3 were already covered in Chapter 2 and Chapter 5, respectively. This chapter will elaborate further on objective 3 to provide comprehensive valuable insights from the research.

6.2. CIM Discussions across Neighbourhoods

6.2.1. Case 1: Khidirpur

Khidirpur, as one of the oldest neighbourhoods in Kolkata, constituted an old-world charm in its physical and social manifestation. Families were living here for generations in both joint and nuclear family structures. It had operational tram routes and option of hand-pulled rickshaw as a part of last-mile connectivity. *Adda* (introduced in Chapter 4) was an active and vibrant form of social activity among both the generations of young and old residents. Spatially, with compact urban form, it provided proximity to local services, generating a higher land-use mix. A higher land-use mix and rich *Adda* culture, in turn, resulted in the promotion of interactive front façade. This urban setting encouraged a higher 'eyes on the street' (Jacobs, 1961) concept or natural surveillance for children's mobility, creating a positive parental perception towards their safety (Figure 6.1). So, even though the neighbourhood experienced higher traffic exposure due to heavy port activities and high residential density, the decline in parents' mobility permission levels were insignificant. Moreover, positive social connection among parents further contributed to higher CIM licenses. Independent mobility permissions by parents were highest for 'go out after dark' and 'to places within walking distances'. An explanation to this can be found within the factors of outdoor socialising residents, trustworthy shop owners, and high street connectivity. Figure 6.2 shows a scale of neighbourhood street with people walking, cycling and indulging in various outdoor activities with children.

(a) (b)

Figure 6.1 (a) The spill over of children on sidewalk and local street after school hours; (b) a wall graffiti painted by children informing about a local cricket tournament in Khidirpur

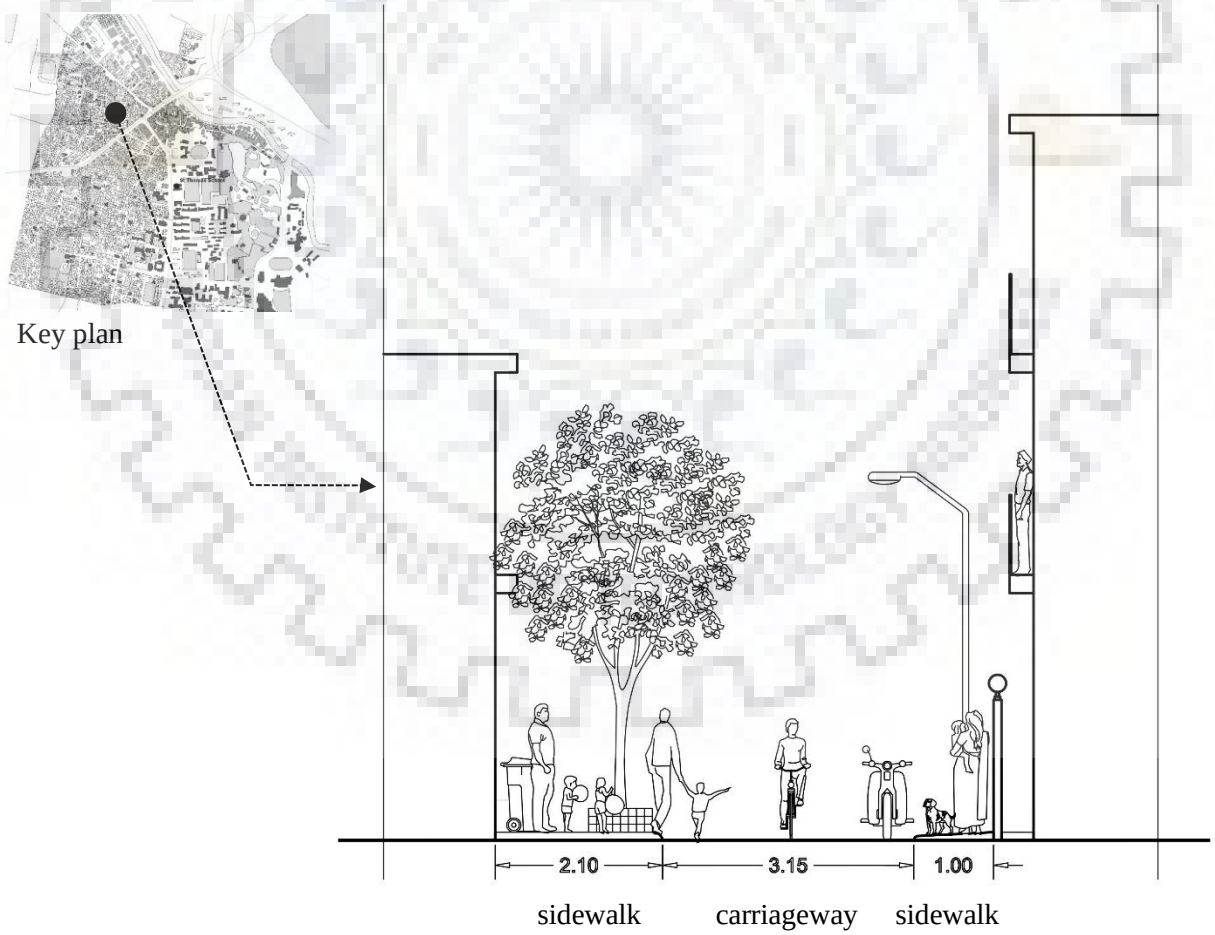


Figure 6.2 Street section of Hari Sava street, Khidirpur

The most withheld mobility permission was to use public transport alone. As reflected in the parental interviews too, where a majority of them expressed disappointment over nonexistence of safe, reliable and accessible public transport infrastructure, especially for children. As a matter of fact, this was nothing unusual, as children in India are not seen and expected to travel independently in public transport, and their mobility needs are often combined with women (Randheer et al., 2011).

Figure 6.3 A multistorey building under construction in Khidirpur

Another issue in Khidirpur was that close-knit bonding was in decline despite having the highest scores for social cohesion, connection, and neighbourhood safety variables. One of the reasons could be understood by the trend among inner-city cores that involved a simultaneous shift of old families and large-scale migration of new families from neighbouring states (Annapurna Shaw, 2015); and Khidirpur was no exception. Parents reported that many old families finding it expensive to maintain their heritage properties were selling them to local builders for conversion into multistorey apartments (Figure 6.3). Such changing demographical, socio-cultural and built environment characteristics were slowly impacting parents' mutual trust in the neighbourhood. Perhaps, it can be assumed that this trend was also resulting in nuclear families granting higher CIM licenses than joint families.

Similar to mobility permissions, actual mobility was highly influenced by a child's age. Older children (10-12 years) were granted higher CIM licenses, and they were moving more independently than the younger ones (7-9 years). Considering the individual mobility licenses, younger children (7-9 years) were found to enjoy higher CIM licenses for going to nearby places within walking distances (56.8 %) but low for daily commuting to school (11.3 %). This phenomenon can be explained by the fact that every day dropping and picking up children from school is considered a major duty within the concept of 'good conforming parents' (Malone, 2007). It was leading to more parents driving or accompanying their children to school despite allowing

them to go to other local destinations alone (Figure 6.4). Another reason could be related to the parent's socialising activity outside school gates. In this case, parents reported to utilize the school trips as an opportunity to interact with each other irrespective of the mode of transport they used to arrive at school. Few parents also informed that they often combine school trips with household running errands, as previously seen in other studies (Fyhri et al., 2011). Thus, school trips were comparatively more dependent than commute to other local destinations. Notably, a child's gender was not found to be significant impacting CIM permissions.

Figure 6.4 Children going back to home from school accompanied by parents in Khidirpur

However, actual CIM levels were found to be higher among boys than girls, owing to two possible reasons. First, the presence of different income households living in close proximity to one another and the influence of negative media reports on girl child's safety in Kolkata. Both causes instilled a negative parental perception and encouraged them to restrict girl's independent mobility. As noted in previous cases (Foster et al., 2014; Hale, 1996), such 'fear of crime' among parents were mostly the result of an emotional response impacted by numerous factors of media reports and perceived vulnerability to crime, than actual incidents within the neighbourhood. In this case, too, crime rates in Khidirpur were lowest across selected neighbourhoods and also the city (Jha, 2019; NCRB, 2018). Yet, when it comes to girl child's safety, parents were most concerned. The other explanation can be found in the apparent gender differences within early childhood practices (as explained in Chapter 2), where boys are encouraged to be independent and risk-takers while girls are taught to be cautious (Morrongiello & Dawber, 1999). Therefore, parental assessment of risk in handling challenging situations outside remains higher for girls, translating into their lower CIM licenses in comparison to boys.

Nevertheless, the overall actual CIM levels were second-highest (after Behala) among neighbourhoods. Destination wise, the highest CIM level was seen for school and local street. Recalling the land-use map and spatial structure of Khidirpur, several reputed schools were located close to this neighbourhood. Also, (previously mentioned) high street connectivity, land-use mix and natural surveillance encouraged parents to allow their children the daily commute to school alone. While, commute to the local street was independent because in the absence of open spaces or playgrounds or parks, children's on-street play was highly supported by parents and thus was quite prevalent (Figure 6.5) and a common sight in Khidirpur (especially as an after-school activity). Although, a high on-street play brings into the question of children's safety given high traffic exposure.

Figure 6.5 Children playing on a street in Khidirpur

Interestingly, the most popular streets for play activities were the ones which had wide pedestrian pathways running along the vehicular roads. Although not continuous and varied in widths, such wide pathways provided a much-needed space for diverse outdoor activities for both children and adults. Originally planned to support the *Adda* culture and pedestrian route network, it emerged as comparatively safer space for children's outdoor play. Besides, the mobility to Maidan (city's largest urban park) which was 2.5 km away from this neighbourhood, was challenging due to the number of road crossings, heavy vehicular traffic, and an overhead bridge. Walking was seen as the popular mode of transport for all local destinations, aligning with the city statistics on the modal share (Roychowdhary et al., 2018).

Looking at the regression model results, they reflected a similar pattern. Both CIM licence (OR= 0.17, p< 0.01) and destination (OR =0.40, p, 0.01) were significantly impacted by traffic exposure and this relationship was negative. An indication that a more regularised, controlled and restricted traffic can prove beneficial for the overall positive outcome of CIM. Simultaneously, the result suggested that a unit increase in land-use mix can further encourage higher actual CIM levels. However, when neighbourhood SE was taken into consideration, it overshadowed any impact of BE on CIM—suggesting that in Khidirpur, social cohesion or mutual trust among residents had more influence on the parental permission and actual CIM levels. Thus, one of the strategies for improving CIM should be to develop community-based programs enhancing mutual trust and restricting vehicular traffic movement within the neighbourhood.

6.2.2. Case 2: Behala

In this research, the sample from Behala consisted of an equal share of boys (50.9%) and girls (49.1%) as well as an equal share of fathers (51.5%) and mothers (48.5%). Among the homemaker parents, Behala had the maximum share of 37.3%, of which all were mothers. Majority of participating parents lived in nuclear family systems (69.2%). Also, half of the households did not own any vehicle (49.1%), owing to a well-connected public transport system catering to the needs of the residents. Yet, the majority of children were not allowed to travel or use public transport independently, in line with the previous result from Khidirpur.

Interestingly, parents had a positive neighbourhood perception in terms of all SE variables of social cohesion, connection and neighbourhood safety (second-highest scores after Khidirpur). Their individual item scores specifically revealed a highly safe environment while walking on the street after dark and the presence of helpful neighbours. An outcome that also explains a high parental mobility licence of ‘to go out after dark’ and ‘to go to nearby places within walking distances’ to their children. Moreover, a high residential density and existing old families translated into an overall close bonding among residents. So much so that socialising and interacting families (especially mothers) outside their residences or on terraces or balconies were a common sight throughout the day (Figure 6.6). Perhaps, it is for this reason that mothers were found more likely to grant higher CIM licenses to children than fathers. Such social setup created a supportive environment for CIM, contributing to the ‘social informal control’ for children’s mobility. In addition to this, low traffic exposure further enhanced the odds of a high CIM (Figure 6.7).

Undoubtedly, such a supporting mix of both social and built environment that made children from Behala enjoy and experience the highest share of independent mobility permissions and actual levels across all neighbourhoods.

Figure 6.6 Narrow street width allows residents to socialise through windows or balconies, while presence of local servicepersons like a laundry aide promote safety parameter in Behala

Figure 6.7 Older children are seen walking or cycling alone from school to home, while a young girl is accompanied by her caregiver in Behala

A typical neighbourhood street section of Behala with people cycling, walking and sitting on a traditional ro'ak is shown in Figure 6.8.

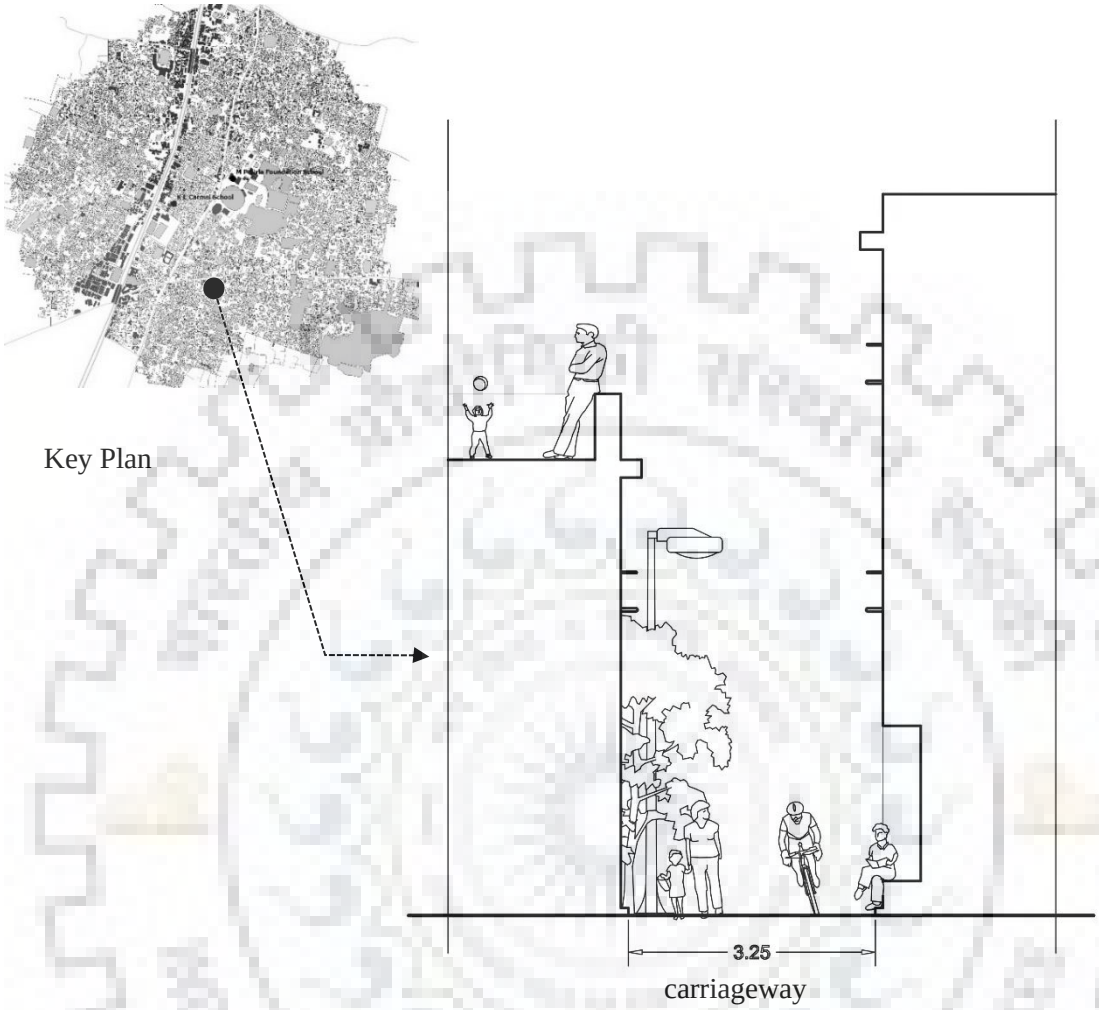


Figure 6.8 Street section of Banamali Ghosal Lane, Behala

However, the only issue was observed and found in the gradual decline of mutual trust among residents. The reason can be understood from the point of household segregations based on income within Behala. Unlike Khidirpur, outward migration of old families was low, while inward migration of informal Sector labourers was high. As a result, originally clear segregation was in place with poor or low-income families restricted within urban villages or slum areas, while high- or mid-income families occupying a majority of area close to the main arterial roads of DHR or James Long Sarani. Eventually, with a rise in population and land availability reduction, this segregation is dissolving, especially in bordering areas, probably generating 'fear of stranger' or 'fear of crime' among parents. It can also be assumed that more than fear, it was the company of children from low-income families that parents consider unsuitable. Parents are seen to apply such

social rules in previous studies (Pinkster & Fortuijn, 2009; Witten et al., 2013), where they allow their children to hang out with particular friends only after knowing or meeting their friend's parents. Nevertheless, at present, the overall CIM levels were the highest.

Child's age was significantly associated with both CIM licence and destination, indicating older children having higher CIM levels than the younger ones. Destination wise, the highest CIM level was seen for school (compared to mid and high rise neighbourhoods) and local street, while the lowest were for local market and structured class. Similar to Khidirpur, there was a lack of open spaces or parks for children's outdoor play, and hence on-street play was an everyday activity, especially in the evenings. Consequently, a large percentage of children marked 'park' as 'do not go there'. Walking was the most popular mode of transport with more than 50% of children walking to school and local street irrespective of dependent or independent mobility.

