

UNIVERSITI TEKNOLOGI MARA

**ASSESSING INFLUENTIAL
FACTORS AND PROPOSED
SAFETY GUIDELINES
FOR CHILDREN WALKING TO
SCHOOL: A CASE STUDY IN SHAH
ALAM CITY, MALAYSIA**

NAIMAH BINTI OSMAN

PhD

June 2026

UNIVERSITI TEKNOLOGI MARA

**ASSESSING INFLUENTIAL
FACTORS AND PROPOSED
SAFETY GUIDELINES
FOR CHILDREN WALKING TO
SCHOOL: A CASE STUDY IN SHAH
ALAM CITY, MALAYSIA**

NAIMAH BINTI OSMAN

Thesis submitted in fulfilment
of the requirements for the degree of
**Doctor of Philosophy
(Built Environment)**

Faculty of Built Environment

June 2026

CONFIRMATION BY PANEL OF EXAMINERS

I certify that a Panel of Examiners has met on 12th March 2026 to conduct the final examination of Naimah binti Osman on her Doctors of Philosophy thesis entitled “Assessing Influential Factors and Proposed Safety Guidelines for Children Walking to School: A Case Study in Shah Alam City, Malaysia” in accordance with Universiti Teknologi MARA Act 1976 (Akta 173). The Panel of Examiners recommends that the student be awarded the relevant degree. The Panel of Examiners was as follows:

Rostam Yaman, PhD
Professor
Faculty of Built Environment
Universiti Teknologi MARA
(Chairman)

Abdul Rauf Abdul Rasam, PhD
Associate Professor
Faculty of Built Environment
Universiti Teknologi MARA
(Internal Examiner)

Syahriah Bachok, PhD
Associate Professor
Kulliyyah of Architecture and
Environmental Design
International Islamic University
Malaysia
(External Examiner)

PROF DR HJH. ZURAEDA IBRAHIM
Dean
Institute of Postgraduates Studies
Universiti Teknologi MARA
Date: 12 June 2026

AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

Name of Student : Naimah binti Osman

Student ID. No. : 2017349993

Programme : Doctor of Philosophy (Built Environment) – AP991

Faculty : Built Environment

Thesis Title : Assessing Influential Factors and Proposed Safety Guidelines for Children Walking to School: A Case Study in Shah Alam City, Malaysia

Signature of Student :.....

Date : June 2026

ABSTRACT

The growing reliance on motorised vehicles for short daily trips, including school trips, has contributed to sedentary lifestyles among Malaysian children. Despite various well-documented health, environmental, and social benefits of Active School Travel (AST), the participation rate of physical activity, particularly walking, in Malaysia remains low, and there is limited context-specific research integrating behavioural, environmental, and safety factors within urban school environments. Thus, this study focuses on (i) identifying influencing factors of children's walking behaviour, (ii) assessing safety conditions of school walking environments, and (iii) developing child-sensitive planning guidelines for school zones. The study aims to analyse key determinants of children's walking behaviour, evaluate pedestrian infrastructure and safety conditions, and propose context-specific guidelines for improving walkability in school environments. The research addresses three primary issues: (1) lack of priorities for walking schoolchildren in terms of pedestrian infrastructure and the surrounding environment, (2) hazardous existing traffic patterns, pedestrian behaviour, and safety infrastructure that contribute to road accidents, and (3) the non-existence of context-specific guidelines for pedestrian facilities and infrastructure provision for school zones. By using Shah Alam City, Malaysia, as a case study, a mixed-methods research design was employed. Data collection included questionnaire surveys with 400 primary schoolchildren aged 7 to 12 years across six schools, field observations of pedestrian infrastructure, and in-depth interviews with key stakeholders, involving representatives from government agencies, urban planning consultants, school staff, and parents. The study found that children's decisions to walk to school in Shah Alam were mainly influenced by age, gender, household income, and distance. Boys, older children, and those from lower-income families walked more often. Parental attitudes and perceived safety also shaped walking behaviour. Field observations revealed inadequate pedestrian infrastructure, including poor sidewalk continuity, limited crossings, and insufficient lighting, compromising safety. Overall, the findings indicate that children's walking behaviour is shaped by the interaction of socio-demographic characteristics, parental perceptions, and the quality of pedestrian infrastructure. Thus, safer environments, supportive parents, and improved facilities were identified as essential to encourage AST and guide child-focused urban planning. Based on the findings, qualitative insights verified the quantitative findings and highlighted gaps between the existing infrastructure and the needs of walking schoolchildren. Therefore, this study proposes context-specific guidelines for pedestrian facility planning, integrating international best practices and designed to fulfil the children's physical and cognitive needs. The research conducted has contributed to the academic discourse by filling contextual, methodological, and research gaps in the AST literature within an urbanisation context. Additionally, this study has significant practical implications for urban planning and transport policy. It aligns with the Quadruple Helix Model, engaging key stakeholders, including government, academia, industry, and community, to collaboratively promote physical activity through safer, healthier, and more walkable school environments. However, the study is limited to selected schools in Shah Alam and relies on cross-sectional data, which may restrict the generalisability of the findings.

ACKNOWLEDGEMENT

In the name of Allah, the Most Gracious and the Most Merciful.

Alhamdulillah, all praise is due to Allah SWT for blessing me and giving me the strength and opportunity to complete this PhD journey and research successfully. I want to express my sincere gratitude to everyone who supported me throughout the completion of this thesis. This work would not have been possible without their guidance, encouragement, and assistance.

First, I sincerely thank my thesis supervisor, Associate Professor Dr Na'asah Nasrudin, and my co-supervisor, Professor TPr Dr Yusfida Ayu Abdullah, for their invaluable guidance, expertise, and patience throughout this research journey. Their insights and constructive feedback were instrumental in shaping the direction and quality of this work. I am truly fortunate to have had the opportunity to learn from such dedicated mentors.

My sincere appreciation also goes to the postgraduate staff of the Faculty of Built Environment, Universiti Teknologi MARA (UiTM), especially Dr Farrah Zuhaira Ismail. Their continuous assistance, administrative support, and professionalism have greatly facilitated my progress throughout my PhD journey.

I would also like to acknowledge the organisations and individuals who contributed data, resources, or access to fieldwork sites, particularly representatives from multiple stakeholders, including those from federal technical agencies, local authorities, academia, school administrations, and parents. Also, appreciation was given to the six schools involved in the survey, namely Sekolah Kebangsaan Seksyen 7, Sekolah Kebangsaan Seksyen 17, Sekolah Kebangsaan Seksyen 19, Sekolah Kebangsaan Seksyen 24, Sekolah Kebangsaan Padang Jawa, and Sekolah Kebangsaan Jalan U3. Their cooperation and support were essential for this study.

On a personal note, I would like to express my heartfelt thanks to my family and friends, especially my beloved mother, Puan Hajjah [redacted], my husband, Mohd Naimuddin Mohd Naziruddin, my brother, Khairul Anuar Osman, and my close friend, Dr Siti Fatimah Hashim, for their unwavering support, encouragement, and understanding. Their belief in me motivated me, even during the most challenging times. I would also like to express my deepest love and appreciation to my two children, Alma Az-Zahrah and Ammar Yusuf, whose presence brought strength, joy, and meaning throughout my PhD journey.