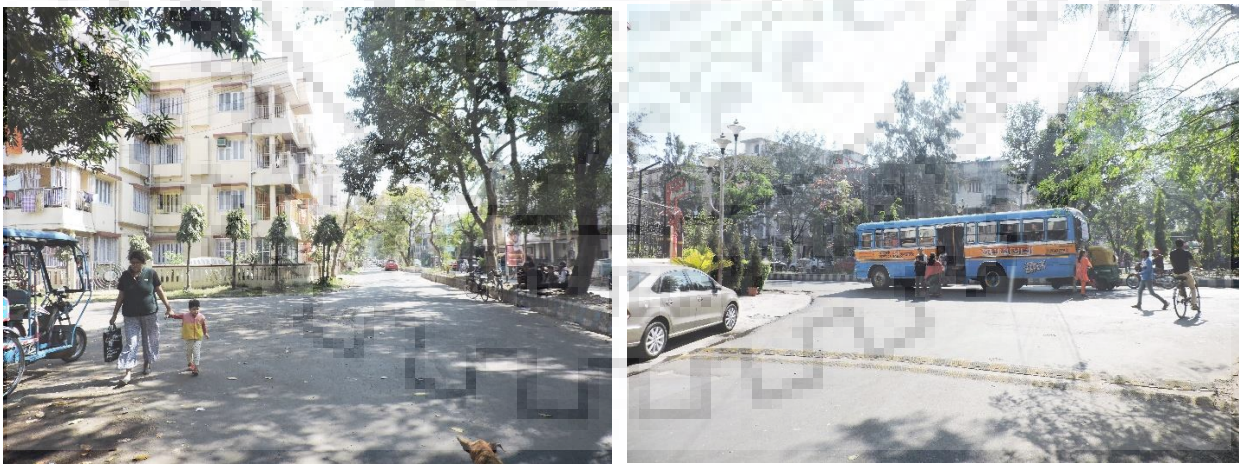
The regression model results revealed land-use mix as positively impacting the overall CIM. An increase in land-use mix was found to increase the odds of a high CIM licence and CIM destination by 8 and 2.65 times, respectively. It was an indication that this neighbourhood required an improvement in the land-use mix with child-specific locations like market, hobbies club, and other structured classes located nearby. The negative impact of traffic exposure ($OR=0.33$, $p<0.05$) on parental permissions can be explained by the traffic issues near the main arterial roads of the neighbourhood. Moving forward, similar to Khidirpur, social cohesion was the only SE variable significantly associated with CIM. As mentioned earlier, cohesion was gradually declining and hence to maintain higher CIM levels, social cohesion levels need to be maintained. When all BE and SE variables were taken together, this is one of the few neighbourhoods where both land-use mix and social cohesion was found to be strongly impacting CIM. Overall, the results suggested that to encourage high CIM levels; it is essential to revise neighbourhood planning policy with strategies to improve both land-use mix, traffic exposure situation as well as community-based social cohesion.

6.2.3. Case 3: Salt Lake Sector 1

Salt Lake was envisioned to accommodate the growing population of Kolkata while at the same time decentralising the major government and private commercial bodies out from the city core. A thoroughly planned and designed neighbourhood soon became a success with an influx of a

large population here due to balanced built vs open spaces, availability of parks and playgrounds, properly defined street networks, and employment opportunities.

The study sample from Sector 1 had an equal share of children (18.7%) and parents (18.8%). Most of these children were 11-year-old (21.3%), but cumulatively, the percentage of younger children (52.7%) were higher than the older ones (47.3%). The number of girls (57.5%) was higher than that of boys (42.5%). Among responding parents, fathers (59.8%) were more than mothers (40.2%), and majority were working full-time (69.3%). All homemaker parents were mothers, as mentioned before. Across all neighbourhoods, Salt Lake Sector 1 had the lowest share of parents living in a joint family system (26.8%). It can be assumed that the majority of families were nuclear, young and probably had both earning members. Since several central and state government offices and their respective employee residential quarters were located in this neighbourhood, there were families from both Bengal and other states (like Odisha, Assam, Madhya Pradesh, Bihar, Rajasthan and Maharashtra) of the country. Hence, multi-cultural and multi-linguistic demographics was prominent. Most households owned a scooter or a motorbike (33.9%) followed by car (33.1%). Approximately only 30 % of households did not own any vehicle. It resulted from a moderate connection of Salt Lake with the city in terms of public transport, with only buses as a viable and most frequent option (Figure 6.9). Cycle rickshaw was also available but only for short distances.



(a) (b)

Figure 6.9 (a) A child walking with his caregiver on a local street; (b) people getting on and off from a city bus in Salt Lake Sector 1

The residential areas of Sector 1 exhibits high street connectivity, residential density and moderate traffic exposure. The reason behind less traffic was a well-designed street hierarchy system that

does not let heavy or passing vehicular traffic enter collector or local streets immediately in front of the residences. On the other hand, land-use mix remains low, especially in comparison to Khidirpur but higher than Behala. As unlike Behala, Sector 1 was planned to maintain self-reliance with commercial shops, parks and community centres located within each block of every Sectoral division. However, to achieve this balance, the planners and designers of Salt Lake deliberately excluded the provisions for the low-income community. A policy, which proved disadvantageous for its residents because low-income working-class (e.g. street vendors, construction workers, domestic workers) forms the backbone of the neighbourhood service economy within India's urban context (Rumbach, 2014). Designated local services at irregular intervals increased the travel distances leading to a rise in informal temporary structures, adversely impacting parental safety parameters (Figure 6.10). Incidentally, this neighbourhood's actual crime rate was a matter of concern among residents (NCRB, 2018). Thereby explaining the lowest rating scores given by parents to the neighbourhood safety items, '*I feel safe to walk on the street after dark*' and 'I *don't worry about the number of crimes in my neighbourhood*'. Despite high scores on the neighbourhood's social cohesiveness, 'fear of crime' fed into the paranoia translated into parents not even trusting their neighbours to keep an eye on their children outdoors as simultaneously confirmed by parental interviews. Clearly, there was satisfaction with the cohesiveness and resident mutual trust, but social connection and neighbourhood safety were points of concerns among parents. It is also reflected in SE variables' overall scores where parents provided a high social cohesion, moderate social connection and low neighbourhood safety scores. Figure 6.11 shows a typical section of a street in Salt Lake Sector 1.

Figure 6.10 Informal temporary structures of local vendors along the street edges in Salt Lake Sector 1

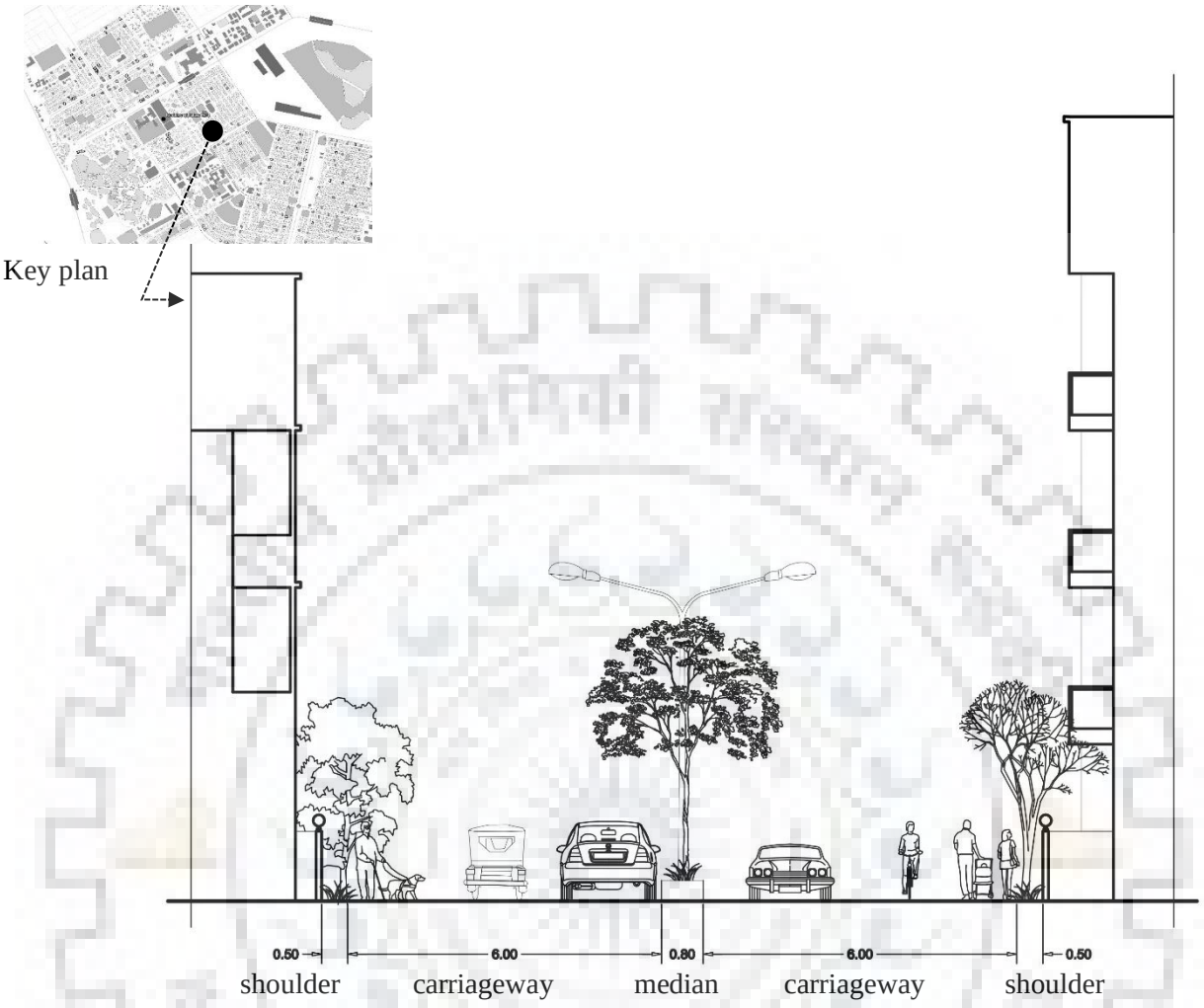


Figure 6.11 Street section of 1A cross road, Salt Lake Sector 1

Looking at the current CIM levels, almost 40% of parental CIM scores were under the category of 'low licence', while 65.4 % of CIM destination ratios obtained by children were under the category of 'low ratio'. A considerable number of parents (26.8%) provided '0'licence score. This data pointed out that overall CIM in Sector 1 was moderately low compared to CIM levels from low-rise neighbourhoods. To understand the reasons behind such a phenomenon, it is essential to evaluate the observations critically. Beginning with individual mobility licenses, the most liberal was 'to go to places within walking distances', similar to the previous neighbourhood results. This was followed by independent mobility permission to cycle within the neighbourhood. An explanation of this lies in the heart of neighbourhood planning. Low-rise neighbourhoods evolved organically with variance in street widths, types, encroachment and heavy vehicular traffic exposure, infusing a parental concern for children's safety. However, Sector 1 provided a well-

managed street hierarchy system with controlled or restricted traffic influx, proving beneficial for children's outdoor cycling activity. This was prevalent despite on-street car parking issues as street widths were perceived sufficient for cycling. However, outdoor play activity was not considered preferable on-street due to the availability of parks or playgrounds close to most residences. Thus, many children (40 %) opted for 'do not go there' in case of local street for any outdoor interaction activity. Thus, street was used primarily for cycling than playing activity.

In line with the previous neighbourhood results, the most withheld mobility permission was to use public transport independently. It was followed by the independent mobility to go out after dark, owing to the negative parental perception and concerns related to fear of crime. Interestingly, the share of CIM licence to school (34.6%) was comparable to Behala (34.9%). But actual CIM to school was extremely low, with only 10 % of children commuting independently compared to 25% of Behala children commuting independently. This showed a major discrepancy between the self-reported scores of parents and children. Further, more than half percentage of children (52.8%) were independently mobile to park, and a large proportion were independently mobile to their friend's house. Walking was the most popular mode of transport with 51.1% children daily walking to school (Figure 6.12) and 43.3% children walking for structured class irrespective of dependent or independent mobility. A striking percentage of children (81%) walked to park with few (11%) cycling to this destination. Mobility to local market (44.1%) and structured class (52%) was highly dependent and moderately motorised.

(a) (b)

Figure 6.12 (a) Younger children accompanied by parents to home from school, (b) a group of girls walking to school independently in Salt Lake Sector 1

Child's age was found to be impacting both CIM licence and destination significantly, while there was no effect of child's gender. The regression model results suggested that among BE variables, only land-use mix was significantly associated with CIM licence (OR =5.47, $p<0.05$) and destination (OR= 2.01, $p<0.05$). While among SE variables, it was neighbourhood safety in both cases. When all variables were taken together, two prime observations emerge. Firstly, neighbourhood safety turns out to be extremely critical for permissions and actual CIM levels. Secondly, safety overpowers the effect of land-use mix in case of CIM licence, advancing its criticality on overall CIM levels. In conclusion, it is evident that both safety and land-use mix are interlinked here and need special focus to further support or encourage CIM.

6.2.4. Case 4: Salt Lake Sector 3

The study sample from Sector 3 also had an equal share of children (17%) and parents (17.8%). Majority of children were in the 'older' age bracket of 10-12 years (55.9%) with maximum of them aged 10 years (21.7%). Percentage of girls (50%) were equal to boys (50%). Responding fathers (53.3%) were more than mothers (46.7%) with the majority working full-time (70.8%) living in a nuclear family system (72.5%). Overall demographics were similar to Sector 1, indicating a high share of dual-earning family members along with a prominent multi-cultural and multi-linguistic population. Maximum households owned scooter or motorbike (40.8%). This neighbourhood had the highest share of households with no vehicular ownership (34.2%) among mid and high rise neighbourhoods. Probably because of its proximity to offices, Sector 5 IT hub and other public spaces with comparatively frequent and better public transport connectivity.

The residential areas of Sector 3 exhibit high street connectivity, low residential density and traffic exposure, and a moderate land-use mix. The low traffic exposure resulted from neighbourhood planning factors similar to the ones mentioned for Sector 1, but the reasons for moderate land-use mix majorly relied upon land-use distribution for Sector 3. This Sector had comparatively more proportion of commercial and institutional areas than in Sector 1, resulting in more active frontage. Despite this, the issues regarding designated local services at irregular intervals and rise in informal temporary structures were the same impacting parents' perceived safety parameters. Also, the positive effect of active frontage usually remained restricted during office hours. For this reason, parents provided high scores to the statements '*It's a good place to buy home*' and '*people are willing to help in my neighbourhood*'. Yet, at the same time, they provided lower scores for '*I feel*

safe walking down the street after dark' and '*I don't worry about the crime in my neighbourhood*'. It indicated a mix neighbourhood perception with satisfactory social cohesion but concerning safety aspect. It was also evident from overall SE scores that were moderate for social cohesion and connection but low for neighbourhood safety. Like Sector 1, the actual crime rate was a matter of concern among residents, especially after dark (NCRB, 2018). Figure 6.13 shows a typical section of a street in Salt Lake Sector 3.

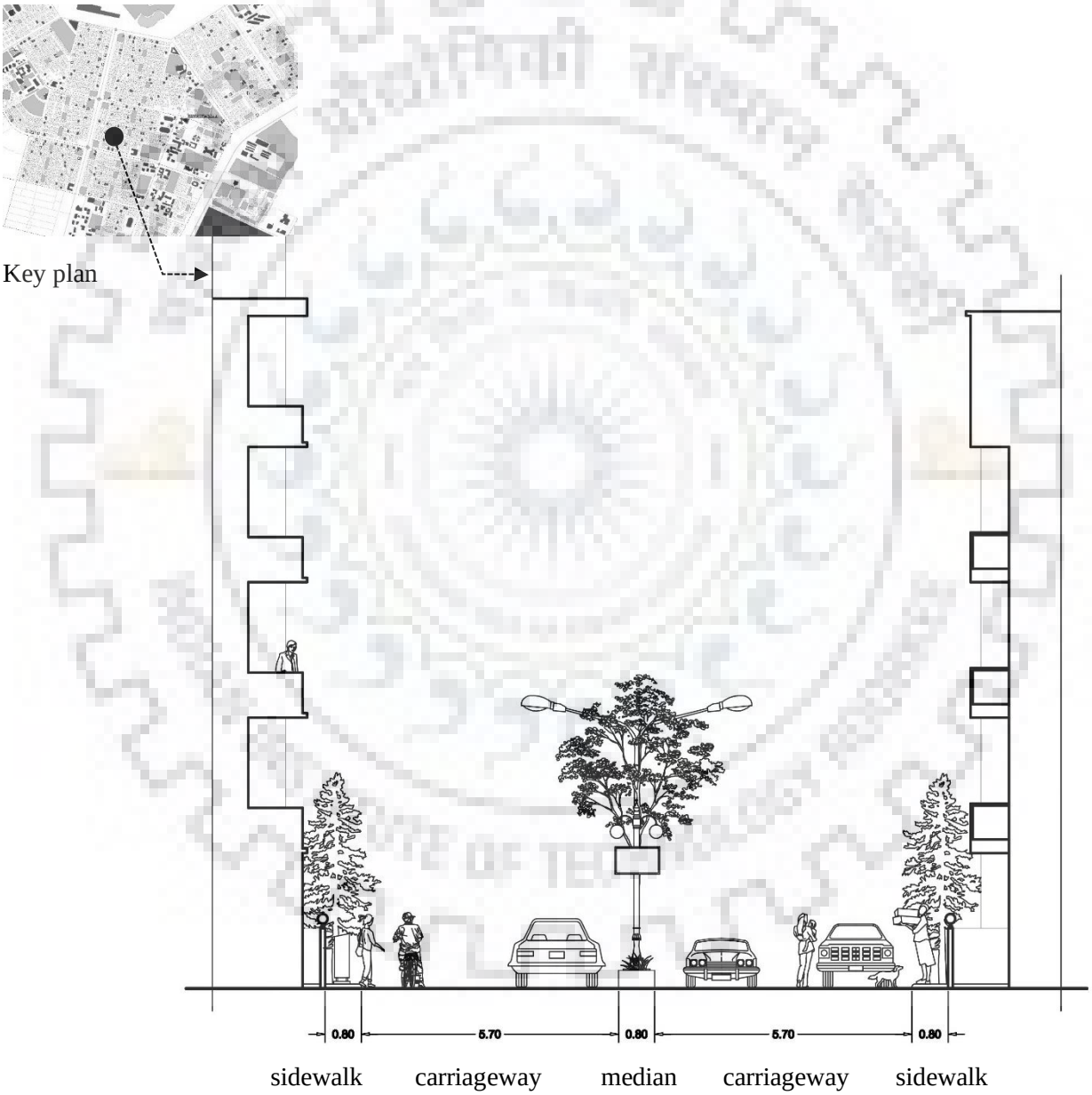


Figure 6.13 Street section of 1A cross road, Salt Lake Sector 3

On the contrary, looking at the individual mobility permissions, most liberal licenses were ‘to go to places within walking distances alone’ and ‘to go out after dark’ (Figure 6.14). Surprisingly, it was in direct contradiction to the result obtained from SE variables. The two opposing results suggested that parents did not feel safe taking a walk on their street after dark but allows their children to go out alone after dark. To comprehend this outcome, two probable explanations are discussed. First, the sequence of these statements given to parents were different. They were asked to first respond on a statement concerning their child, followed by a statement on their own safety in the next phase. This could have resulted in parents perceiving them differently as temporal matching between children’s and adults’ outdoor activities remain limited. Usually, permission for children’s outdoor activities remains restricted before dinner timings, often coinciding with office rush hours and open local shops that add to active street life and natural surveillance. While late evening walks in case of adults usually happens after dinner when streets in Salt Lake are quiet and often deserted. Second, Kolkata as a city on the eastern side of the country experiences early sunset both during summers and winters. Perhaps a reason which could also explain a high permission level to children for going out alone after dark across all neighbourhoods.