Thank you to everyone who helped me achieve this milestone. I am genuinely grateful for the opportunity to pursue this research and look forward to contributing to the field in the future.

TABLE OF CONTENTS

	Page
CONFIRMATION BY PANEL OF EXAMINERS	ii
AUTHOR’S DECLARATION	iii
ABSTRACT	iv
ACKNOWLEDGEMENT	v
TABLE OF CONTENTS	vi
LIST OF TABLES	xiv
LIST OF FIGURES	xvii
LIST OF PLATES	xviii
LIST OF SYMBOLS	xxi
LIST OF ABBREVIATIONS	xxii
 CHAPTER 1 INTRODUCTION	 1
1.1 Research Background	1
1.2 Problem Statement	3
1.2.1 Infrastructural and Environmental Determinants of Walking to School	3
1.2.2 Contributing Factors to Pedestrian Accidents: Traffic Patterns, Pedestrian Behaviour, and Safety Infrastructure	5
1.2.3 Lack of Context-Specific Guidelines for Pedestrian Infrastructure in Primary School Zones	7
1.3 Research Gaps	9
1.3.1 Design and Policy Gap: Insufficient Policy-Guided Design Research	9
1.3.2 User Perspective Gap: Underrepresentation of Children’s and Parents’ Perspectives	9
1.3.3 Contextual Gap: Limited Evidence in the Malaysian Urban Contexts	10

1.3.4	Methodological Gap: Field Observation and In-Depth Interviews Conducted to Support the Study	11
1.3.5	Synthesis of Research Gaps and Study Positioning	11
1.4	Research Aim	12
1.5	Research Questions (RQs) and Research Objectives (ROs)	13
1.6	Research Scope	13
1.6.1	Factors Influencing Children’s Decision to Walk to School	13
1.6.2	Assessment of Pedestrian Infrastructure and Facilities in School Zones	14
1.6.3	Safety Conditions Affecting Walking Schoolchildren	15
1.6.4	Review of Existing Policies, Guidelines, and Design Standards for Pedestrian Infrastructure	16
1.7	Research Methodology	18
1.7.1	Introduction to Methodological Approach	18
1.7.2	Stages of the Study	19
1.7.3	Data Collection Methods	24
1.8	Significance of the Study	25
1.9	Limitations of the Study	28
1.10	The Structure of the Thesis	30
1.11	Summary	31
	CHAPTER 2 LITERATURE REVIEW	32
2.1	Introduction	32
2.2	Concept and Importance of Walking to School	33
2.2.1	Definition and Terminologies	33
2.2.2	Global Trends and Significance	34
2.2.3	Evolution of Active School Travel (AST): Global and Malaysian Context	35
2.2.4	Benefits of Active School Travel (AST) for Children	37
2.3	Theoretical Foundation of Active School Travel (AST)	40
2.3.1	Socio-Ecological Model (SEM)	40
2.3.2	Application of SEM in AST Studies	40
2.4	Children’s Independent Mobility (CIM)	43

2.4.1	Dimensions of CIM	43
2.4.2	Relationship Between CIM and Active School Travel (AST)	45
2.5	Theoretical Integration of the Social Ecological Model (SEM) and Children's Independent Mobility (CIM)	46
2.6	Key Factors Influencing Children in Walking to School	48
2.6.1	Demographic and Socio-economic Background	48
2.6.2	Built Environment Characteristics	56
2.6.3	Safety Factors and Risk Conditions	62
2.7	Critical Synthesis: Universal and Context-Specific Influencing Factors	64
2.7.1	Universal Predictors	65
2.7.2	Context-Specific Predictors	65
2.8	Policy and Planning Context	66
2.8.1	International Initiatives: Safe Routes to School (SRTS)	67
2.8.2	Malaysian Policy and Planning Framework	68
2.8.3	Critical Evaluation of Policy Implementation in Malaysia	69
2.8.4	Implications for Child Mobility Planning	70
2.9	Research Gap and Conceptual Framework Development	71
2.10	Summary	73
 CHAPTER 3 RESEARCH METHODOLOGY		74
3.1	Introduction	74
3.2	Research Design	75
3.2.1	Method Triangulation	76
3.3	Research Strategy	78
3.4	Conceptual Framework of Active School Travel (AST)	79
3.5	Research Framework	81
3.6	Case Study	83
3.6.1	The Practice of Sustainable City in Shah Alam	84
3.6.2	Rationale for Choosing Shah Alam City as the Case Study	86
3.7	Method of Data Collection	94
3.7.1	Pilot Survey	94
3.7.2	Questionnaire Survey	95
3.7.3	Field Observation	104

3.7.4	In-Depth Interview	106
3.7.5	Secondary Data Collection	109
3.8	Data Analysis Methods	110
3.8.1	Quantitative Data Analysis	110
3.8.2	Qualitative Data Analysis (In-depth interview)	111
3.8.3	Qualitative Data Analysis (Field Observation)	111
3.8.4	Data Triangulation and Integration	112
3.8.5	Summary of Analytical Techniques	113
3.9	Summary	113

CHAPTER 4 ANALYSIS OF DEMOGRAPHIC AND SOCIO-ECONOMIC FACTORS INFLUENCING CHILDREN'S WALKING TO SCHOOL

		114
4.1	Introduction	114
4.2	Socio-demographic Factors	115
4.2.1	Demographic Background of Respondents	115
4.2.2	Socio-economic Background of Parents or Guardian	117
4.2.3	Distribution of Respondents' Travel to School	120
4.3	The Relationship Between the Distribution of Respondents' Travel Patterns to School According to Demographic Background	122
4.3.1	The Association of Walking Frequency to School Based on Students' Demographic Background	122
4.3.2	The Association of Walking Distance Based on Students' Demographic Background	123
4.3.3	The Association of Mode of Transport to School Based on Students' Demographic Background	125
4.3.4	The Association of Companionship During Walk to School Based on Students' Demographic Background	127
4.4	The Relationship Between the Distribution of Respondents' Travel Patterns to School According to Socio-economic Background	128
4.4.1	The Association of Frequency of Parental Exercise Based on Socioeconomic Background	129

4.4.2	The Association of Mode of Transport to School Based on Socioeconomic Background	130
4.4.3	Summary of Significant Findings on Demographic and Socio-economic Factors Influencing Schoolchildren's Walking to School	132
4.5	Summary	134