(a) (b)

Figure 6.14 (a) People walking on the local street; (b) playground in Salt Lake Sector 3

Nevertheless, moving forward, the most withheld independent mobility licence was to use public transport and commute to school, in line with previous findings from neighbourhoods. The maximum score for CIM licence was ‘5’, with the highest share under the category of ‘low licence’ (45.8%). In the case of CIM destination also, the highest share was under the category of ‘low ratio’ (70.8%). Yet in comparison to Sector 1, parents from Sector 3 were more likely to grant

some level of independent mobility licence than no licence at all. Considering the 'destination types', the highest independent mobility was to park (43%) with 60% walking to this destination. Similar to reasons discussed in Sector 1, a high proportion of children (38%) did not go to local street for interactions, play or any other outdoor activity. The highest dependent mobility was to school (90%) as 32.5% of children were daily commuting by school bus, followed by walking (25.8%) accompanied by parents or caregivers. In fact, walking was the popular mode of transport for rest of the local destinations irrespective of dependent or independent mobility type.

Child's age was an important factor both in the case of CIM licence and destination. As children's age increases, they were granted more mobility permissions and experiences high actual independent mobility. Child's gender or any other socio-demographic factor was not significantly impacting the CIM levels. Looking at the regression model results, land-use mix was the common BE variable impacting positively both CIM licence (OR= 5.77, $p<0.05$) and destination (OR= 2.13, $p<0.05$). Besides, for the first time, residential density was also found to impact actual CIM destination positively. It adds to a new understanding of the effect of BE on children's actual mobility at the neighbourhood scale. When impact of only SE is considered, neighbourhood safety turned out to be the significant factor for both CIM licence (OR= 4.02, $p<0.05$) and destination (OR= 1.77, $p<0.05$), which was an obvious result. In the last model, where all BE and SE variables were taken into account, the prominence of safety was seen in both cases. However interestingly, unlink Sector 1, land-use mix was found to be overshadowing the effect of safety for CIM licence. This is despite Sector 3 having a higher land-use mix than Sector 1. Perhaps, the need for diversity in the typology of available services with a more child-focused lens could explain this outcome. As currently, Sector 3 had more large-scale commercial and institutional services than local scale child-specific destinations.

6.2.5. Case 5: New Town

As the upcoming high-rise gated neighbourhood, New Town represents a modern and futuristic Kolkata moving forward with time. It's rising skyline brings hope to many new families looking for affordable housing in the city with quality facilities and services. One of the main reasons to include this in the research was to investigate the existing scenario in a newly developing neighbourhood while suggesting a direction for encouraging a higher CIM.

The neighbourhood sample had the lowest share of participating children (14.6%) and parents (16.7%). Percentage of girls (51.3%) was almost equal to boys (48.7%). Age-wise breakup suggested a higher share of older children (56.6%) with maximum children aged 10 years (28.3%). Among responding parents, the proportion of fathers (53.1%) was higher than that of mothers (46.9%). Parents' response on household characteristics reflected a young, nuclear and dual-earning member family demographics with a considerable proportion of parents (35.4%) having high academic qualification (post-graduation) in comparison to other neighbourhoods. Similar to the reasons discussed for mid-rise neighbourhoods and owing to rising employment opportunities, this neighbourhood had a multi-cultural and multi-linguistic population with several families from diverse parts of the country.

Yet homogeneity was maintained due to clear income-based segregation often employed and practised by builders and real estate developers across Indian cities. This segregation usually takes the form of flats exclusively reserved for high (HIG), middle- (MIG) and low-income group (LIG) families, respectively (Jana & Sarkar, 2018). This is probably one of the major reasons behind parents giving high average scores to the statements; '*people in my neighbourhood get along well with each other*' and '*people are willing to help in my neighbourhood*', indicating a satisfactory social cohesiveness. The statistics from vehicle ownership data presented a predictable outcome that showed New Town with highest car ownership (51.3%) followed by scooter or motorbike (20.4%). Only a handful of families (16.8%) did not own any vehicle suggesting that they might be newly shifted families. As presently, New Town supported a culture of private vehicle ownership with ample parking space, extensive and well-maintained roads along with limited public transport, pedestrian and cycling infrastructure (Figure 6.15). Even the frequency of aggregator-based taxi services like Ola and Uber was moderate and restricted only during office hours (Basu, 2019). These factors compelled residents to rely heavily upon private vehicles resulting in high traffic exposure. Besides, New Town exhibited a poor land-use mix, low residential density and moderate street connectivity.

Figure 6.15 New Town supports a culture of private vehicle ownership with extensive roads and limited public transport, pedestrian or cycling infrastructure

Further, several publications and parental interviews reported that many high-rise buildings' occupancy rate was less than 75% (Jana & Sarkar, 2018). A low occupancy was not only because New Town was still growing or developing but also due to the prevailing culture of real estate investment among Indian families. Many native families residing in other parts of the city had purchased apartments here for three possible reasons for future occupancy, long-term financial investment or high rent generating potential (R. Sinha, 2018). This predominant trend resulted in several purchased yet unoccupied apartments and frequently changing tenants. Both situations adversely affected parents' perception of neighbourhood social connection and safety parameters. As clearly evident from the low scores provided on statements '*It's a good place to buy home*' and '*parents in my neighbourhood know their children's friends*'. Also, considering the overall SE scores, social connection and neighbourhood safety were given least scores while cohesion had an average score. Here 'safety' can be understood from both perspectives of within and outside building boundary situations. Outside building boundary, the neighbourhood built environment lacked social interaction and an active frontage component. This resulted from prioritising vehicles over pedestrians, often deserted roads after office hours and limited public transport (A. Sengupta, 2017). Late evening traffic majorly comprised of people arriving or leaving shopping malls, cinema theatres or other public spaces located away from residential areas. Besides, even the mobility of students or staff from large-scale university campuses located here was restricted after office hours within the boundaries.

An obvious consequence of such built and social environment was found in the considerable share of parents (35.4%) granting no independent mobility permission (score = 0) to their children. The maximum CIM licence score of '4' out of '6' was the lowest among all neighbourhoods. The majority of CIM licence and CIM destination scores were under the category of 'low licence' (56.6%) and 'low ratio' (77.9%) respectively. Looking at the individual mobility licenses, it seemed that except the question on mobility to school and use of public transport, parents responded to all other questions from a mutual understanding that children's mobility is within building boundaries. Since the most liberal licenses were 'to go out after dark alone' (30%) followed by 'to go to places within walking distances' (27.4%) and 'cycling' (27.4%) alone. As mentioned before, New Town had limited and, in some cases, a complete absence of any pedestrian or cycling infrastructure. Thus, allowing children to do the same does not seem viable even with adult's supervision. Also, the average scores for independent mobility to school or use of public transport were '0', revealing the actual situation of CIM in case of outside boundary areas. Figure 6.16 shows a typical section of a street in Action Area I, New Town.

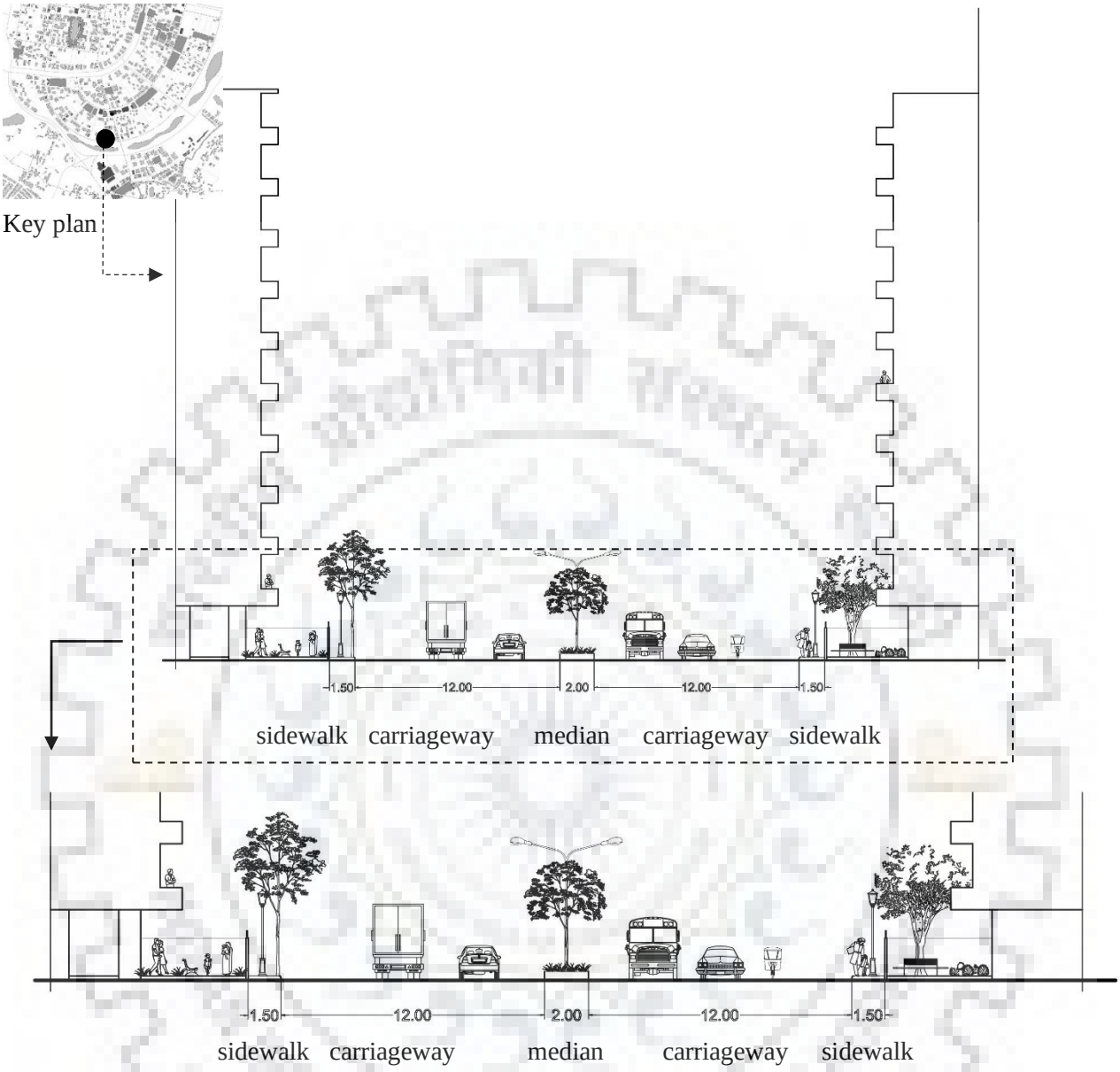


Figure 6.16 Street section of street number 0306, Action Area I, New Town

Expectedly, it was the only neighbourhood with 100% dependent children's mobility to school with almost half of them driven by school bus (45.1%) followed by car (31.9%). The highest independent mobility was to park (31.9%) with a remarkable share of children (67.3%) walking to this destination. Friend's house was another local destination with above-average independent mobility levels (27.4%) and walking as the popular mode of transport (54%). Similar to the reasons provided for mid-rise neighbourhoods, a considerable proportion of children (40.7%) do not use local street for any outdoor activity. Likewise, a large percentage of children (41.6%) were also not going for any structured classes. One reason could be non-availability of child-specific

destinations (including hobby class, structured sports class, etc.) in close proximity to this neighbourhood.

In line with previous cases, 'child's age' was found to be the only significant socio-demographic variable associated with both CIM licence and destination. Interestingly, unlike previous cases, where age 10 years was seen as the shifting point for a positive CIM, here the same shift was observed from age 11 years onwards. The regression results revealed land-use mix as the most critical factor affecting both parental permission (OR=5.53, $p<0.05$) and actual CIM levels (OR=2.81, $p<0.05$) positively. Traffic exposure had a significant negative relationship in case of CIM licenses (OR=0.13, $p<0.05$), supporting the previously discussed point on heightened parental 'fear of traffic'. Moreover, evidence on 'fear of crime' can be seen from the point that neighbourhood safety was the only SE variable impacting CIM. When all variables were taken into consideration, two different results emerged. Parents' permission dependent largely upon neighbourhood safety (OR= 5.53, $p<0.05$), while actual CIM levels were most affected by land-use mix (OR=2.81, $p<0.05$). This outcome is in line with an earlier mentioned point that a higher land-use mix generates a high natural surveillance or 'eyes on the street' concept (Jacobs, 1961). Concludingly, to encourage or improve the current levels of CIM in New Town, it is essential to begin by re-locating child-specific destinations closer to residential areas and provide safe pedestrian or cycling infrastructure for residents.

6.3. Comparative Analysis across Neighbourhood Typologies

All five cases under three neighbourhood typologies speak volume about the factors that enable or restrict CIM. It presents an in-depth view of parental concerns regarding allowing their children an unsupervised exploration of local surroundings. The key points from the comparative analysis of the neighbourhoods are summarised in Table 6.1 and explained in detail as follows:

Table 6.1 Comparative analysis of three neighbourhood typologies

S.No.	Low-rise Neighbourhoods	Mid-rise Neighbourhoods	High-rise Neighbourhood
1	**CIM levels**		
	Children experienced the highest CIM level due to compact urban form, high land-use mix and high street connectivity generating natural surveillance.	Children experienced a higher CIM level compared to children from high-rise neighbourhoods. It resulted from limited traffic exposure, availability of park/playground nearby and high street connectivity.	Children experienced the lowest CIM levels due to high traffic exposure, low land-use mix, moderate street connectivity and minimum active frontage, especially after office hours.
2	**Demographic Characteristics**		
	Presence of old families living for generations created a sense of familiarity and contributed to strong community bonds- supportive element for CIM	Presence of multi-cultural and multi-linguistic families owing to rising employment opportunities – supportive element for CIM	Presence of multi-cultural and multi-linguistic families owing to rising employment opportunities with clear segregation based on income -resulted in high social cohesiveness- supportive element for CIM
3	**Spatial Planning**		
	Organic spatial planning and presence of wide-pedestrian walkways foster social interactions- supportive element for CIM	Planned growth with balanced built v/s open space ratio with parks and playgrounds equally distributed within each block- supportive element for CIM	Planned growth with a poor land-use mix, low residential density and moderate street connectivity discouraged walking or cycling as a mode of transport to any local destination- barrier for CIM
4	**Mobility Infrastructure**		
	Well-connected public transport resulted in low private vehicle ownership that encouraged positive parental perception towards active mode of transport	Moderate public transport connectivity, lack of child-centric destinations nearby & on-street parking issues- barrier for CIM	Built environment supported a culture of private vehicle ownership with ample parking space, wide roads and inadequate public transport connectivity- barrier for CIM

5	**Parental Concerns**		
	Major parental concerns – stranger danger and traffic. Stranger danger: It resulted from outward shifting of old families and large-scale inward migration of low-income families. Traffic: Presence of heavy commercial activities rendering bottleneck situations on roads	Major parental concerns- stranger danger. Stranger danger: Due to high actual crime rates, unevenly distributed local services and low active frontage component, especially after dark.	Major parental concerns- stranger danger and traffic. Stranger danger: Due to low occupancy rate with several purchased yet unoccupied apartments and frequently changing tenants Traffic: Vehicles were prioritised over pedestrians and lack of nearby child-specific destinations
6	**Regression Model**		
	Regression models suggested- an improvement in land-use mix and social cohesion will further encourage a higher CIM.	Regression models suggested- an improvement in neighbourhood safety and land-use mix require immediate attention for encouraging a higher CIM.	Regression models suggested that an improvement in land-use mix, traffic exposure and neighbourhood safety is required as the first step in encouraging a higher CIM.

6.3.1. Low-rise Neighbourhoods

Children from these neighbourhoods experienced the highest CIM levels owing to a network of supportive built and social environment structures. Presence of compact urban form, high street connectivity and residential density resulted in a higher land-use mix generating natural surveillance for children. Several old families living for generations created a sense of familiarity among residents and contributed to strong community bonds. Besides, these neighbourhoods by virtue of its organic spatial planning and wide-pedestrian walkways foster social interactions in forms of Adda(s) (a part of the intangible cultural heritage of Kolkata) and terrace or balcony communications forming an integral part of daily neighbourhood life. These wide and safe pedestrian walkways also acted as a proxy space for children's outdoor play in the absence of parks or playground. Further, a well-connected public transport network leads to low private vehicle ownership that encourages a positive perception among parents towards an active mode of transport, especially walking. Undoubtedly, unlike other neighbourhood typologies, a high

proportion of children from inner-city cores were found to daily commute to school on foot. Taken as a whole, parents indicated a high social connection and neighbourhood safety parameters, especially while going out or walking after dark owing to an active frontage across local streets.