CHAPTER 5 ASSESSMENT OF PEDESTRIAN INFRASTRUCTURE AND FACILITIES IN SCHOOL ZONES

5.1	Introduction	135
5.2	Evaluation of Pedestrian Infrastructure in School Zones	136
5.3	Findings by School	138
5.3.1	SK Seksyen 7	139
5.3.2	SK Seksyen 17	149
5.3.3	SK Seksyen 19	158
5.3.4	SK Seksyen 24	167
5.3.5	SK Padang Jawa	177
5.3.6	SK Jalan U3	185
5.4	Discussion	193
5.4.1	Walkway Width and Surface Quality	193
5.4.2	Crosswalks, Visibility and Safety	194
5.4.3	School Zone Infrastructure and Traffic Control	194
5.4.4	Ancillary Facilities: Lighting, Seating and Shelter	194
5.4.5	Accessibility and Inclusivity	195
5.4.6	Pedestrian Behaviour and Risk	195
5.4.7	Environmental and Land Use Context	195
5.4.8	Best Practice Schools in Pedestrian Planning and Infrastructure	198
5.5	Summary	200

CHAPTER 6 SAFETY FACTORS AFFECTING CHILDREN WALKING TO SCHOOL: A MULTI-DIMENSIONAL ANALYSIS

6.1	Introduction	201
6.2	Infrastructural Safety Factors	202

6.2.1	Pedestrian Infrastructure	203
6.2.2	Crossing Facilities	207
6.2.3	Traffic Conditions	209
6.2.4	Summary of Infrastructural Safety Findings	214
6.3	Environmental and Social Safety Factors	215
6.3.1	Street Lighting and Visibility	215
6.3.2	Perceived Crime and Security Threats	219
6.3.3	Summary of Environmental Safety Findings	221
6.4	Behavioural Safety Factors	222
6.4.1	Children's or Parents' Perception of Safety	222
6.4.2	Walking Supervision and Group Walking	224
6.4.3	Summary of Behavioural Safety Findings	226
6.5	Comparative Safety Assessment among Schools	226
6.6	Summary	228

CHAPTER 7 CHILD-SENSITIVE PLANNING AND DESIGN GUIDELINES FOR WALKABLE SCHOOL ZONES 229

7.1	Introduction	229
7.2	Objectives of the Framework and Guidelines	230
7.2.1	Improve Walkability and Safety for Schoolchildren	230
7.2.2	Promote Active Transport	231
7.2.3	Integrate Child-Friendly Urban Design Principles	231
7.3	Implementation Framework and Proposed Guidelines for Safe School Zone Pedestrian Infrastructure and Facilities: From Planning to Maintenance	232
7.3.1	Legal Policy and Current Guidelines	233
7.3.2	Guiding Principles	235
7.3.3	Proposed Guidelines	236
7.4	Stakeholder Roles and Responsibilities	240
7.5	Key Influencing Factors and Stakeholder Framework for Child-Friendly Walking Environments	242
7.6	Funding and Resource Allocation	243
7.6.1	Funding Sources from the Public Sector	243

7.6.2	Private Sector and Corporate Social Responsibility (CSR) Contributions	243
7.6.3	Community-Based Funding Initiatives	244
7.7	Policy Recommendations and Integration Strategies	244
7.8	Conclusion	246
 CHAPTER 8 CONCLUSION AND RECOMMENDATIONS		247
8.1	Introduction	247
8.2	Research Summary	247
8.2.1	Stage 1: Preliminary Study	247
8.2.2	Stage 2: Mixed Method of Data Collection	248
8.2.3	Stage 3: Data Analysis and Research Findings	249
8.2.4	Stage 4: Development of Framework, Guideline and Validation Process	249
8.3	Reflection of Objective Achievement	250
8.3.1	Research Objective 1: To analyse the demographic, socio-economic characteristics and built environment factors that influence children's decision to walk to or from school.	250
8.3.2	Research Objective 2: To assess the current provision and condition of pedestrian infrastructure and facilities in school zones.	251
8.3.3	Research Objective 3: To examine how environmental conditions, pedestrian behaviour, and infrastructure influence the safety of primary school children walking in Shah Alam.	252
8.3.4	Research Objective 4: To propose child-sensitive guidelines for effective pedestrian infrastructure and facility planning in school zones.	253
8.4	Research Contributions	254
8.4.1	Contributions to the Body of Knowledge	254
8.4.2	Practical Contributions for Urban Planners and Local Authorities	254
8.4.3	Contributions for School Administrators and Communities	254
8.4.4	Contributions for Policy Makers and Government Agencies	255
8.4.5	Methodological Contributions	255

8.5	Novelty of the Study	256
8.6	Implications for Planning and Policy	257
8.7	Recommendations for Future Research	258
8.8	Final Concluding Remarks	260
REFERENCES		261
APPENDICES		276
AUTHOR'S PROFILE		339

LIST OF TABLES

Tables	Title	Page
Table 1.1	Research Questions and Research Objectives	13
Table 2.1	Variables Included in the Questionnaire and Secondary Data Categorised by the Social Ecological Model (SEM)	41
Table 2.2	Level of Service (LOS) Conditions for Pedestrian Flow	58
Table 3.1	Socio-Economic Profile of State Constituencies (Kota Anggerik and Batu Tiga) Supporting School Site Selection in Shah Alam	88
Table 3.2	Table for Determining Sample Size from a Given Population	102
Table 3.3	Sample Size for each School	103
Table 3.4	Profile of the Stakeholders Involved in the Interview Sessions	107
Table 3.5	Summary of Data Collection Methods and Corresponding Data Analysis Techniques	112
Table 4.1	Demographic Background	115
Table 4.2	Socio-economic Background	118
Table 4.3	The Details of Walking to School	120
Table 4.4	The Relationship Between Age Group and Walking Frequency to School in a Week	122
Table 4.5	The Relationship Between Gender and Walking Frequency to School in a Week	123
Table 4.6	The Relationship Between Age Group and Walking Distance to School	123
Table 4.7	The Relationship Between Gender and Walking Distance to School	124
Table 4.8	The Relationship Between Age Group and Mode of Transport to School	125
Table 4.9	The Relationship Between Gender and Mode of Transport to School	126
Table 4.10	The Relationship Between Age Group and Companionship During Walk to School	127

Table 4.11	The Relationship Between Gender and Companionship During the Walk to School	128
Table 4.12	The Relationship Between Parental Education Level and Frequency of Parental Exercise	129
Table 4.13	The Relationship Between Parental Income and Frequency of Parental Exercise	129
Table 4.14	The Relationship Between Parental Employment Status and Frequency of Parental Exercise	130
Table 4.15	The Relationship Between Parental Income and Mode of Transport to School	130
Table 4.16	The Relationship Between Parental Employment Status and Mode of Transport to School	131
Table 4.17	The Significant Findings based on Demographic, Socio-economic Factors and Distribution of Respondents' Travel Patterns to School	132
Table 4.18	The Significant Findings based on Travel Patterns to School and their Demographic Background	133
Table 4.19	The Significant Findings Based on The Distribution of Respondents' Travel Patterns to School and Their Socioeconomic Background	134
Table 5.1	Assessment Criteria for Pedestrian Infrastructure Around Schools	136
Table 5.2	Assessment Criteria for Pedestrian Infrastructure Around Schools	197
Table 6.1	Safety Assessment Indicator for Walking Schoolchildren	202
Table 6.2	Preference to Walk on the Grass and Road rather than the Sidewalk	204
Table 6.3	Respondents' Views on the Ease of Walking to School without Facing Obstacles	204
Table 6.4	Respondents' Exposure to Personal Security Threats while Walking to or from School	220
Table 7.1	Current Policies, Legislation and Guidelines to refer to	233

Table 7.2	Proposed Child-Centric Guidelines for the Planning, Design, Monitoring, and Maintenance of Pedestrian Infrastructure in Primary School Zones	236
Table 7.3	Roles and Responsibilities of Key Stakeholders in Providing Pedestrian Facilities and Enhancing Pedestrian Safety in Primary School Zones	240
Table 7.4	Key Influencing Factors, Identified Issues, Strategic Framework Components, and Relevant Stakeholders for Enhancing Schoolchildren's Walking Environment in Shah Alam	242

LIST OF FIGURES

Figures	Title	Page
Figure 1.1	Relationship between the Research Aim, Problem Statements, Research Questions and Objectives, Scopes, and Expected Outcomes	17
Figure 1.2	Research Framework	23
Figure 1.3	Quadruple Helix Model	25
Figure 1.4	The Chapter Sequence in Thesis	30
Figure 3.1	Triangulation Method Applied in the Study	76
Figure 3.2	Conceptual Framework for Understanding the Influencing Factors on Children's Walking to School	80
Figure 3.3	Research Framework	82
Figure 3.4	Location Map of Shah Alam, the Study Area	84
Figure 3.5	Map of Shah Alam indicating the Locations of All Selected Schools, with Distance Markers from SACC	90
Figure 3.6	Land Use Map Showing the Spatial Distribution of Selected Primary Schools in Shah Alam Study Area	92
Figure 3.7	Sample Size Calculation Using Raosoft Sample Size Calculator	102
Figure 6.1	Perception of Drivers Exceeding Speed Limits in School Zones	213
Figure 6.2	Perceptions of the Adequacy of Lighting and Visibility on	218
Figure 6.3	Respondents' Agreement Levels on Parental Support for Walking to School	223
Figure 6.4	Distribution of Walking Companions among Respondents (N=400)	224

LIST OF PLATES

Plates	Title	Page
Plate 5.1	Main Entrance of SK Seksyen 7	139
Plate 5.2	Pedestrian Network: SK Seksyen 7	140
Plate 5.3	Well-Designed Pedestrian Walkway at SK Seksyen 7	140
Plate 5.4	Curb Ramp Enhancing Accessibility at SK Seksyen 7	141
Plate 5.5	Obstructions from Trees and Street Furniture at SK Seksyen 7	141
Plate 5.6	Marked Crosswalk Near School Entrance at SK Seksyen 7	142
Plate 5.7	Speed Hump for Vehicle Speed Reduction at SK Seksyen 7	142
Plate 5.8	Flashing Light Installed (Non-functional) at SK Seksyen 7	143
Plate 5.9	Drop-off Zone Adjacent to Bus Stop at SK Seksyen 7	143
Plate 5.10	Bus Stops Positioned on Both Sides at SK Seksyen 7	144
Plate 5.11	School Zone Signage Present at SK Seksyen 7	144
Plate 5.12	Dedicated and Street Lighting at SK Seksyen 7	145
Plate 5.13	Seating and Resting Spots at SK Seksyen 7	145
Plate 5.14	Covered Walkways at SK Seksyen 7	146
Plate 5.15	Students Using Designated Walkways at SK Seksyen 7	146
Plate 5.16	Slow Traffic Flow Observed During Morning (7:00 am) and Afternoon (1 pm) Peak Hours Near SK Seksyen 7	147
Plate 5.17	Slow Traffic Volume Observed During Peak Hours at SK Seksyen 7	148
Plate 5.18	Main Entrance of SK Seksyen 17	149
Plate 5.19	Pedestrian Network and Surrounding Land Use: SK Seksyen 17	150
Plate 5.20	Narrow Pedestrian Pathway at SK Seksyen 17	150
Plate 5.21	Poor Surface Condition of School Walkway at SK Seksyen 17	151
Plate 5.22	Obstructions Blocking Pedestrian Flow at SK Seksyen 17	152
Plate 5.23	Marked Crosswalk Near School Entrance at SK Seksyen 17	152
Plate 5.24	Pedestrian Signal with Push Button at SK Seksyen 17	153
Plate 5.25	Speed Hump for Traffic Calming at SK Seksyen 17	153
Plate 5.26	Unclear Signage at SK Seksyen 17	154

Plate 5.27	Two-Way Bus Stops at SK Seksyen 17	154
Plate 5.28	Street Lighting at SK Seksyen 17	155
Plate 5.29	Limited Seating and Shelter at SK Seksyen 17	155
Plate 5.30	Lack of Fencing at SK Seksyen 17	156
Plate 5.31	Traffic Flow Observed During Morning (7:00 am) and Afternoon (1 pm) Peak Hours Near SK Seksyen 17	157
Plate 5.32	Main Entrance of SK Seksyen 19	158
Plate 5.33	Narrow Walkways at SK Seksyen 19	159
Plate 5.34	Damaged and Poorly Maintained Pedestrian Surface at SK Seksyen 19	159
Plate 5.35	Pedestrian Network and Surrounding Land Use: SK Seksyen 19	160
Plate 5.36	Obstructions at SK Seksyen 19	160
Plate 5.37	Faded Crosswalk Markings at SK Seksyen 19	161
Plate 5.38	Speed Hump for Traffic Calming at SK Seksyen 19	162
Plate 5.39	Basic School Zone Signage at SK Seksyen 19	163
Plate 5.40	Shared Drop-off and Bus Stop Area at SK Seksyen 19	163
Plate 5.41	One-Way Bus Stop at SK Seksyen 19	164
Plate 5.42	Limited Seating with No Shade at SK Seksyen 19	164
Plate 5.43	Traffic Flow Observed During Morning (7:00 am) and Afternoon (1 pm) Peak Hours Near SK Seksyen 19	166
Plate 5.44	Main Entrance of SK Seksyen 24	167
Plate 5.45	Pedestrian Network and Surrounding Land Use: SK Seksyen 24	168
Plate 5.46	Wide and Continuous Pedestrian Walkway at SK Seksyen 24	168
Plate 5.47	Non-Compliant Curb Ramp at SK Seksyen 24	168
Plate 5.48	Visual Obstructions at SK Seksyen 24	169
Plate 5.49	Faded Crosswalk Markings at SK Seksyen 24	170
Plate 5.50	Speed Hump for Traffic Calming at SK Seksyen 24	170
Plate 5.51	Damaged and Inadequate School Signage at SK Seksyen 24	171
Plate 5.52	Drop-off Zone Adjacent to Bus Stop at SK Seksyen 24	171
Plate 5.53	Dual Bus Stops at SK Seksyen 24	172
Plate 5.54	General Street Lighting at SK Seksyen 24	173
Plate 5.55	Seating and Resting Spot at SK Seksyen 24	173