The major concerns raised by parents centred around the universal fear of stranger and traffic. The data set revealed a gradual decline in the social cohesiveness of the neighbourhood. It resulted from the outward shifting of old families and large-scale inward migration of low-income families from neighbouring states. On the other hand, traffic was creating a problem due to the presence of heavy commercial activities rendering bottleneck situations on arterial and sub-arterial roads near neighbourhoods. The most adverse effect of both these situations was reflected in higher restricted girls' independent mobility compared to boys. An outcome which was not observed in case of mid or high rise neighbourhoods. Evidently, regression models also suggested more improvement in land-use mix and social cohesion of the neighbourhood to encourage a higher CIM.

6.3.2. Mid-rise Neighbourhoods

Children from these neighbourhood experienced a higher CIM level in comparison to high-rise neighbourhood but lower than low-rise neighbourhoods. Several factors emerged as supportive elements for children's unsupervised explorations. At the planning level, mid-rise neighbourhoods had a well-balanced built v/s open space ratio with parks and playgrounds equally distributed within each Sectoral block. Traffic exposure was controlled and restricted due to the planned street hierarchy system, proving beneficial for a higher CIM to park, friend's house and cycling activity. Multi-cultural and multi-linguistic demographics with closely residing similar income families generated a positive social cohesion among residents. High street connectivity further supported a higher CIM licence to places within walking distances in the neighbourhood.

One of the major concerns revealed was related to neighbourhood safety. Parents provided lowest scores on this parameter owing to reasons ranging from high actual crime rates, unevenly distributed local services and low active frontage component, especially after dark. Additionally, despite a moderate land-use mix, there was a lack of child-centric destinations in close proximity, compelling parents to drive their children outside neighbourhood. Besides, on-street parking and moderate public transport connectivity resulted in low parental preference towards an active mode of transport. A considerable share of parents not granting any mobility licence was a point of concern. It indicated a possible shrinkage to children's independent roaming range in the near

future. The regression model results supported this claim with neighbourhood safety and land-use mix as significant variables that need immediate attention for encouraging a higher CIM.

6.3.3. High-rise Neighbourhood

Children from high-rise neighbourhood experienced the lowest CIM levels across all neighbourhoods. Like mid-rise neighbourhoods, the demographics were majorly multi-cultural and multi-linguistic with a considerable proportion of dual-earning member households due to rising employment opportunities. Social cohesiveness was strong as a result of clear segregation of housing based on income, and thus higher shared values among residents. Independent mobility to park and friend's house was high and mostly active. Child's age was found to be impacting CIM, but child's gender had no effect on the same. BE supported a culture of private vehicle ownership with ample parking space, wide roads and inadequate public transport connectivity.

In general, several issues were noted both in the built and social environment of this neighbourhood, creating a barrier for CIM. For instance, poor land-use mix, low residential density and moderate street connectivity discouraged walking or cycling as a mode of transport to any local destination. Low occupancy rate with several purchased yet unoccupied apartments and frequently changing tenants adversely impacted on social connection and neighbourhood safety parameters for parents. Inevitably, opportunities for social interaction and the presence of active frontage were minimal. As vehicles were prioritised over pedestrians, none of the children were allowed to commute to school alone. Moreover, like mid-rise neighbourhoods, lack of close proximity of child-centric destinations resulted in many children either not going or only driven to structured hobby classes. The regression model suggested that an improvement in land-use mix, traffic exposure and neighbourhood safety is required as the first step in encouraging a higher CIM.

6.4. Connection with Thesis Frameworks

Each neighbourhood provided several valuable insights into the existing status of CIM and the influential surrounding environment. Recalling the study's theoretical framework, these findings correspond to each model generating strong evidence on CIM from Kolkata. In reference to the 'Bullerby' model, the two aspects of children's possibilities of independent mobility and their opportunities to actualise environmental affordances were measured using CIM licence and CIM destination, respectively. The research findings revealed a similarity between the two data sets with 33.4% children enjoying high CIM licence and 34.7 % of children actually travelling

independently to local destinations. In retrospect, majority of children were not found to be independently mobile in comparison to several international cities (M Kyttä et al., 2015; Ben Shaw et al., 2015; Smith et al., 2019) across the globe. A need is thus established to improve the existing local surroundings to encourage a higher CIM.

The 'socio-ecological' model helped identify the focus elements which should be prioritised to fulfil the said need. It is found that a high land-use mix with controlled and restricted vehicular traffic along with high perceived social cohesion and safety are essential elements that could support a positive environment for CIM in the neighbourhood. Also, as CIM highly depends upon 'child's age', creating a balanced neighbourhood environment can increase the possibility of lower age limits for different mobility licenses across neighbourhoods.

The effect of elements on CIM emerges from their complex interlinkages with each other as identified with the assistance of 'systems' model. For instance, a higher land-use mix with low traffic exposure will only prove beneficial if close proximity of child-specific destinations is included at the planning stage. As seen in case of Salt Lake Sector 3, where the land-use mix was higher than Sector 1 but majorly comprised of commercial and institutional areas, not directly catering to the daily needs of children and their caregivers. Consequently, CIM levels were lower in comparison to Sector 1. Besides, a well-planned street hierarchy system with neighbourhood policies fostering social interactions adds a complementary layer to create an ideal environment for a higher CIM. The interlinkages also relate to the study's conceptual framework, where the relationship between different elements is divided into two categories of socio-demographic and neighbourhood factors.

6.5. Discrepancies in Findings

The discrepancies are essential to mention and discuss for providing an unbiased view of the results and improve future research. A total of three discrepancies were noted while interpreting the results, each in one neighbourhood as discussed below:

a) Salt Lake Sector 1:

Parents reported a higher CIM licence to school (34.6%), while actual CIM levels reported by children were relatively low (10%). A mismatch like this in any data can be misleading, generating inappropriate conclusions. One of the solutions to minimise this discrepancy is to employ two

additional tools of GPS devices and travel diaries. Several international studies have used GPS technology to track real-time data of children's mobility, receiving additional information on route selection for school journeys. In addition, travel diaries are another useful tool in which children are required to fill the sheets, and parents cross-check it daily. Besides, public participation GIS (PPGIS) based software called SoftGIS (Kahila & Kyttä, 2009) can also be employed for participatory mapping with children to identify mobility type and patterns accurately.

b) Salt Lake Sector 3

Parents provided low scores to the statement asking them about their perceived safety while walking down the neighbourhood street after dark. On the other hand, they provided a higher score to the statement referring to their permission levels of letting their children go out after dark. As discussed in the previous section, one probable reason could be temporal differences between the two activities. Another likely cause could be an inappropriate sequencing of questions provided to parents. A solution to minimise this discrepancy besides revising the questionnaire sequence is to employ computer-assisted telephonic interviews (CATI). It is a telephonic surveying technique that is customisable and speeds up the collection process while educating the respondents about each question (Shure et al., 1978). This method can be used as per the time and budget allowance of the study.

c) New Town

Parents responded to four out of six questions with a mutual understanding that children's mobility is within their building boundaries. This occurred because the international tool developed for measuring CIM licence does not provide any separate guidance on its employment in high-rise gated communities. The issue further gets complicated with an increase in the size of gated communities, as they become mini-cities within themselves and investigating CIM levels within these communities become irrelevant. A probable solution is to modify and revise the licence statements by conducting pilot studies taking few gated communities as cases.

6.6. Chapter Summary

The results from this thesis provide empirical evidence on the significance of neighbourhood in overall CIM levels. It underscores the role of socio-cultural, economic, and political layers underneath the neighbourhood's urban fabric towards children's overall mobility experience.

Recalling the results, low-rise neighbourhoods inheriting an organic spatial character proved more beneficial for CIM than planned mid-rise or high-rise neighbourhoods. Thus, this research finds itself placed between the age-old debate of organic and planned neighbourhoods (Talen, 2017). However, it does not suggest that for promoting an improved CIM experience, policymakers should negate the planning process of future neighbourhoods. Instead, it encourages a reconsideration of the social benefits of old urban cores that foster interaction, cohesion and close bond among its residents. Such reconsideration is necessary for a simple reason that parent's decision of allowing children to move freely is an emotional process influenced by the complex interplay of physical, social and cultural neighbourhood factors, individual parental factors and characteristics of the child.

In terms of CIM licence scores, this research also considered the share of parents who did not grant any independent mobility permissions to their children. An aspect which demands equal attention as it points to the fact that CIM may not even be an aspiration goal, within cultural models of child-rearing practices of Asian parents (J Rudner & Wickramaarachchi, 2013). As noted in a study from Hong Kong (Lam & Loo, 2014), Eastern parenting emphasises on family interdependence through multiple caregivers (besides parents) unlike notions of Western parenting that encourage the development of independence and individualism. Thus, it underscores the need to first understand the conceptual meaning of independence from the parents' viewpoint on a large scale. Concludingly, this chapter informed that to enhance children's unsupervised mobility experience; it is first crucial to investigate the contextual factors to provide effective solutions for the same.

Chapter 7

Wrapping Up: Conclusions and Recommendations

'We need to consider how children will move around a neighbourhood before we place a single building'

-Dinah Bornat, ZCD Architects

Chapter 7 Wrapping Up: Conclusions and Recommendations

The chapter summarises overall thesis findings while presenting it in a broader frame of reference. The findings are articulated to the research questions as well as research aim and objectives. It acts as the thread's end, completing the loop highlighting the significance of research contributions and implications. Further, recommendations are provided in the form of 'neighbourhood design strategy' for promoting higher CIM levels in Kolkata. Additionally, a conceptual auditing framework for evaluating CIM-friendliness is discussed within the Indian neighbourhood context. The chapter concludes by outlining thesis shortcomings and suggesting avenues for future research.

7.1 Concluding Observations

The thesis findings build on the adopted theoretical models, weaves a narration unfolding different layers of macro and microsystems affecting children's independent explorations, as illustrated in Figure 7.1. Beginning with the macro layer, neighbourhood policies directly impact the resulting built, and social environment on top of the existing historical, political, economic, and geographical layers of the neighbourhood. Schools located near neighbourhoods also experience an immediate impact of the existing policies. An overall combined effect of these separate yet inter-connected dimensions reflect on the household characteristics at an individual or micro level. Children's individual characteristics play an equal role in affecting parents' perception of their child's maturity level, which in turn impacts their decision on CIM.

CIM is thus, a result of complex inter-related dimensions that need to be understood from both macro and micro-level perspectives. Following sub-sections will provide a brief explanation of each dimension connecting with research questions.

7.1.1 CIM Overview

CIM levels across all neighbourhoods revealed a declining trend, especially pertaining to neighbourhood typology. Even among neighbourhoods with higher CIM levels, the overall share was less than 50%, raising alarming concern for children's mobility experience in Kolkata. In terms of local destinations, less than 20% of children were allowed to go to school independently, and this figure aligns with the CIM levels for the local market and structured class.

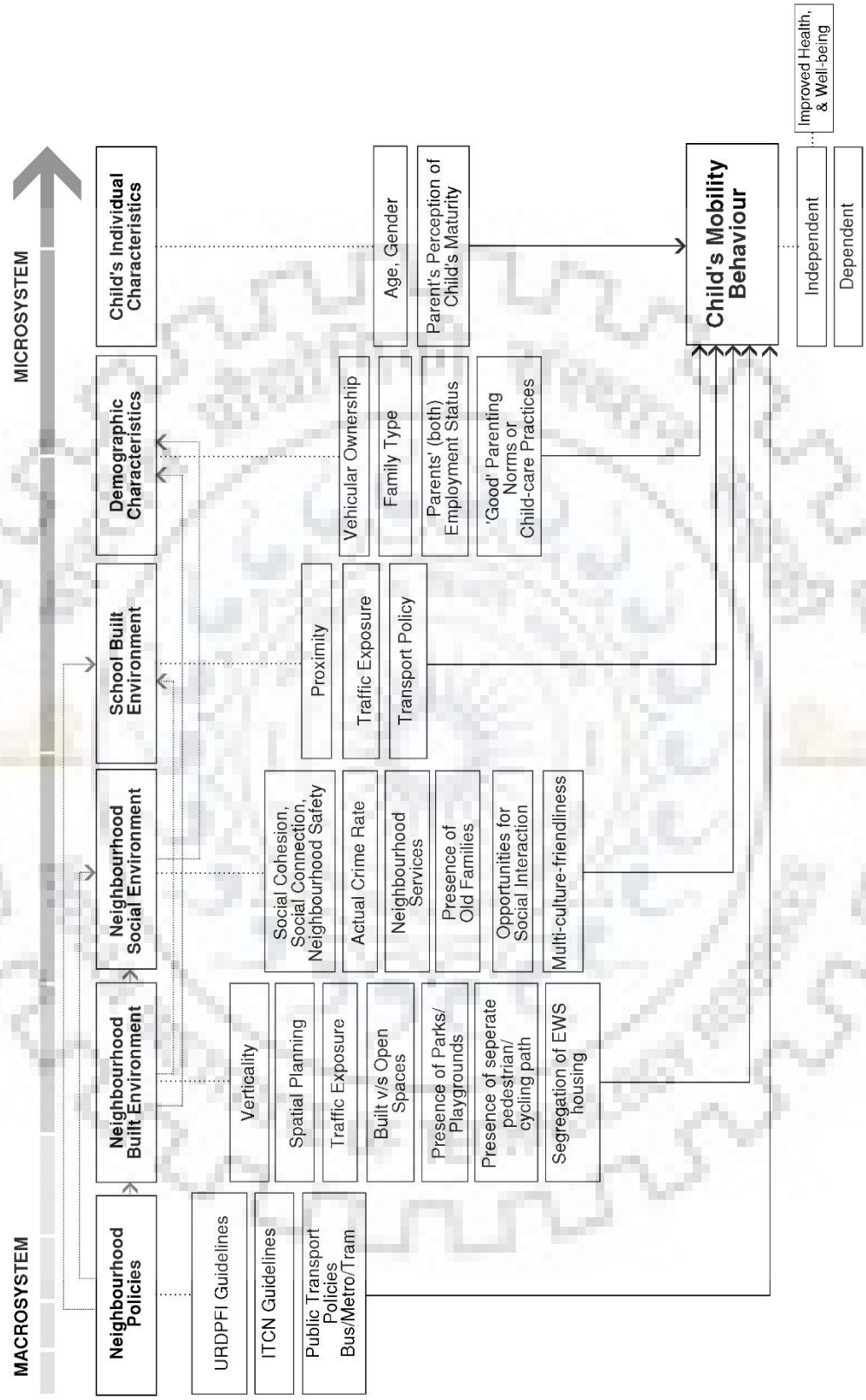


Figure 7.1 Overall thesis findings (Source: author)

‘Park’ is the only local destination for which comparatively large proportion of children (40%) enjoys independent mobility. On the other hand, ‘going to places within walking distances other than school’ was found to be the most liberal mobility licence. As seen from the previous chapter, on a global platform, these findings indicate that Indian children enjoy limited independent mobility levels. Majority of the times, it is the child’s age which seems to be affecting the most than child’s gender, yet it brings out multiple other questions on such outcome. For instance, why do parents show a liberal attitude towards children’s mobility to ‘park’ and not ‘school’? Is it embedded in their child-care cultural practices? Or is it related to the absence of supportive school-built environment? The answers to such questions as obtained from the research findings are explained in next sub-sections in relation to research questions.

7.1.2 Research Question One: CIM and BE

Restating the first research question ‘what is the relationship between CIM and built-environment (BE) of urban neighbourhood?’, this thesis finds a strong linkage between these two variables. It can be understood from the two outer layers of ‘neighbourhood policies’ and ‘neighbourhood built environment’ as discussed below:

1. Neighbourhood verticality matters for children’s outdoor mobility behaviour. The findings suggest that low-rise or mid-rise residential neighbourhoods offer a higher degree of safety perception among parents or caregivers than high-rise neighbourhoods. This is because such settings foster a culture of interaction among residents on terraces or balconies while also keeping a watch on neighbourhood street promoting informal social control for children (as seen in Behala). On the other hand, high-rise gated communities increase the disconnect between children’s outdoor activities on ground and residential spaces above.
2. Similarly, organic spatial growth with high land-use mix than grid or geometrically planned growth is found to be more beneficial for a higher CIM. Notably, significance of ‘land-use mix’ as a component is already acknowledged in URDPFI and ITCN guidelines, but this thesis further points that land-use mix becomes more beneficial when it includes child-specific destinations. As seen in Salt Lake sector 3, where despite a moderate land-use mix, CIM was low as proximity to child-specific destinations was not considered.
3. Besides, as expected, limited traffic exposure was found to encourage more children to play on street or use active mode of transport for commuting to local destinations alone.

4. Presence of ample open spaces like parks, playgrounds or gardens at regular intervals was also revealed as profoundly affecting CIM across neighbourhoods. Parents were found to be granting a higher CIM licence for parks than any other destinations, indicating the value of nearby park in neighbourhoods for children.
5. Undoubtedly, the presence of wide and well-maintained pedestrian pathways was a boon for children's safe mobility experiences. Especially in low-rise neighbourhoods that lack open spaces or playgrounds, such pathways act as a proxy for outdoor play or other activity spaces.
6. An interesting outcome revealed was in relation to income-based segregation of residential spaces. Neighbourhoods with allocated separate EWS (Economically weaker section) housing had children enjoying a higher CIM than neighbourhoods with mixed-income residential settings.
7. Built-environment around schools was also seen playing a significant role in CIM. Factors such as proximity to residential spaces, limited traffic exposure and school transport policies promoting active transport directly impacted a higher CIM.

7.1.3 Research Question Two: CIM and SE

Restating the second research question 'what is the relationship between CIM and social-environment of urban neighbourhood?', this thesis finds a strong linkage between these two variables. It can be understood from the three layers of 'neighbourhood social environment', 'household characteristics' and 'child's individual characteristics' as discussed below:

1. Parent's positive perception regarding neighbourhood cohesion, connection and safety matter the most in relation to a higher CIM outcome. The thesis findings provided evidence showing parents providing higher scores to these variables were more likely to grant high CIM licenses to their children.
2. Lower actual crime rate also encourages safety parameters for parents, thus translating into improved CIM levels.
3. High level of formal and informal neighbourhood services creates a family-oriented neighbourhood setting. As seen from the results, Khidirpur offered ample space and cultural acceptance for informal street vendors (shop keepers, domestic workers etc.). At the same time, Salt Lake, through its planning policies, tried to avoid them initially. Consequently, CIM

levels in Khidirpur were higher than Salt Lake due to reduced distances to such services, active frontage and thus increased trust among parents.

4. Thesis findings also reveal that a sustainable neighbourhood that offers comfort to families in the sense that they stay for generations encourage social cohesiveness and long-term bonds among neighbourhood residents. Thus, the presence of old families is an indicator of a healthy and positive social environment of a neighbourhood that adds to CIM's supportive elements.
5. A neighbourhood through its planning policies or cultural activities encourages social interactions among existing and new residents, thereby supporting a higher CIM. As noted from the findings, unlike CIM licence, SE was overpowering any effect of BE on actual CIM levels. Thus, even if neighbourhood BE does not fully support children's positive mobility experience, a healthy neighbourhood SE can immensely support children's unsupervised mobility.
6. The results obtained from participating parents showed a supportive inclination towards multi-cultural or multi-linguistic demographics. The findings suggest that parents had a positive attitude towards allowing their children exposure to diverse cultures or languages within local surroundings. The only prerequisite was the exclusion of EWS families.
7. There was no direct impact on CIM in terms of vehicular ownership, but the data revealed households that were having no vehicular ownership had children enjoying comparatively a higher CIM level. Besides, such households usually belonged to neighbourhoods with high last-mile connectivity through public transport and well-maintained pedestrian network – all encouraging active mobility and high CIM.
8. Few household characteristics that were found to impact CIM were family type, parents' employment status and child-care practices. Nuclear families with full-time working parents were found to grant higher CIM licenses than joint families with single parent working. Reasons for such outcome are attributed to trip chaining needs and time constraints. On the other hand, child-care practices are a complex phenomenon arising out of multiple factors like parental beliefs, society expectations, and neighbourhood BE and SE.
9. Lastly, 'child's age' was an essential criterion for CIM as parents tend to have an improved level of perception of their maturity with an increase in age. Child's gender was not found to be impacting CIM levels in the majority of cases.

7.2 Research Contributions and Implications

The thesis contributes towards addition to CIM knowledge base, methodology and developing countries context as detailed in Table 7.1. These contributions are made taking one city as a case, and therefore results should not be generalised but looked at from a perspective of additional knowledge that requires further investigations across cities in the Indian context.

Table 7.1 Thesis research contributions and implications for research/practice and policies

Sno.	Research Contributions	Implication for Research/Practice/Policies
A	*CIM knowledge base*	
1	First study to provide evidence on low levels of CIM from a megacity in India.	Nationwide primary survey is required to gather information on CIM levels for comparisons at international level.
2	CIM levels found to decline with a rise in verticality and planned spatial growth of neighbourhoods with limited opportunities for social interactions.	Policymakers should reconsider the social benefits of organically grown old urban cores and incorporate in future neighbourhood planning.
3	Diverse layers of socio-economic, political, and cultural dimensions affect CIM outcome	Each neighbourhood despite similar built typology require modified policies and guidelines for promoting CIM
4	Clear segregation of EWS housing encourages safety parameters among parents increasing CIM.	A portion for EWS housing needs to be provided mandatory in neighbourhoods with clear segregation.
5	Presence of old families and the provision of informal neighbourhood services increases CIM.	Need for a sustainable and flexible neighbourhood that grows with time to attract families to stay for generations

		should be the focus for new neighbourhood planning guidelines.
6	Parent's decision on CIM relies heavily on child-care practices.	More research is required to provide empirical evidence on child-care practices among different communities across developed and developing countries
B	*Methodological*	
7	Development of a participatory model for working with children and parents following ethical considerations and contextual factors in India.	The process of field survey, data collection, and measures can be replicated in other India cities for conducting similar research.
C	*Developing countries context*	
8	The thesis puts India on the map of CIM domain, adding to the growing list of developing countries (Bangladesh and Sri Lanka) from the global south.	More comparative studies are required from culturally rich developing countries to complete CIM's picture from the global south.
9	In the absence of any geographic database for objectively measuring BE variables, GIS maps of neighbourhood with street network was prepared manually by the researcher.	The data sets developed for Kolkata can be used and further improved by BE professionals, minimising their reliance on findings from developed countries.

7.3 Recommendations for CIM-friendly Neighbourhood Design

The thesis outcome informs about the multiple contextual factors that create support or barrier for CIM within neighbourhoods of Kolkata. Although the influence of these factors varies across distinct neighbourhood typologies, certain commonalities exist that are identified and reviewed for its applicability to the design of neighbourhood built environment. Figure 7.2 presents the

recommendation in the form of a neighbourhood design strategy. This illustration is generated out of the study results and review of existing literature on neighbourhood design for children, and therefore it is applicable for Kolkata.

Figure 7.2 Neighbourhood design strategy for supporting CIM (Source: author)

The four key design goals form the foundation to relook at each neighbourhood from the lens of children's mobility. Presented in a cyclic format, these interlinked goals indicate that designing a neighbourhood for CIM is a continuous and evolving process. It should be looked at as a long-term commitment rather than a one-time solution for all. The proposed recommendations against each goal for both existing and new neighbourhoods are discussed below:

1. Goal 1: Reduce

The first strategy should be to reduce the impact of vehicular traffic on children within the neighbourhood. The three ways to achieve this are by employing traffic calming measures; improving parking facilities, and introducing clear and legible street segregation for multiple users.

For existing neighbourhoods:

- Two key aim of any traffic calming measure should be to reduce traffic volume and vehicular speed. An effective measure is rerouting passing traffic away from residential areas, especially within inner-city low rise neighbourhoods. Identify a workable route on the outer boundaries and simultaneously close a section of inner streets for vehicles during office hours. Expand the city's already existing one-way traffic regulations to neighbourhood local streets with proper signage and wide publicity.
- Replace speed bumps with tabletop crossings, especially on non-signalised intersections within neighbourhoods following the IRC 103-2012 guidelines (Indian Road Congress 'Guidelines for pedestrian facilities'(IRC, 2012).
- Employ parking area management plan (PAMP) uniformly across a well-defined neighbourhood. PAMPs promote shared and priced public parking by acknowledging the neighbourhoods' contextual space constraints (Roychowdhury et al., 2018). Space reclaimed from on-street parking can be reallocated for several CIM-friendly purposes like widening of sidewalks, adding a cycle lane or allowing spillover of local eateries.
- Reclaim a certain portion of street by reducing the number of travel lanes. Using paints, bollards and landscaping, space for walking, cycling, dedicated bus lane, rickshaw stops etc. can be demarcated, especially on arterial and sub-arterial streets (BVLF, 2018). The extra width can be further added to expand the median reducing the street crossing distance for pedestrians.

For new neighbourhoods:

- Planning cul-de-sacs into the neighbourhood design have proved to be beneficial in reducing impact of traffic on children. Cul-de-sacs act as 'play areas' for local children, who use them for informal play activities, especially in neighbourhoods that lack open spaces and are highly dense.
- Adding chicanes on street is another beneficial element that slows traffic speed and increases the amount of public space available simultaneously (NACTO, 2013).
- Strict enforcement of speed limit for vehicles up to 10-15 km/hour (according to ITCN and URDPFI guidelines) can ensure reduced pedestrian-vehicular conflict (BVLF, 2018; TCPO, 2015).

- Plan parking facility either in underground garages or multi-level parking infrastructure located at the end of each residential area block. Such an arrangement can generate ample 'car-free' space on streets encouraging children to roam around freely without adult supervision (Krysiak, 2019).
- The concept of 'shared streets' called 'Woonerfs' in Netherlands or 'Home zones' in the UK can be applied to local residential streets. Using different paving material, strategically placing planters or bollards and clear signages can create equal space for pedestrians, cyclists and motorised vehicles while slowing down the overall traffic speed (BVLF, 2018).

2. Goal 2: Diversify

The second strategy should be to diversify various services or facilities for children and their caregivers within neighbourhood. These multiple services should cater to children of all age groups and available within walking distances of the residences, thereby activating the neighbourhood's street life. Examples of facilities could include a daycare center, stationary shop, grocery shop, laundry services, hobbies club or tuition classes, sports centre, eating joints etc. Additionally, families with children and other local residents should have the right to decide on the types of facilities within neighbourhood. The three ways proposed to achieve diversification are an improved land-use mix; balanced ratio of parks and open spaces; and utilisation of unused spaces within neighbourhoods.

<u>For existing neighbourhoods:</u>

- Strategically positioning mixed facilities for children and their caregivers along the commonly used pedestrian routes and key transit hubs can help improve land-use mix (BVLF, 2018). These facilities can be both formal and informal with clearly demarcated area either with paints or signages. Planning space for weekly markets within small pockets of neighbourhood can reduce the commuting distance while also improving land-use mix.
- Unused spaces (like vacant plots, unused parking area etc.) can be converted into pop-up play parks in dense neighbourhoods with limited open spaces. These parks can be maintained by *para* or local community members, allowing children to play freely without regulations often applied in parks maintained by municipal officials.

- In case of neighbourhoods having balanced proportion of parks and playgrounds, it is suggested to remove boundaries around them. It assists in increasing connection with the immediate street while improving "eyes on the street" element of the neighbourhood.

For new neighbourhoods:

- Adopt Transit-Oriented Development (TOD) concept for achieving an ideal land-use mix while enhancing connectivity and provision of walkable destinations through densification (TCPO, 2015).
- Integrate child-centric facilities near residential spaces or on ground floor of high-density multi-storey buildings. The ground floor can be open to a courtyard or immediate street for improving indirect supervision (Krysiak, 2019).
- Design intergenerational spaces within neighbourhood parks and playgrounds (Krysiak, 2019).

3. Goal 3: Embrace

The third and one of the most significant strategy should be to embrace each neighbourhood's cultural and contextual factors. As seen in Kolkata, *Adda* & *para* forms a unique part of cultural legacies of older neighbourhoods; it should be taken into consideration while proposing design interventions promoting social interactions. Similarly, the design should also cater to the need of formal and informal street vendors as they form an integral part of neighbourhood economy. On the other hand, the contextual factors may include key destinations (like school/museum/ public library) or challenges that require innovative design solution at the local level.

For existing neighbourhoods:

- Identify spaces for designing formal or informal sitting spaces, especially for children, their caregivers and elderly. Integrate sitting spaces near contextual challenges like a temple or a tree on a sidewalk.
- Identify and upgrade the areas for street vendors.
- In case of school present within neighbourhood boundaries, demarcate it with strict traffic regulations. Provide clear signages and paint the reduced speed limit or street closure timings on road for motorised vehicles.

For new neighbourhoods:

- Interactive edges on street intersections act as a space for *Adda*, spillover for local eateries or grocery shop in old Kolkata neighbourhoods. New neighbourhoods should accommodate the cultural legacies (Dasgupta & Tyagi, 2021) by simulating social activities on these edges.
- Plan urban street vending zones within each residential cluster in neighbourhoods. The zones should have facilities for both stationary and mobile types of street vendors following the URDPFI guidelines (TCPO, 2015).
- Besides demarcating school zones within neighbourhoods, incorporate incentivising school owners to share their amenities (like parks and playgrounds) with residents after school hours (BVLF, 2018). Additionally, create safe waiting spaces for parents or caregivers outside school boundaries for enhancing social interactions (NACTO, 2020).

4. Goal 4: Connect

The fourth and last strategy should be to connect local destinations and places of value for children and their caregivers with the residential areas in a neighbourhood. The connection should be safe, comfortable and enjoyable for children, while at the same time providing them with multiple commuting options. The three ways of achieving the same include creating safe pedestrian and cycling infrastructure; incorporating both public and IPT hubs; and creating spaces for pause and play on the mobility routes within neighbourhood.

For existing neighbourhoods:

- Identify, upgrade and demarcate children's common pedestrian travel routes with paints or signages or graphics. Child-friendly graphics can be stencilled on the sidewalk edges, to remind young children to look both ways before crossing the street. Signages could be installed at a visible distance warning vehicular traffic of the child priority route (BVLF, 2018; Krysiak, 2019).
- Widen sidewalks, especially near local shops by reclaiming space from carriageways on street.
- Add mid-block crossings on longer streets, reducing the pedestrian travel time and risk involved with pedestrian-vehicular conflicts (NACTO, 2020).

- Upgrade all transportation hubs by first installing safe and accessible waiting areas catering to children and their caregivers. Install clear signages and provide real-time information for bus and tram services.
- An important indicator while designing neighbourhoods for CIM is designing amenities that provide children with things to 'see' and 'do' (LEAP, 2020). This could be achieved by adding murals, other artwork and playful elements on sidewalk with paints and durable furniture (NACTO, 2020).

For new neighbourhoods:

- Plan wide, accessible and well-lit sidewalks, especially near local shops, school, library or any other key child-centred destination within neighbourhood. Provide curb extensions and pedestrian refuge islands on arterial and sub-arterial roads to minimise street crossing distances.
- Plan a comprehensive network of bicycle lanes connecting neighbourhoods and key destinations of value for children and their caregivers (NACTO, 2020).
- Integrate child-friendly infrastructure for public transport stops and IPT waiting areas at regular intervals within neighbourhood.
- Add parklets along the designated parking space on neighbourhood street, preferably near a local eatery (NACTO, 2013).
- Promote a culture of 'streets as playground' by adding playful art or installation for positively engaging children with their surroundings (NACTO, 2020) while travelling to local destinations.

Overall, these suggested strategies are interdependent and can only work holistically. As clearly evident, design interventions for CIM do not require heavy financial investments, rather flexible and adaptable approach is needed at neighbourhood scale prioritising children and their mobility needs.

7.4 Conceptual Note on Auditing Neighbourhood for CIM-friendliness

The relationships established in the research findings provide a direction to audit neighbourhoods for its CIM-friendliness within an Indian context. Therefore, a conceptual auditing checklist is proposed that can be taken up in the future to develop a robust toolkit for the same. Total four key parameters should be checked as discussed below:

1. CIM levels

It is essential to get data on the average CIM destination ratio of each neighbourhood. The most important criterion is obtaining the percentage of children actually commuting to and from school independently (if school is within neighbourhood boundaries). Besides, data on the usage and frequency of children's active mode of transport to local destinations can also be checked.

2. Traffic situation

Obtain information on the presence and types of traffic calming measures within neighbourhoods and traffic speed at intersections on major routes. Additionally, check the percentage of on-street parking in comparison to the percentage of barrier-free sidewalks. It will give information on the user group priorities on the street. Also, check the percentage of one-way streets and clear signage of speed reduction near key destinations (school, playground etc.) within neighbourhoods.

3. Infrastructure (street and neighbourhood layout)

Check the presence, width, continuity and quality of sidewalks, especially near child-centred key destinations within neighbourhood. Collect information on the distance between street crossings, pedestrian refuge island and shaded seating with legible signages on major routes. Check if the neighbourhood has a separate cycle lane with a dedicated cycle network plan. The neighbourhood layout can be evaluated in terms of land-use mix, percentage of open spaces or parks, unused and unutilised spaces, cul-de-sac, intergenerational spaces, area for informal street vendors and accessible waiting area at transportation hubs. The spatial planning component can also be checked along with typology of housing units and EWS housing segregation. Additionally, identifying streets and the duration for which they were active after office hours can be useful data for CIM.

4. Socio-demographic characteristics

Obtain information on the percentage of families living for more than two generations, families from outside the state and families owing car or motorbike. If feasible, data on parents' perception of neighbourhood safety can also be taken into consideration.

7.5 Directions for Future Research

As mentioned earlier, the investigations on CIM within the Indian context is at a nascent stage. This research by providing a case of one megacity initiates an intense discourse on children's

mobility in a country with enormous diversities within social, cultural and urban environment structures. Future studies could advance by incorporating CIM range and time, besides CIM licence and destination. Secondly, considering the diversities among Indian cities, a more flexible definition for neighbourhood could be adopted. Instead of taking the buffer method or pre-defined administrative boundaries, other options such as the resident's perception and children's 'home-range' methods can be explored. Thirdly, additional built-environment variables like distance to destination, destination availability and accessibility, percentage of urban green spaces and street characteristics (street width, presence of walkway, no. of crossings etc.) having a strong association with CIM can be taken into consideration. Traffic volume may also explain a better picture of actual traffic conditions on Indian roads than traffic exposure, used in the study as a proxy measure. Fourthly, 'climate' can be taken up as a variable to understand its effect on CIM by conducting longitudinal studies within India's different geographical locations, including the Himalayan belt. Additionally, child's well-being and parental style can be looked at in comparison to CIM levels. Lastly, children's meaningful participation to understand their neighbourhood perspectives, mode of transport, and route choices can further expand the overall CIM knowledge base from India.

7.6 Ending Remarks

CIM has evolved globally in the past three decades, as a concept, concern and tool to evaluate a city's performance for a child's positive and safe mobility experiences. Its significance is acknowledged by UN and multiple researchers, as seen with the initiation of CFCI and growing field-based evidences at local levels. Consequently, strong advocacy and opinions have emerged to create a safe, accessible and engaging built environment for children. In the global south, the picture is slowing appearing on the existing levels of CIM from countries like Bangladesh, Sri Lanka, Myanmar, Indonesia and Singapore, adding small yet impactful footprints on the CIM map. In India, the focus is currently on creating child-friendly public spaces and streets by conducting pilot level experiments using tactical urbanism. Little is known about the impact of built and social neighbourhood environment on children's mobility in the Indian context. At this juncture, the present research finds its place as the first study investigating the effect of the existing neighbourhood environment on urban childhoods, taking Kolkata as a case.