Plate 5.56	Sheltered Walkway at SK Seksyen 24	173
Plate 5.57	Traffic Flow Observed During Morning (7:00 am) and Afternoon (1 pm) Peak Hours Near SK Seksyen 24	176
Plate 5.58	Main Entrance of SK Padang Jawa	177
Plate 5.59	Narrow Walkways at SK Padang Jawa	178
Plate 5.60	Pedestrian Network and Surrounding Land Use: SK Padang Jawa	178
Plate 5.61	Informal Vendors and Bus Stops at SK Padang Jawa	179
Plate 5.62	Marked Crosswalk at SK Padang Jawa	180
Plate 5.63	Speed Hump at SK Padang Jawa	180
Plate 5.64	Damaged Signage at SK Padang Jawa	181
Plate 5.65	Narrow Bus Stop Lacking Lay-by Area at SK Padang Jawa	181
Plate 5.66	Street Lighting at SK Padang Jawa	182
Plate 5.67	Seating Area at SK Padang Jawa	182
Plate 5.68	Shaded Walkway at SK Padang Jawa	182
Plate 5.69	Traffic Flow Observed During Morning (7:00 am) and Afternoon (1 pm) Peak Hours Near SK Padang Jawa	184
Plate 5.70	Main Entrance of SK Jalan U3	185
Plate 5.71	Pedestrian Walkway at SK Jalan U3	186
Plate 5.72	Pedestrian Network and Surrounding Land Use: SK Jalan U3	186
Plate 5.73	Hazardous Obstruction at SK Jalan U3	187
Plate 5.74	Clear Crosswalk Near Entrance at SK Jalan U3	187
Plate 5.75	Speed Hump Reducing Vehicle Speed at SK Jalan U3	188
Plate 5.76	Properly Posted Speed Limit at SK Jalan U3	188
Plate 5.77	Bus Stop Cum Drop-off Area at SK Jalan U3	189
Plate 5.78	Street Lighting at SK Jalan U3	190
Plate 5.79	Shade and Shelter at SK Jalan U3	190
Plate 5.80	Traffic Flow Observed During Morning (7:00 am) and Afternoon (1 pm) Peak Hours Near SK Jalan U3	192
Plate 6.1	Narrow Sidewalk at SK Padang Jawa	205
Plate 6.2	Street Furniture that Blocks the Pathway	206
Plate 6.3	Inexistence of Dedicated Lighting for the Pedestrian Walkway at SK Seksyen 7 and SK Seksyen 17	216

LIST OF SYMBOLS

Symbols

n	Sample size
N	Number of total populations
%	Percentage
OR	Odds Ratio
p	p-value

LIST OF ABBREVIATIONS

Abbreviations

AAP	American Academy of Paediatrics
ACS	Active Commuting to School
AST	Active School Travel
ATJ	Arahan Teknik Jalan
CIM	Children's Independent Mobility
COVID-19	Coronavirus Disease 2019
EPU	Economic Planning Unit
eRAS	e-Research Approval System
GIS	Geographic Information System
HBSC	Health Behaviour in School-aged Children
JKR	Jabatan Kerja Raya
JPNS	Jabatan Pendidikan Negeri Selangor
LCC	Low Carbon City
MBSA	Majlis Bandaraya Shah Alam
M-CAT	Model of Children's Active Travel
MCO	Movement Control Order
MIROS	Malaysian Institute of Road Safety Research
MKJR	Majlis Keselamatan Jalan Raya
MOE	Ministry of Education

MOT	Ministry of Transport
MVPA	Moderate to Vigorous-intensity Physical Activity
NGO	Non-Governmental Organisation
NPP-4	National Physical Plan 4
NTP	National Transport Policy
NUP-2	National Urbanisation Policy 2
PA	Physical Activity
PASTA	Physical Activity through Sustainable Transport Approaches
PPP	Public-Private Partnership
PTAs	Parent-Teacher Associations
REC	Research Ethics Committee
RO	Research Objective
RQ	Research Question
SACC	Shah Alam City Council
SDGs	Sustainable Development Goals
SEM	Socio-Ecological Model
SES	Socio-Economic Status
SK	Sekolah Kebangsaan
SRTS	Safe Routes to School
STP	School Travel Plan
TOD	Transit-Oriented Development
UiTM	Universiti Teknologi MARA

UBBL	Uniform Building By-Laws 1984
UMK	Universiti Malaysia Kelantan
US	United States
VLR	Voluntary Local Review
WHO	World Health Organisation
13MP	13th Malaysia Plan

CHAPTER 1

INTRODUCTION

1.1 Research Background

Travelling to school accounts for a significant share of daily trips in most urban areas and forms a habitual pattern that may influence transportation choices in adulthood (Muromachi, 2017). When a behaviour becomes habitual, it becomes relatively automatic and receives less cognitive attention. In many countries, including Malaysia, this has led to a significant reliance on private vehicles for school transportation. Such dependency contributes to adverse urban outcomes, including traffic congestion, higher travel costs, longer travel times, environmental degradation, and a greater risk of road accidents (Ferdaus et al., 2025).

In contrast, Active School Travel (AST), particularly walking and cycling, offers a sustainable and health-enhancing alternative. Walking is categorised as a form of physical activity and is widely recognised for its benefits in improving children's health and wellbeing (Uddin et al., 2019). The World Health Organisation (WHO) recommends that children aged 5 to 17 years engage in at least 60 minutes of moderate-to-vigorous-intensity physical activity (MVPA) daily (Hawley et al., 2019; Tewahade et al., 2019). Active travel to school contributes significantly to achieving this goal (Delice et al., 2019). Strong evidence suggests that children who use active transportation are more physically active than those who rely on passive modes such as private vehicles or buses (Uddin et al., 2019). A recent longitudinal study conducted in Japan by Sasayama (2025) further supports this, indicating that travelling to and from school on foot accounted for 39-40% of children's daily MVPA, highlighting the critical role of AST in sustaining healthy activity levels among children.

However, the participation rate in AST remains low across many countries, including Malaysia. Most schoolchildren in Malaysia are chauffeured to school by car or bus, raising concerns about declining physical activity among youth. This is supported by a survey conducted by the Malaysian Institute of Road Safety Research (2020) that covered 5,426 parents in Selangor. It was found that 41% of students commute by car, 27% by school bus or van, and only 10% walk or cycle to school. The Twelfth Malaysia Plan (2021-2025) notes that while progress has been made in

promoting sports and active living, the general participation rate in mass sports remains moderate, rising only slightly from 59.8% in 2017 to 63% in 2020 (Economic Planning Unit, 2021). This modest increase is hindered by factors such as poor time management, sedentary lifestyles, and a lack of awareness about the importance of an active lifestyle.