More specifically, this research adds to the growing body of CIM literature, providing evidence on its declining trend to school and non-school local destinations from a megacity in India. Moreover, it extends the global discussions on the impact of different urbanisation levels on CIM by including the case of distinct neighbourhood typologies typical to an Indian metropolitan context. The thesis empirically establishes the correlations between neighbourhood built and social environment with CIM, bringing in the dimensions of 'verticality' and 'long-term sustainability of families' into the picture. Broadly, it suggests that low-rise or mid-rise neighbourhoods with organic spatial growth having high land-use mix and less vehicular traffic offers comparatively a more conducive environment for CIM than high-rise planned neighbourhoods. At the same time, neighbourhoods that are able to retain families for generations and supports multi-cultural or multi-linguistic demographics encourages a higher social cohesiveness that directly results in higher CIM. Interestingly, the results also reveal that for parental permission levels or CIM License, neighbourhood BE is a more influential factor while for children's actual unsupervised mobility or CIM Destination, neighbourhood SE is comparatively more overpowering. Additionally, child's age was also found to be a significant factor for CIM. Therefore, it is understood that CIM is a complex and conditional phenomenon arising from a dynamic interplay of neighbourhood BE and SE along with socio-demographic factors.

Overall, one of the novel contributions of the research is in the development, validation and contextualization of participatory tools and mixed method approach for an urban Indian setting. The replicability of the participatory model therefore calls for large -scale future studies on CIM documenting qualitative and quantitative perspectives from both children and their caregivers. In fact, it is here that the key limitations of the research are acknowledged in terms of scale, variables, target demographics, operational definitions and children's ladder of participation. Further studies at different urban scales (urban public spaces, city planning etc.), adopting refined neighbourhood definitions, considering other variables (traffic volume, distance to destination, street characteristics etc.) and co-creating urban solutions with children from all age-groups, can add value to the existing CIM discussions on a more advance level.

Concludingly, the core argument of this research is that neighbourhoods should be relooked not only from the perspective of children but also from families. Therefore, the focus should be on the overall development of a supportive environment for families with children. The main purpose is

to revive and promote the culture of CIM for today's generation. Ultimately, our urban neighbourhoods should not only be a place where childhood merely survives but a place where it should successfully thrive.

Epilogue

This PhD research project took me on a journey that deeply impacted my thinking ideologies concerning urban childhoods. It made me aware and sensitized towards the developmental needs of children in the constantly urbanizing world. On-field working with children and their caregivers provided insights that opened doors for numerous possibilities of creating healthy and connected cities. At the time of writing this thesis, the world suddenly came to a standstill due to the global outbreak of COVID-19 pandemic. This outbreak led to significant changes in the daily lives of people, compelling them to shift gears in line with the local guidelines. Residents were asked to stay indoors, and unprecedented restrictions were imposed on their movement within public spaces (Honey-Rosés et al., 2020). A sudden rise among people regarding the importance of open spaces, socially active neighbourhood and green areas have emerged.

The most noticeable effect was seen among the lives of children and adolescents. The crowd reducing guidelines translated into closure of schools (in 146 countries), kindergartens, sports facilities and even parks or playgrounds for an indefinite period. Consequently, a sharp rise in stress, anxiety, emotional and psychological issues was reported among children through surveys conducted across the globe. One apparent reason emerging out from such investigations was the absence of peer learning. Online classes or virtual interactions with friends were not sufficing the human connection need required for children's healthy developmental growth and overall well-being.

With fewer places to go, there was also an increase in children's screen time, sedentary activities and a decline in outdoor physical activity levels (Moore et al., 2020). Rooftops and local street immediately in front of residences gained profound significance as places for some level of children's outdoor activities. At the same time, families also realized that free and safe access to these places is a privilege in current times. As reduced vehicular traffic on the street resulted in speeding cars, while pedestrian walkways were not wide enough to follow the two-meter social distancing guidelines (Russell & Stenning, 2020). Cycling tracks were almost non-existential in the majority of countries. Besides, in many cases such as high-rise buildings, rooftops were shared spaces currently out of bound for residents.

Several child right's advocates raised their voices (Power et al., 2020; Stenning & Russell, 2020) on this situation pressurizing governments to respond by bringing in favourable policies or guidelines into effect for children. The Canadian government, for instance, encouraged families to get active and outdoors while maintaining social distancing (Moore et al., 2020). In some Canadian cities, select streets were closed to car traffic for supporting children's active transport and other outdoor activities improving physical activity. Few municipal parks remained open with physical distance guidelines, while campgrounds and park trails were closed (Power et al., 2020). While, the UK government responded by investing in supportive built infrastructure and policies like widening footpaths, creating temporary cycling lanes, reducing speed limits and closing residential streets for motorized traffic entirely (Russell & Stenning, 2020). The Japanese government, on the other hand, initially decided to allow school playgrounds to remain open for easing the increased mental and emotional stress among children and encourage outdoor play (Jiji, 2020).

Unfortunately, in developing countries, the vision for children in government narratives on the pandemic response remained limited. In India, no debates or talks were going on to support children's right to public spaces or streets. The national-level priority regarding children remains confined to the discussions on reopening the schools. An indication that a majoritarian perception related to children does not take into account their developmental needs and the role of local surroundings for the same. News reports were filled with guidelines and suggestions for parents to act responsibly for their children's mental health, but advocacy pushing government to provide support were limited.

Given the current situation, the need to raise awareness and opinionated voice on children's right to outdoor mobility and play activities becomes even more essential. As we are progressing and understanding this virus, several scientific evidences are pointing to the fact that children are less susceptible to COVID19 (Lee et al., 2020). Besides, sharing living quarters and residing indoors is found to be riskier than outdoors if physical distancing is maintained. Naturally, the significance of children's independent mobility (CIM) has become even more essential than ever before (Riazi & Faulkner, 2020). As a higher CIM has the potential for reducing the parental load of supervising children outdoors while full-time working from home.

Therefore, cities across the globe have a once in a decade chance to re-look at their built environment for fostering social connections and cohesiveness. This pandemic has shaken us to

read our physical space from a new lens. A lens that zooms into the neighbourhood level planning and design requirements concerning its residents, especially children. To question not only the energy consumption of our buildings but also the people-centric approach employed in its planning and execution. The recently launched 'Designing Streets for Kids' guidelines by Global Design Cities Initiative (GDCI) is an example that provides guidance in this direction. It supports the quest for questioning our existing local surroundings to encourage a safe and healthy childhood. On similar lines, in November 2020, a ray of hope emerged with the launch of 'Nurturing Neighbourhoods Challenge' by the Smart Cities Mission, Ministry of Housing and Urban Affairs (MoHUA), Government of India in collaboration with BvLF and WRI (World Resources Institute) India. This challenge encourages and provides support to Indian cities for adopting an early childhood lens in designing neighbourhood-level interventions. Evidently, we can say - the need is now. We need to 'Build Back Better' and listen to the global call for human-oriented urbanism (Bullmore, 2020) that requires a long time commitment for constant strategizing and planning. Keeping children as indicator species is the way forward.

'If you design a street that works for kids, you design a street that works for everyone.'

- Janette Sadik-Khan, NACTO-GDCI Chair

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Appendices

Appendix IA

Parents' consent form and questionnaire on CIM Licence

Please complete this survey sheet below:

A. Personal Information

1. Name : _____
2. Date : _____
3. Are you a: Mother_____ or Father _____ (Please tick)

4. Your child's age, gender and name:

S.No.	Age (Years)	Gender (Please tick)	Name
1	_____	M/F	_____
2 (if applicable)	_____	M/F	_____

5. Your contact information:

E-mail address: _____
Mobile No. : _____
Current residential address:
_____

B. Family Profile

6. What type of family structure do you live in Kolkata? (Please tick)
   (A) Joint_____ (B) Nuclear_____

7. What is your current employment status? (Please tick)
   (A) Full-time_____ (B) Part-Time_____ (C) Homemaker_____

8. What is your highest qualification? (Please tick)
   (A) Post-graduate_____(B) Graduate_____(C) Senior Secondary_____
   (D) Other (please specify) _____

9. Which of the following does your family own? (Please tick)
   (A) Car _____How many? _____
   (B) Scooter/bike _____How many? _____
   (C) None _____

10. How does your child travel to and from school? (Please tick)
    (A) Walk _____(B) Cycle_____(C) School bus/ Van_____
    (D) Motorbike/Scooter_____(E) Car_____
    (F) Any other (please specify) _____

C. Please read the following questions carefully and tick the appropriate answer in the last columns

Sno.	Questions (English)	Questions (Hindi)	Questions (Bengali)	Yes (1)	No (0)
1	Do you allow your child to travel home from school and vise-versa alone*?	क्या आप अपने बच्चे को स्कूल अकेले आने या जाने देते हैं ?	আপনি কি আপনার বাচ্চাকে একা স্কুলে যেতে বা আসতে দেন?		
2	When going to places other than school that are within walking distance (i.e at a walking distance of 5-10 minutes from your house like park, local shop or a friend's house etc.) is your child allowed to go alone?	क्या आप अपने बच्चे को घर से 5 या 10 मिनट की पैदल दूरी वाली जगहों पर अकेले जाने देते हैं ?	আপনি কি আপনার বাচ্চাকে বাড়ি থেকে ১০-১৫ মিনিটের হাঁটার দূরত্বের জায়গাতে একলা যেতে দেন?		
3	Is your child usually allowed to go out alone (to local destinations) after dark?	क्या आप अपने बच्चे को घर के आस पास वाली जगाहों पर, अंधेरा होने के बाद अकेले जाने देते हैं?	আপনি কি আপনার বাচ্চাকে বাড়ির আশেপাশের জায়গাতে সন্ধ্যের পর একলা যেতে দেন?		
4	Is your child allowed to cross main roads near your house alone?	क्या आपके बच्चे को घर के पास वाली मुख्य (main) सड़क,अकेले पार करने की अनुमति है?	আপনি কি আপনার বাচ্চাকে বাড়ির কাছের মেন রোড একলা পার হওয়ার অনুমতি দেন?		
5	If your child has a bicycle, are they allowed to cycle on (main roads) neighbourhood roads/ streets/ lanes alone?	अगर आपके बच्चे के पास साइकल है , तो क्या उसे घर के आस पास वाली सड़कों या गलियों पर अकेले साइकल चलाने की अनुमति है?	যদি আপনার বাচ্চার সাইকেল থাকে, তবে আপনি কি তাকে বাড়ির আশেপাশের রাস্তাএ বা গলিতে একা সাইকেল চালানোর অনুমতি দেন?		
6	Is your child usually allowed to use city buses / autorickshaw/ hand-pulled rickshaw/ tram/ metro/ alone?	क्या आपके बच्चे को city buses / autorickshaw/ hand-pulled rickshaw/ tram/ metro/ पर अकेले सफर की अनुमति है?	আপনি কি আপনার বাচ্চাকে একা বাস/ অটো/ রিক্সা/ ট্রাম/ মেট্রো রেলে চড়ার অনুমতি দেন?		

***Here the term 'alone' refers to the child either travelling alone or with friends or elder sibling (brother/sister below the age of 18 years), but no adult.**

*यहाँ "अकेले" शब्द का अर्थ यह है कि बच्चा या तो बिलकुल अकेला है या फिर अपने दोस्तो के साथ है या कोई भाई /बहन (जो 18 साल कि उम्र से कम है), लेकिन किसी बड़े व्यक्ति के साथ नहीं है।

* এখানে 'একা' শব্দর অর্থ হল যে বাচ্চা নিজে একলা অথবা নিজের বন্ধুদের সাথে বা কনো ভাই/দিদির সাথে(যে ১৮ বছরের চেয়ে কম বয়সী) কিন্তু কনো প্রাপ্তবয়স্ক বেক্তির সাথে নয়।

Appendix IB

Parents' questionnaire sheet on neighbourhood perception
(Google survey sheet)

Section 1: Neighbourhood Cohesion

This section requires you to answer questions with respect to the trust and attachment among the neighbours around your house (para or society). Kindly rate on a scale of 1 to 5 (1 being strongly disagree and 5 being strongly agree) for the following set of five questions:

1. People are willing to help in my neighbourhood (मेरे आस-पड़ोस के लोग एक दूसरे की मदत करने के लिए तयार रहते हैं।)

1	2	3	4	5
(Strongly disagree)	(Disagree)	(Neutral)	(Agree)	(Strongly agree)

2. Mine is a close-Knit neighbourhood (मेरा आस-पड़ोस एक दूसरे से काफी जुड़ा हुआ है।)

1	2	3	4	5
(Strongly disagree)	(Disagree)	(Neutral)	(Agree)	(Strongly agree)

3. The people in my neighbourhood can be trusted (मेरे आस-पड़ोस के लोगो पर विश्वास कीया जा सकता है।)

1	2	3	4	5
(Strongly disagree)	(Disagree)	(Neutral)	(Agree)	(Strongly agree)

4. The people in my neighbourhood get along well with each other (मेरे आस-पड़ोस के लोग एक दूसरे से काफी घुल मिल कर रहते हैं।)

1	2	3	4	5
(Strongly disagree)	(Disagree)	(Neutral)	(Agree)	(Strongly agree)

5. The people in my neighbourhood share the same norms and values (मेरे आस-पड़ोस के लोग एक ही विचार धारा और आदर्शो को मानते हैं।)

1	2	3	4	5
(Strongly disagree)	(Disagree)	(Neutral)	(Agree)	(Strongly agree)

Section 2: Neighbourhood Connection

Kindly rate on a scale of 1 to 5 (1 being strongly disagree and 5 being strongly agree) for the following set of five questions:

6. Parents in my neighbourhood know their children's friends (मेरे आस-पड़ोस मे रहने वाले parents अपने बच्चो के दोस्तों को पहचानते हैं।)

1	2	3	4	5
(Strongly disagree)	(Disagree)	(Neutral)	(Agree)	(Strongly agree)

7. Parents in my neighbourhood generally know each other (मेरे आस-पड़ोस मे रहने वाले parents एक दूसरे को भी जानते हैं।)

1	2	3	4	5
(Strongly disagree)	(Disagree)	(Neutral)	(Agree)	(Strongly agree)

8. Adults of my neighbourhood can recognize almost all the local children (सभी बड़े लोग, मेरे आस पड़ोस के बच्चो को पहचानते हैं।)

1	2	3	4	5
(Strongly disagree)	(Disagree)	(Neutral)	(Agree)	(Strongly agree)

9. I can trust on the people of my neighbourhood to watch out for my children's safety (मैं अपने आस-पड़ोस मे रहने वाले लोगो पर, अपने बच्चो की safety को ध्यान मे रखते हुए , विश्वास कर सकती/ सकता हूँ कि वो उन पर निगरानी रख सकते हैं।)

1	2	3	4	5
(Strongly disagree)	(Disagree)	(Neutral)	(Agree)	(Strongly agree)

Section 3: Neighbourhood Safety

This section requires you to answer questions regarding the experience of safety within your neighbourhood. Kindly rate on a scale of 1 to 5 (1 being strongly disagree and 5 being strongly agree) for the following set of five questions:

10. There are safe places for my children to play in the neighbourhood (मेरे आस-पड़ोस मे काफी safe जगाहे हैं जहां बच्चे खेल सकते हैं।)

1	2	3	4	5
(Strongly disagree)	(Disagree)	(Neutral)	(Agree)	(Strongly agree)

11. It's a good place to bring up children (यह काफी अच्छी जगह है बच्चो के साथ रहने के लिए।)

1	2	3	4	5
(Strongly disagree)	(Disagree)	(Neutral)	(Agree)	(Strongly agree)

12. I feel safe walking down my street after dark (अंधेरा हो जाने पर भी, अकेले सड़क पर चलते समय मैं काफी safe महसूस करती / करता हूँ।)

1	2	3	4	5
(Strongly disagree)	(Disagree)	(Neutral)	(Agree)	(Strongly agree)

13. I worry about the number of crimes committed in our neighbourhood (मुझे इस आस-पड़ोस मे बढ़ रहे जुर्म को देख कर काफी चिंता होती है।)

1	2	3	4	5
(Strongly disagree)	(Disagree)	(Neutral)	(Agree)	(Strongly agree)

14. It's a good place to buy a home (यह बहुत अच्छी जगह है घर खरीदने के लिए।)

1	2	3	4	5
(Strongly disagree)	(Disagree)	(Neutral)	(Agree)	(Strongly agree)

Appendix IC

Parents' semi-structured interview sheet

Parent code P_____
Name _____
Gender Female_____ Male_____ (tick here)
Residential address _____
_____

Start Time: _____ End Time _____

Q1 What do you think about children's independent mobility or CIM as a concept/idea?

Q2 Is there a need for a built environment that supports CIM or not and why?

Q3 On a daily basis, what are the issues in your neighbourhood that compels you to restrict your child's independent mobility?
(Vehicular traffic/ distance from home/child unreliable or too young/ stranger danger/ pollution)

Appendix II

Children's questionnaire sheet on CIM Destination

Your Name _____

Your age _____ years, Your Class_____Section_____

Are you a girl_____ or a boy_____(please tick)

Your home address_____

_____

Part A (Tick the right answer)

Q1. Are you allowed to cross main roads on your own?

- Yes
- No

Q2. Are you allowed to go on local buses (other than school bus) on your own?

- Yes
- No

Q3. If you have a bicycle, are you allowed to ride to go to places without any grown-ups?

- Yes
- No

Part B (Tick the right answer in the box)

Q4. How do you usually travel to the following Places?

Sno.	Place	Walk 	bicycle 	School bus/ school van 	Hand-pulled rikshaw/ auto 	Motorbike/ motorcycle 	Car 	Local bus/tram/ metro	Don't go there
1	**School**								
2	**Park/ playground**								
3	**Local street**								
4	**Friend's house**								
5	**Local shop/ market**								
6	**Tuition/ hobby/ sports class**								

Q5. With whom do you usually travel to these following Places?

Sno.	Place	Alone 	With other children (friends/ sibling) 	With adult (parents/ grandparents) 	Don't go there
1	**School**				
2	**Park/ playground**				
3	**Local street**				
4	**Friend's house**				
5	**Local shop/ market**				
6	**Tuition/ hobby/ sports class**				

Appendix III

Approach email to school Principals

To,
The Principal
XXXXXX School
XXXX, Kolkata
February 2019

Subject: Permission to conduct survey with children of class III to class VIII as a part of a Ph.D. project at IIT Roorkee

Respected Ma'am/Sir,

As an introduction, I am a Ph.D. research scholar from the Department of Architecture & Planning at the Indian Institute of Technology Roorkee (IIT Roorkee). I am doing a research on 'children's independent mobility to school and other local destinations in Kolkata'. This is a participatory research which requires a survey to be done with children from class III to class VII. The questions will be related to their daily travel to school and places of interest within their neighbourhood. The survey sheet for class III to class VII consists of 2 pages and total 5 questions, that will require a minimum of 15-20 minutes to be filled by children together in the class itself. It will be collected back then and there. There is also one booklet for parents, which will be distributed to children to take back home and parents can voluntarily fill and return. The total time required for the entire process is 5-6 days.

The results from the survey will be published in an international journal and the name of your school will be acknowledged. The funding for this research is provided by the Ministry of Human Resource Development (MHRD). It will be highly appreciated if you could provide me with the permission to conduct the survey for the same.

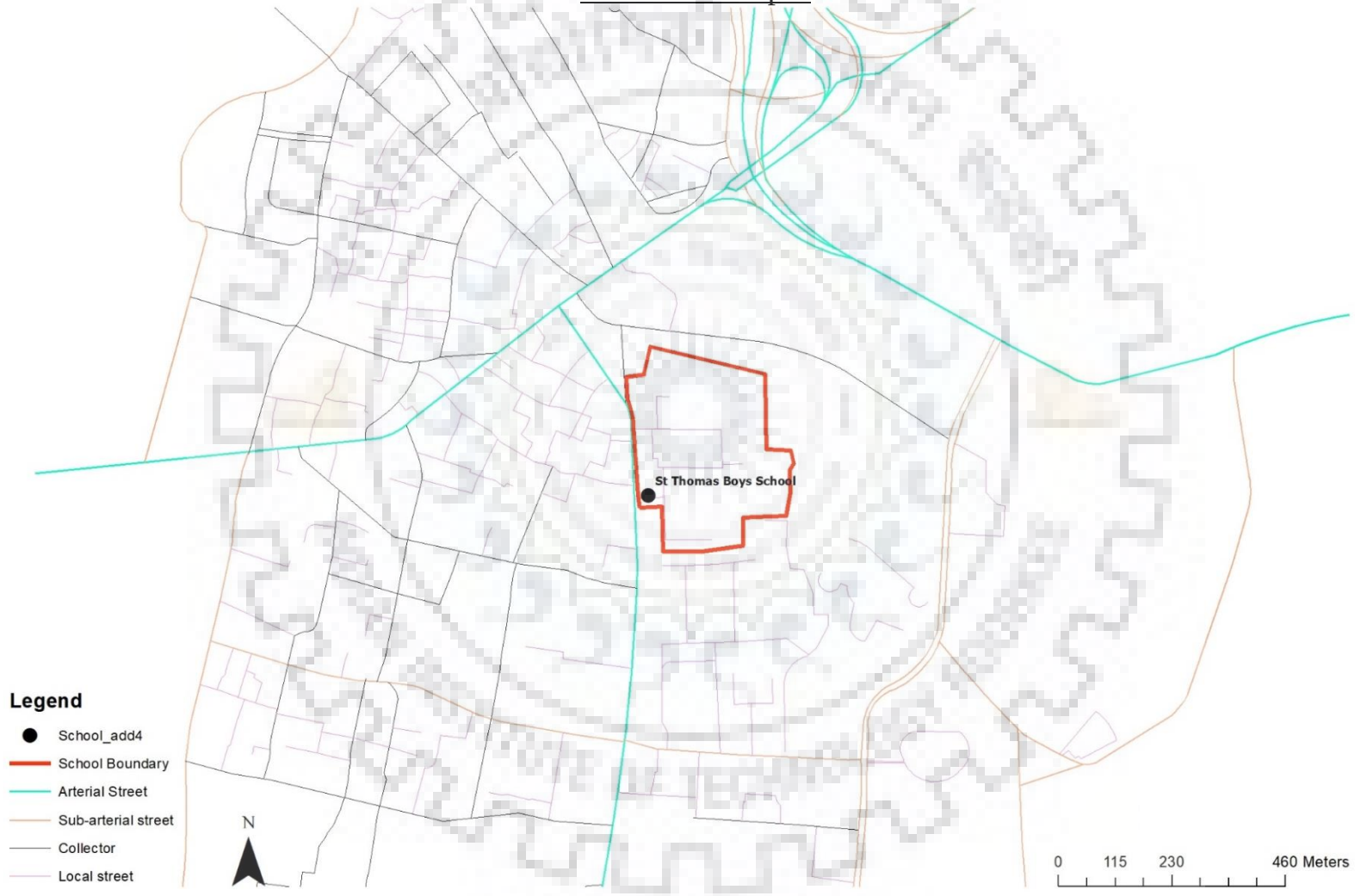
Thanking You.
Regards,

Megha Tyagi
Ph.D. research scholar
Department of Architecture & Planning
Indian Institute of Technology Roorkee
mtyagi@ar.iitr.ac.in

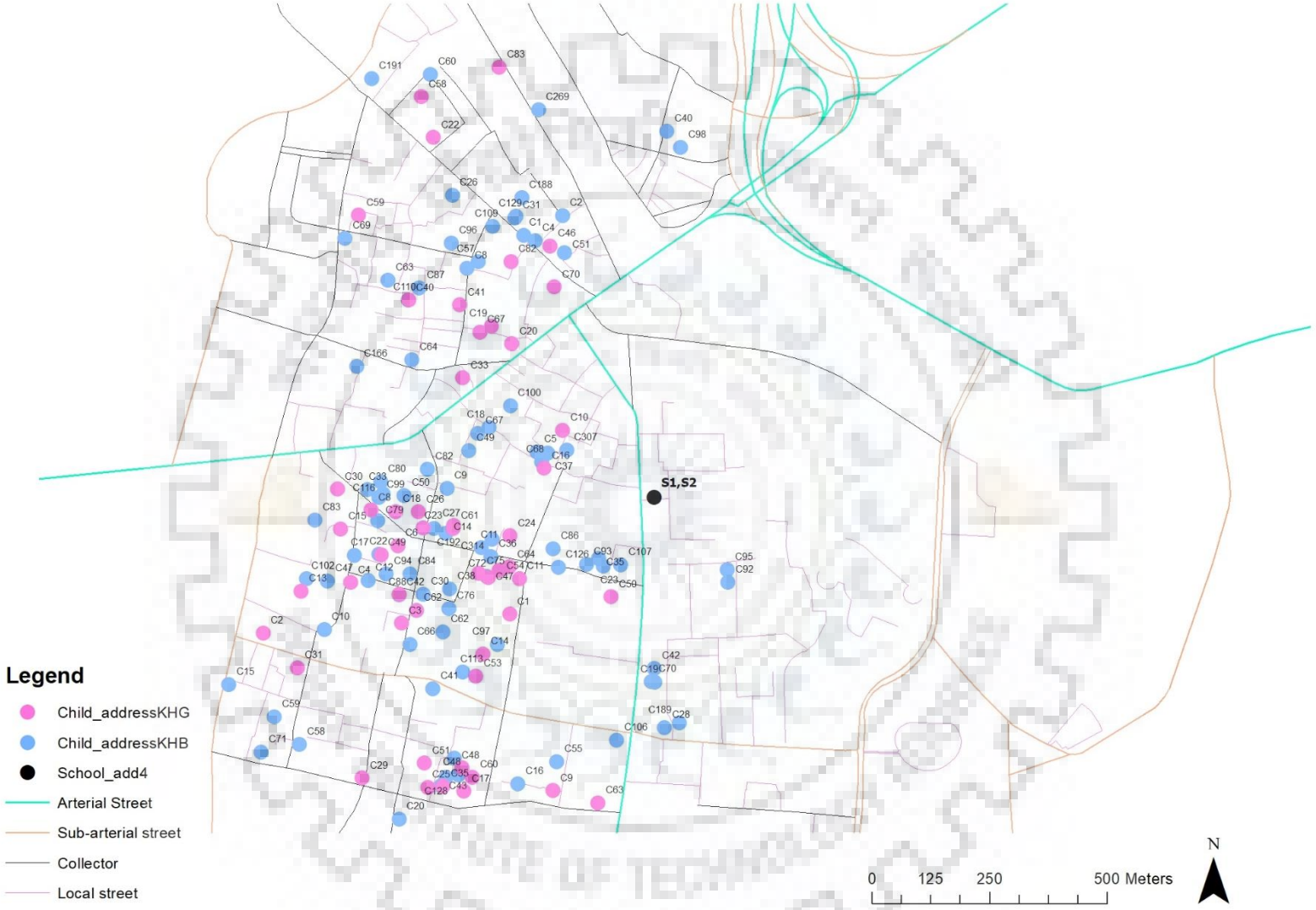
Appendix IV

Street hierarchy and children's residential location maps of neighbourhoods

Case 1: Khidirpur



Street hierarchy map of Khidirpur (Source: Author)

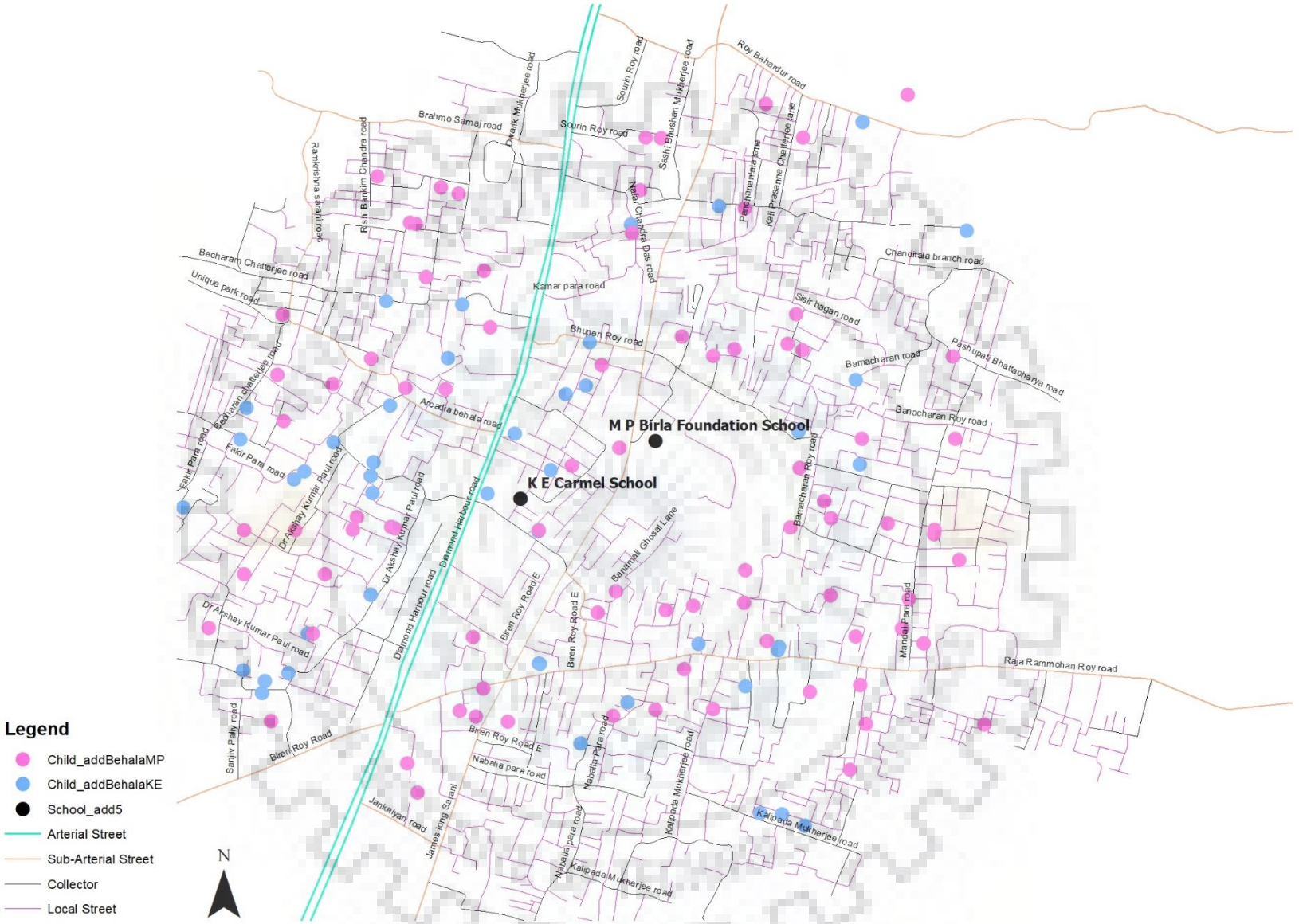


Map showing geocoded children's residential addresses in Khidirpur (Source: Author)

Appendix IV

Case 2: Behala

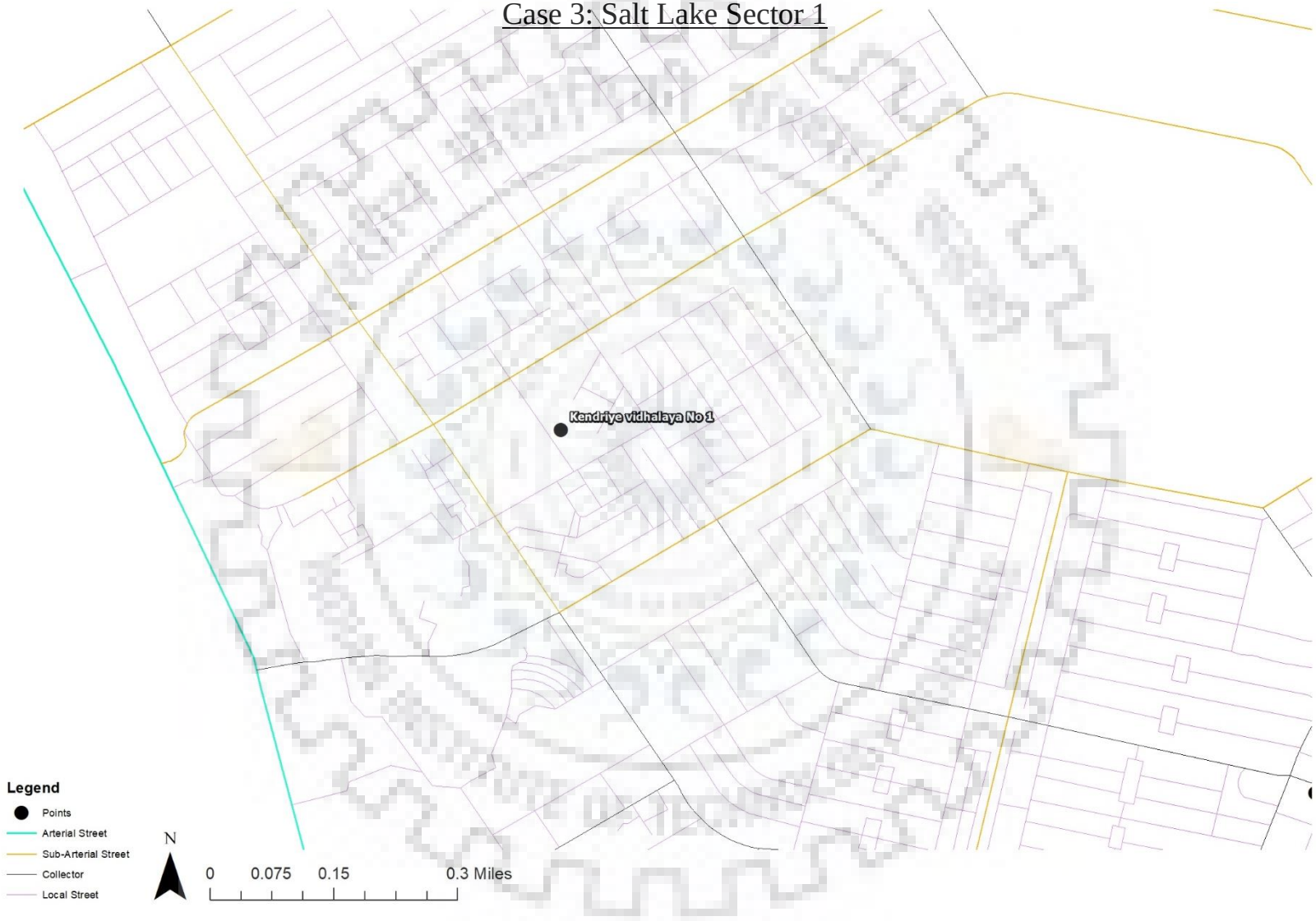
Street Hierarchy map of Behala (Source: Author)