Sedentary lifestyles are increasingly common among Malaysians, primarily due to a growing reliance on motorised transport for short daily trips, including school travel. This shift is partly driven by the perception that cars offer convenience and time savings. Additionally, schoolchildren often prefer less physically demanding routines, such as being chauffeured, which further reduces their daily physical activity. Guzauskas & Sukys (2019) highlight that a lack of time, heavy academic loads, low motivation to exercise, and an unsupportive school environment are key barriers to children's physical activity. Recent work by Ibrahim et al. (2024) emphasises that although the walking environment around Malaysian schools is often conducive to independent mobility practice, parental mindsets in Malaysia typically limit children's independent mobility. This underscores the pivotal role of social attitudes in shaping school travel behaviours among schoolchildren.

Moreover, the lack of safe, accessible, and efficient walking infrastructure can foster negative attitudes toward active commuting. Safety concerns, especially from parents, remain a persistent deterrent to walking to school. Perceived mediators such as traffic safety, neighbourhood safety, and proximity to school remain consistent predictors of children's likelihood of engaging in AST, underscoring the need for built environment interventions to mitigate parental safety concerns (Wangzom et al., 2023). Likewise, a recent multi-country analysis by Timperio et al. (2025) revealed that parental perceptions, including walkability, traffic safety, and pedestrian infrastructure, are consistently associated with adolescents' active transport to school. This indicates the influence of socio-ecological factors beyond the local context. Promoting active transport not only enhances health but can also alleviate traffic-related and environmental issues tied to car dependency.

Over the past few years, researchers in high-income Western countries have examined various barriers to AST, including extended distances, unsafe environments, and negative parental perceptions. However, most of these studies have been conducted in Western, industrialised countries. Research on this topic remains limited in upper-middle-income countries, including Malaysia. In particular, few studies have explored in depth the specific factors influencing children's decision to walk to school in the

Malaysian context. Recent evidence suggests that AST behaviours are complex, with multiple interacting factors varying by context. These factors span across socio-ecological domains, including individual, social, environmental, and policy-level influences (Hawley et al., 2019). A better understanding of these context-specific determinants is crucial for addressing the challenges and opportunities in promoting AST.

Given this gap, the present study aims to investigate the factors influencing children's decisions to walk to school in selected areas of Shah Alam, Malaysia. By incorporating the perspectives of schoolchildren and their parents, supported by assessments of pedestrian facilities in the site area through field observations, and obtaining views and perceptions from various stakeholders, these concerns highlight the need to understand better the underlying factors of how demographic and socio-economic characteristics, the built environment, and safety concerns influence children's decisions to walk to school. Without a clear understanding of these determinants, urban planners and policymakers may struggle to design effective interventions to promote safer, more walkable school environments. Furthermore, this study highlights the potential of urban planning strategies to support more active, healthier school travel practices in Malaysian cities.

1.2 Problem Statement

Generally, people have been walking less over the last few decades due to car-friendly city design and a lack of pedestrian-friendly environments, including incomplete or poorly maintained sidewalks and footpaths. This study identifies three key issues regarding active school transport, as elaborated in the following section. There is increasing concern that the following issues are detrimental.

1.2.1 Infrastructural and Environmental Determinants of Walking to School

When providing pedestrian facilities, government agencies and consultants must consider various aspects to ensure they are inclusive, accessible, and functional for all users. Pedestrian walkways must be adequately designed to facilitate walking and crossing the road. According to the NZ Transport Agency (2009), pedestrians can be grouped into three categories: those on foot, those with small wheels, and those with

mobility impairments. Infrastructure should therefore be designed to accommodate these diverse users. The lack of appropriate facilities often limits movement and discourages walking.

In Malaysia, pedestrian needs are often given low priority. Road widening for vehicles has reduced pedestrian space, resulting in narrow walkways that discourage walking (Muhammad, 2015). In some cases, walkways are shared with other road users, causing pedestrians to avoid designated paths and increasing the risk of conflict, particularly during peak hours. This issue is also prevalent in Selangor, where evaluations of school zones reveal inadequately marked crossings and frequent traffic conflicts, compromising the safety of schoolchildren walking to school (Shabadin et al., 2022).

Inadequate infrastructure, such as the absence of continuous sidewalks, poorly located or inaccessible pedestrian crossings, and limited amenities, can make walking uncomfortable, especially for schoolchildren. These issues are compounded by poorly maintained roads, limited shading, and insufficient pedestrian-supportive elements, such as seating areas. According to Patel et al. (2025), the walkability concept emphasises physical design features, such as sidewalks, shade, crossings, and street connectivity, which significantly influence one's likelihood of walking, whether for everyday needs or school travel.

The surrounding environment also influences children's willingness to walk. Many Malaysian schools are located near high-traffic areas, such as bus stations, petrol stations, and commercial zones, which contribute to congestion. According to Muhammad (2015), adjacent land use, such as residential areas or rural road layouts with sharp corners and poor conditions, also affects the feasibility of walking. This is supported by research findings from the U.S. that show that the qualities of school walk zones, such as landscape buffers and reduced traffic, are positively associated with walking to school (Kweon et al., 2023). Moreover, interventions that promote active commuting in specific locations, such as the "walking school bus," indicate that attributes like street connectivity and mixed land use significantly increase children's MVPA and active commuting rates, even when basic crossing infrastructure remains constant (Oreskovic et al., 2014).

Inadequate pedestrian infrastructure and unfavourable environmental conditions can discourage children from walking to school and increase their exposure to traffic risks. These issues are partly attributed to the absence of child-sensitive design

considerations in the planning of pedestrian facilities. Although general pedestrian infrastructure standards exist, they are primarily developed for adult users and do not sufficiently account for children's physical characteristics, walking behaviour, and safety needs. Consequently, pedestrian facilities around schools often fail to provide safe, comfortable, and accessible walking routes for children.

1.2.2 Contributing Factors to Pedestrian Accidents: Traffic Patterns, Pedestrian Behaviour, and Safety Infrastructure

Beyond infrastructure and environmental factors, traffic conditions and pedestrian behaviour are critical elements influencing the safety of schoolchildren walking to school. In Malaysia, schools in urban areas pose greater risks to pedestrian safety than those in rural areas, mainly due to the high volume of vehicles and limited space (Muhammad, 2015). During peak hours, when schoolchildren travel to and from school, pedestrians often walk along the roadside, increasing their exposure to fast-moving traffic and the potential for road accidents.

Several traffic-related factors contribute directly to pedestrian risk. High vehicle speeds, in particular, are associated with increased accident severity and likelihood. Implementing traffic calming measures, such as speed bumps, reduced speed zones, and school zone signage, can significantly reduce risks near schools. For example, in New York City, physical interventions such as speed humps and turn-traffic calming layouts have been shown to reduce the likelihood of pedestrian injuries by 16% and fatalities by up to 80% (Roberts et al., 2024). Similarly, Taipei's initiative to paint green pedestrian paths, install speed limit markings, and establish parking zones led to a 5% decline in daytime traffic accidents and an 8% reduction in injuries (F. Y. Huang & Huang, 2025).

Heavy traffic congestion, especially at school gates, creates unsafe conditions for children attempting to cross streets or navigate intersections. In many cases, the absence of functional safety features, such as designated crosswalks, traffic signals, or pedestrian barriers, further exacerbates these risks. According to Shabadin et al. (2022), school zone crashes remain a concern in Malaysia, primarily influenced by road type and pedestrian volume, which significantly affect the risk of conflicts near schools.

Pedestrian behaviour also plays a pivotal role in road safety outcomes. According to the police data cited in *The Star*, Zolkepli et al. (2013) stated that

pedestrian fatalities ranked third among total road accident deaths, with an average of 562 pedestrian deaths annually. Children made up nearly 40% of these casualties, primarily in the age group of 6 to 10 years. Common behavioural factors contributing to these fatalities include jaywalking, crossing busy roads without designated crossings, and unpredictable pedestrian movement, such as sudden entry into traffic. These behaviours are especially prevalent among children, who may lack the judgment and experience to assess traffic situations accurately. The Ministry of Transport also reports that pedestrian fatalities ranked third (after motorcyclists and car drivers) and averaged 542 annually over the 2006–2017 period, showing little sign of decline (Ministry of Transport Malaysia, n.d.).

Additionally, local studies revealed that fewer than 30% of children aged 7 to 9 demonstrate safe pedestrian behaviours, such as wearing bright clothing or walking with their faces toward oncoming traffic. Meanwhile, some children still engage in hazardous activities, such as darting between parked vehicles or wearing dark clothing at night (Fin et al., 2019). As stated by Nasrudin et al. (2023), a model-based study conducted in Shah Alam indicates that both traffic conditions and human behavioural factors significantly affect pedestrians' decisions to cross the street.

The lack of proper pedestrian safety features further compounds the issue. Many school zones lack clear signage, faded markings, inadequate road lighting, and safety mirrors and barriers to guide pedestrian movement. Without these critical features, drivers may not be adequately alerted to the presence of pedestrians, and children may be unsure of where or how to cross roads safely.

While traffic conditions and pedestrian behaviour significantly influence pedestrian safety, the effectiveness of safety measures largely depends on the presence of well-designed and clearly implemented infrastructure. In many Malaysian school zones, safety features such as visible crossings, traffic calming devices, and child-oriented signage are either inconsistent or insufficient. This situation reflects the broader absence of comprehensive design guidelines that specifically address the safety needs of children as pedestrians. Without structured and child-sensitive planning standards, it becomes difficult to ensure the consistent implementation of effective safety measures around primary schools.

1.2.3 Lack of Context-Specific Guidelines for Pedestrian Infrastructure in Primary School Zones

In Malaysia, the planning and provision of pedestrian facilities around primary schools are not guided by dedicated, child-specific standards. Existing infrastructure is generally developed according to broad frameworks such as the Uniform Building By-Laws 1984 (UBBL), which are not tailored to school environments or the specific needs of children. This lack of targeted guidelines results in inconsistencies in pedestrian infrastructure, particularly in school zones, where age-appropriate design considerations are often overlooked.

The absence of formal, school-focused guidelines raises concerns regarding safety, accessibility, and walkability. Unlike adults, children exhibit distinct walking characteristics, including shorter stride lengths, reduced visibility, and lower traffic awareness. However, current planning practices often ignore these aspects, resulting in sidewalks that are too narrow, discontinuous walking paths, and pedestrian facilities shared with other road users. These conditions are already highlighted in the broader infrastructure concerns discussed earlier.

Moreover, without proper design standards, critical features such as safe crossings, traffic calming measures, and accessible routes for children with disabilities are either inadequate or absent altogether. This creates unsafe walking environments and limits the inclusivity of pedestrian facilities.

The lack of clear, context-sensitive planning frameworks for school pedestrian zones hampers planners' and local authorities' ability to implement consistent, safe, and child-friendly environments. As a result, children walking to school are frequently exposed to unsafe conditions that could be mitigated by implementing proper design standards. However, recent policy advancements in Malaysia show a positive indication. In 2024, the government decided to reduce the default speed limit in school zones from 40 km/h to 30 km/h and introduce new traffic calming measures, including speed bumps and raised crossings. These measures align with global road safety standards (World Health Organisation, 2024) and are part of Malaysia's National Road Safety Action Plan 2022-2030.

Additionally, the Malaysian NGO coalition MKJR's "Safe School Zone" initiative is dedicated to actively promoting child-sensitive school zone infrastructure (Majlis Keselamatan Jalan Raya Malaysia, n.d). The recommendations include well-

marked pedestrian crossings, clear warning signage, traffic calming measures, enhanced lighting, and safer drop-off areas, all designed to meet the safety needs of primary schoolchildren.

According to the AIP Foundation (2025), globally, practitioner-oriented guidelines, such as the “Safe School Zones Guide,” offer multifaceted recommendations for enhancing safety, particularly in school zones. These ideas encompass traffic management, pedestrian infrastructure, and stakeholder engagement, serving as valuable design references that can be adapted for local contexts.

To ensure safe and inclusive pedestrian infrastructure, there is an urgent need to establish formal guidelines tailored explicitly to primary school zones. These guidelines should consider children’s physical, cognitive, and behavioural characteristics, supporting not only safer journeys but also the broader goal of promoting AST in Malaysian cities.

A study conducted by Ibrahim et al. (2024) suggested that practical recommendations, including spatial guidelines for school selection and walking distances, are feasible within the context of local planning in Malaysia. The study’s findings highlight that key destinations for schools should ideally be located within 400 to 450 meters (approximately a 5-minute walk) of residential areas, thereby promoting AST among children.

1.3 Research Gaps

The preliminary review of the literature reveals several critical limitations in existing studies on AST, particularly regarding children's walking behaviour. These gaps highlight the need for a more comprehensive, context-sensitive, and methodologically integrated approach, especially within the Malaysian urban context.

1.3.1 Design and Policy Gap: Insufficient Policy-Guided Design Research

In Malaysia, although general standards for pedestrian infrastructure are outlined in the Uniform Building By-Laws 1984 (UBBL) and urban planning regulations, there is a notable absence of specific guidelines tailored to children's walking characteristics. Based on observations, most pedestrian facilities in Malaysia are designed with an emphasis on adult users, overlooking children's physical, cognitive, and behavioural differences, such as limited visibility, lower risk awareness, and shorter walking distances. Additionally, safety features such as child-height signage, traffic calming devices, and secure crossing zones are inconsistently implemented, particularly in areas surrounding primary schools.

The lack of child-centric design guidelines for pedestrian facilities contributes to a serious risk and limits the potential of walking as a safe and sustainable mode of school travel. Furthermore, there is limited research that translates empirical findings into actionable planning and design guidelines for policymakers and practitioners.

Therefore, a significant gap exists in the development of context-specific, child-centred planning frameworks that integrate safety, accessibility, and behavioural considerations into the design of pedestrian infrastructure in school environments.

1.3.2 User Perspective Gap: Underrepresentation of Children's and Parents' Perspectives

The underrepresentation of children's and parents' perspectives on active commuting to school is another major shortcoming in previous research. Most studies are based on planning assumptions or expert viewpoints, overlooking the lived experiences of those directly affected. Individuals, particularly children, have different perceptions of distance, safety, and the environment than adults, and their insights are

essential for identifying real-world barriers. Furthermore, those children with disabilities or mobility impairments are often excluded entirely from the planning of pedestrian facilities provision. Thus, there is a pressing need to incorporate user-centred data collection that reflects the daily challenges faced by walking schoolchildren in urban areas, particularly in Malaysia.