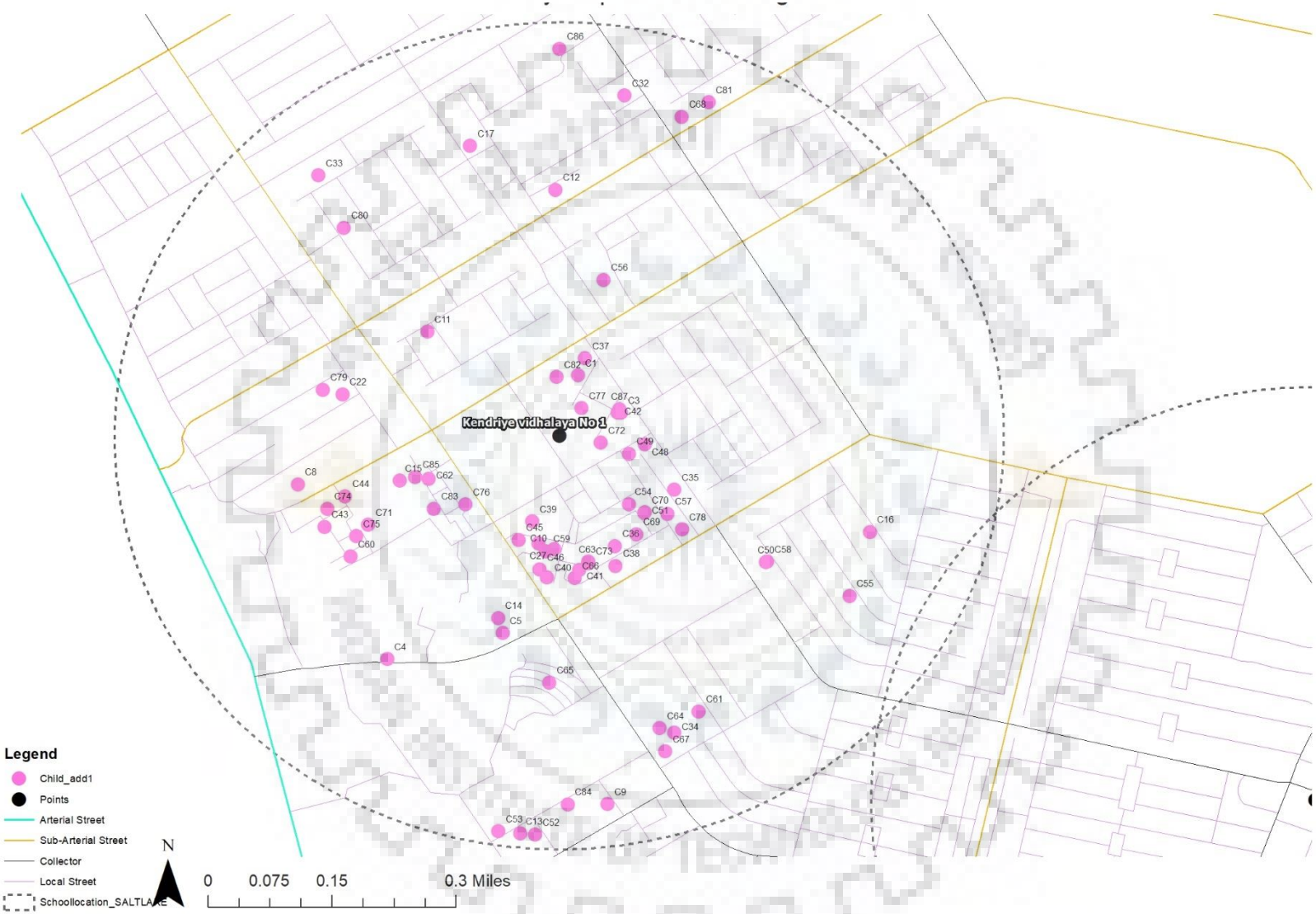
Map showing geocoded children's residential addresses in Behala (Source: Author)

Appendix IV

Case 3: Salt Lake Sector 1



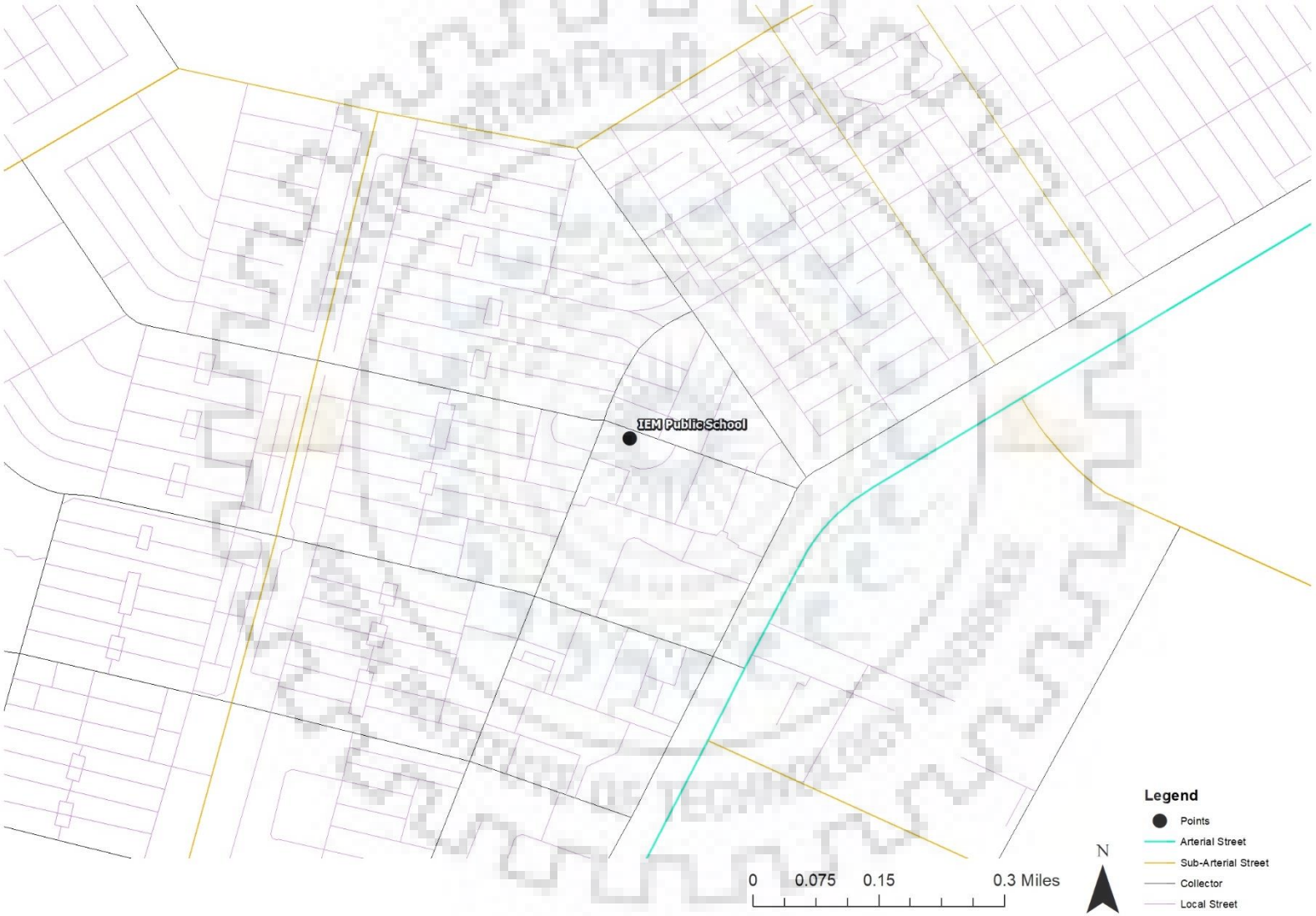
Street Hierarchy map of Salt Lake Sector 1 (Source: Author)



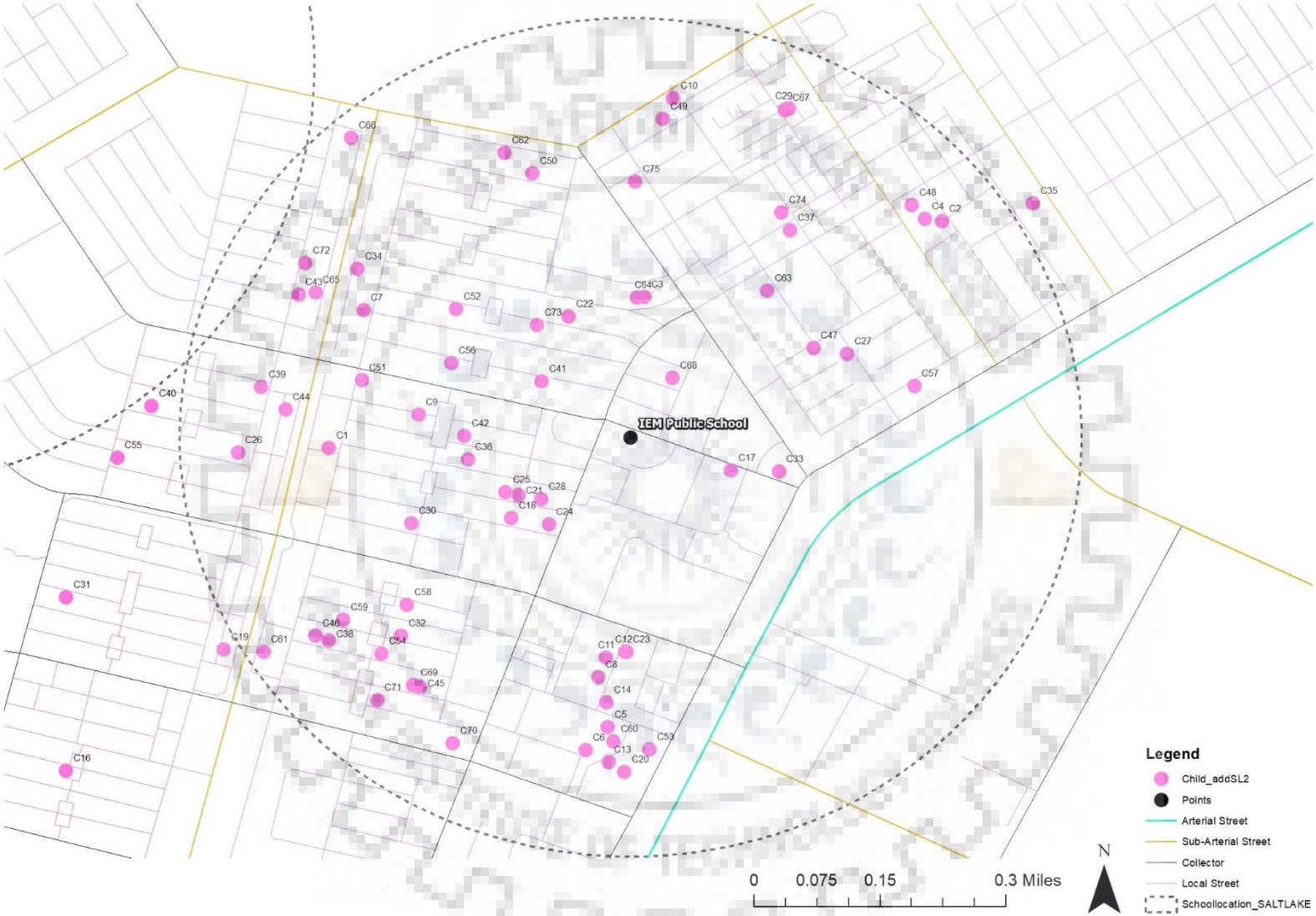
Map showing geocoded children's residential addresses in Salt Lake Sector 1 (Source: Author)

Appendix IV

Case 4: Salt Lake Sector 3



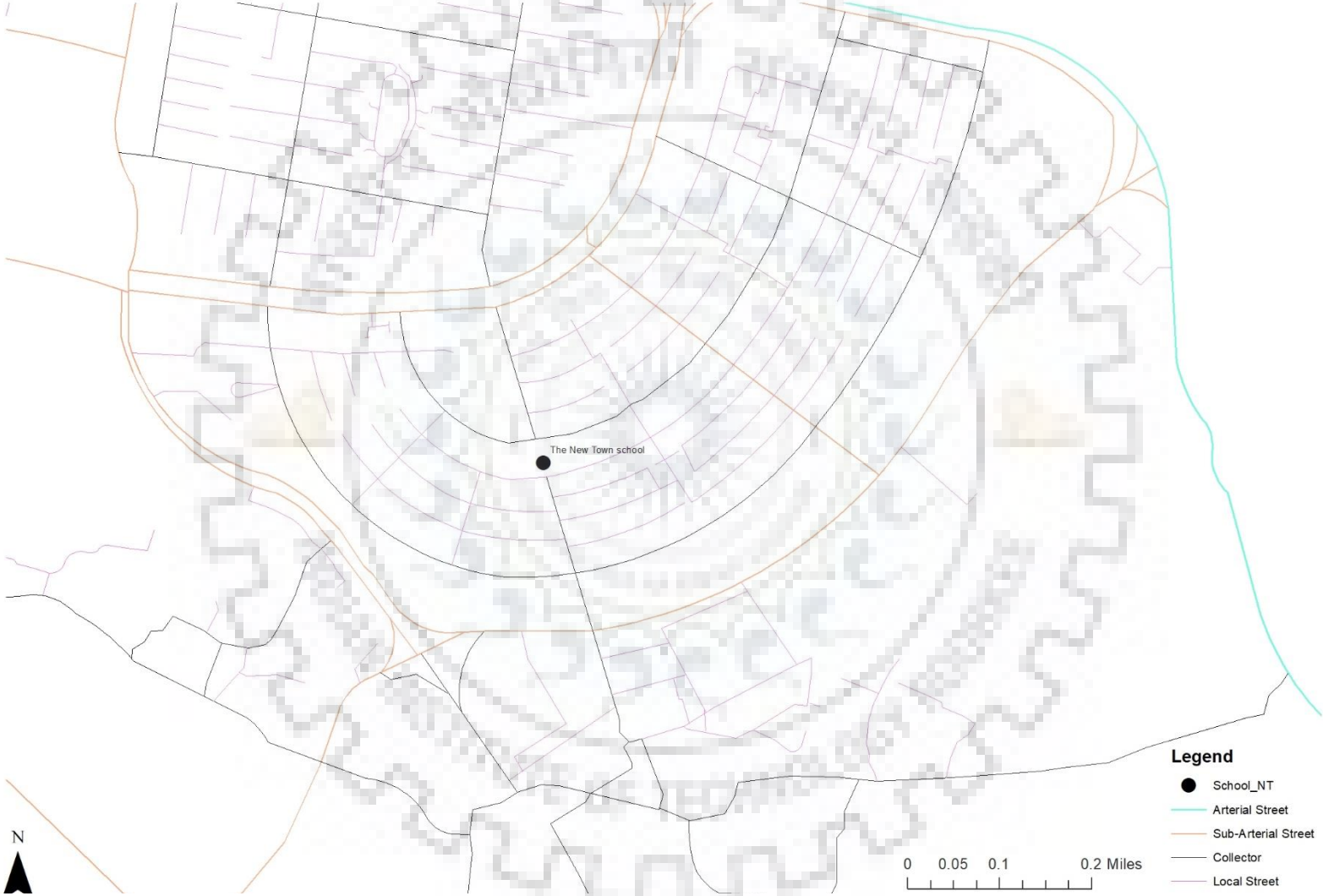
Street Hierarchy map of Salt Lake Sector 3 (Source: Author)



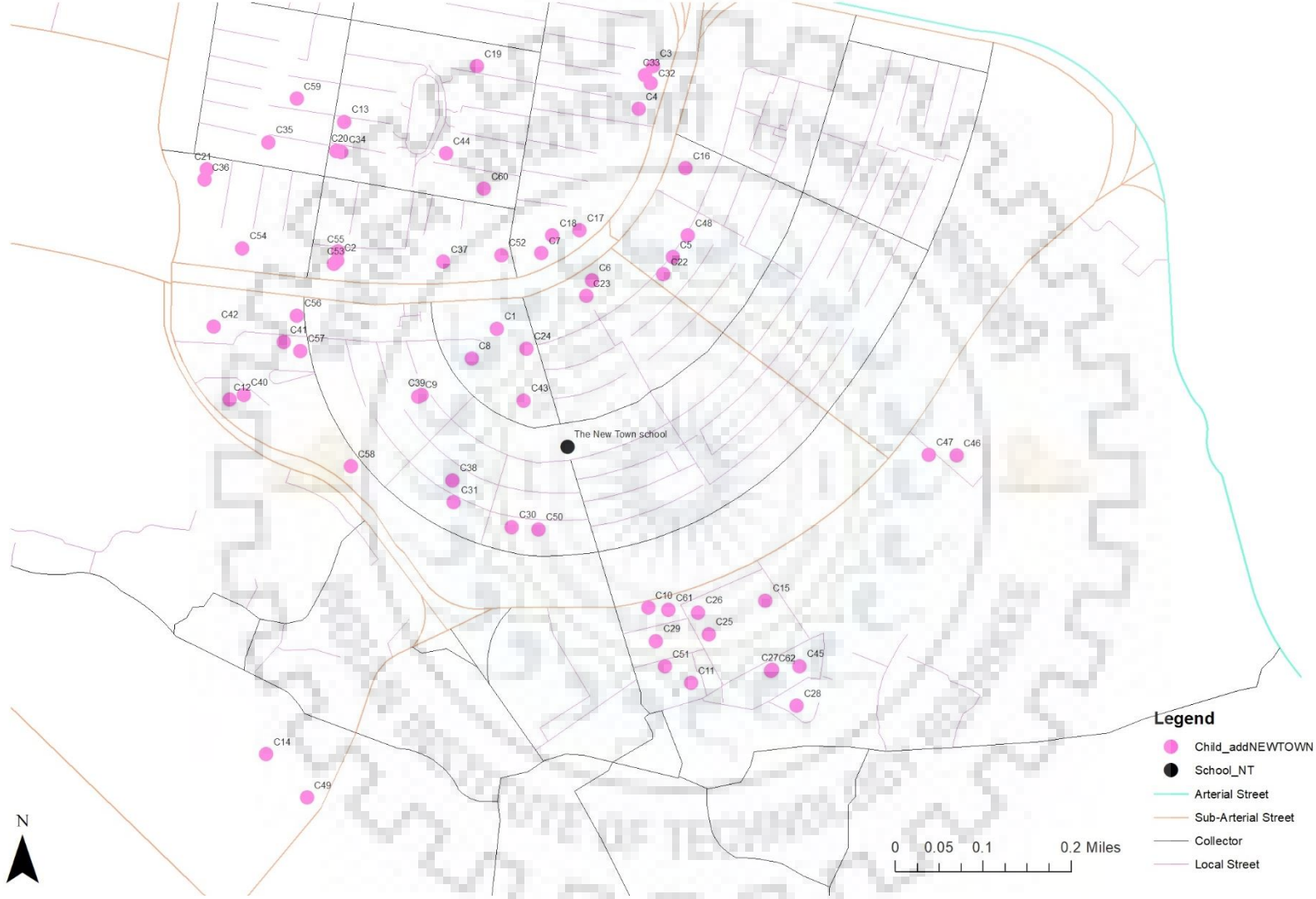
Map showing geocoded children's residential addresses in Salt Lake Sector 3 (Source: Author)

Appendix IV

Case 5: Action Area I, New Town



Street Hierarchy map of Action Area I, New Town (Source: Author)



Map showing geocoded children's residential addresses in Action Area I, New Town (Source: Author)