Also, the study prioritises user perspectives by considering the voices of schoolchildren and their parents, who are commonly underrepresented as subjects in transport planning. Addressing this gap requires incorporating the voices and experiences of children and parents to develop a more inclusive, realistic, and human-centred understanding of school travel behaviour.

1.3.3 Contextual Gap: Limited Evidence in the Malaysian Urban Contexts

The existing literature on children's walking behaviour and pedestrian safety has primarily focused on high-income Western countries, where urban design, transportation policies, and socio-cultural norms differ significantly from those in developing or upper-middle-income contexts, such as Malaysia. For example, studies conducted in Europe, North America, and Australia often focus on advanced urban mobility systems and pedestrian infrastructure that do not currently reflect local conditions in Malaysian cities, which are characterised by car-oriented planning, different parental attitudes toward safety, and varying levels of pedestrian infrastructure provision. Furthermore, in the Malaysian context, there have been limited studies examining the key factors influencing children's walking decisions, raising concerns about the direct applicability of global findings to local settings. Thus, this underscores the need for place-specific research, such as that being conducted by the researcher in this study.

This lack of localised empirical evidence creates a critical gap in understanding how context-specific factors such as socio-cultural norms, urban form, and policy environments shape children's walking behaviour in Malaysia. Therefore, there is a need for place-based research that reflects the realities of Malaysian urban environments, particularly in rapidly developing cities such as Shah Alam.

1.3.4 Methodological Gap: Field Observation and In-Depth Interviews Conducted to Support the Study

Previous studies on children walking to school have typically relied heavily on secondary data and questionnaire-based approaches, often neglecting direct physical evaluation of pedestrian infrastructure and real-time observational data. This study also considers stakeholders' perspectives. This results in a limited understanding of the actual conditions and usability of facilities provided, such as sidewalks, crossings, signage, and other ancillary facilities installed near school zones. As a result, the lack of in-depth field observation and stakeholder engagement limits the depth of analysis, particularly in assessing infrastructure usability, safety conditions, and environmental barriers. This methodological limitation results in a fragmented understanding of the interaction between the built environment, behaviour, and safety.

To address this gap, the researcher used a mixed-methods approach, combining quantitative and qualitative data from multiple data collection methods to produce comprehensive and reliable findings.

1.3.5 Synthesis of Research Gaps and Study Positioning

Collectively, the above research gaps indicate that current research on children's walking to school lacks policy applicability, a user-centred perspective, contextual relevance, and methodological integration within the Malaysian setting. The studies conducted tend to examine factors in isolation rather than to understand the complex interactions among all factors.

Besides, it was notable that limited attention has been given to translating research findings into practical planning guidelines to support decision-making among urban planners, local authorities, and policymakers. In response to these, this study adopts a mixed-methods approach to investigate children's walking behaviour in Shah Alam, Malaysia, integrating quantitative analysis, field observations, and stakeholder perspectives to provide a comprehensive understanding of the factors influencing children's walking to school. Also, the study aims to bridge the gap between research and practice by proposing child-sensitive planning and design guidelines to create safer, more walkable school environments.

These gaps are systematically addressed across the subsequent chapters of this thesis as presented in the following table.

Table 1.1
Alignment of Identified Research Gaps with Thesis Chapters

Gap	Chapter	Aspects
Contextual Gap	Chapter 4	Socio-demographic and behavioural determinants
Methodological Gap	Chapter 5	Evaluation of pedestrian infrastructure conditions
	Chapter 6	Analysis of safety factors
Safety and Behavioural Gap	Chapter 6	
Policy / Design Gap	Chapter 7	Develops a child-centred planning framework and design guidelines

1.4 Research Aim

This study aims to assess factors influencing children's walking to school and to propose child-sensitive pedestrian safety guidelines for primary school zones. A key factor influencing children's decision to walk to school was examined, and an evaluation of the safety conditions of walking environments in school zones in Shah Alam, Malaysia, was conducted to support the development of child-sensitive pedestrian planning guidelines.

1.5 Research Questions (RQs) and Research Objectives (ROs)

The thesis aims to unravel several research questions and objectives. In particular, this thesis will examine four main research questions, which are narrowed down to research objectives and presented in Table 1.2.

Table 1.2
Research Questions and Research Objectives

Research Question	Research Objective
RQ1: What are the demographic and socio-economic characteristics and built environment factors that influence children's decisions to walk to or from school?	RO1: To examine the demographic and socio-economic characteristics and built environment factors that influence children's decision to walk to or from school.
RQ2: What is the current condition and availability of pedestrian infrastructure and facilities around selected school zones?	RO2: To analyse the current provision and condition of pedestrian infrastructure and facilities in school zones.
RQ3: How do environmental conditions, pedestrian behaviour, and infrastructural factors affect the safety of schoolchildren walking to and from school in Shah Alam?	RO3: To evaluate how environmental conditions, pedestrian behaviour, and infrastructure influence the safety of primary school children walking in Shah Alam.
RQ4: What key factors should be considered in developing child-sensitive pedestrian infrastructure guidelines for school zones?	RO4: To formulate child-sensitive guidelines for the planning and design of pedestrian infrastructure in school zones based on identified key factors.

1.6 Research Scope

This study adhered to the research scope to achieve the previously set research aim and objectives. The descriptions below provide detailed explanations of each research scope.

1.6.1 Factors Influencing Children's Decision to Walk to School

The increasing concern over children's physical activity levels has underscored the importance of active commuting, particularly walking to school. Understanding the factors that influence children's walking decisions is crucial for promoting healthier lifestyles and enhancing community well-being, especially among schoolchildren. This research examines the key factors that influence children's walking habits, focusing on three primary areas: (i) demographic and socio-economic background, (ii) built environmental factors, and (iii) safety factors.

Demographic and socio-economic background significantly influence children's walking to school. Key demographic variables, such as age, gender, race, and socio-economic status, include household income, parental employment, and educational levels, which shape children's commuting choices. It is essential to understand the factors that influence the development of targeted interventions to promote walking habits among children from diverse socio-economic backgrounds.

Additionally, the built environment plays a significant role in determining children's likelihood of walking to school. Key aspects such as the availability and quality of sidewalks, along with the proximity to schools, are vital in establishing safe walking conditions for children. Safety factors were also considered, as they are crucial in determining whether children walk to school. In this regard, the researcher will examine how traffic patterns, pedestrian behaviour, and pedestrian infrastructure affect the safety of walking schoolchildren.

This scope will be discussed in detail in Chapters 4, 5 and 6, where multiple data collection methods will also be applied. Examining these factors is vital for creating supportive infrastructures and facilities that encourage active commuting to school.

1.6.2 Assessment of Pedestrian Infrastructure and Facilities in School Zones

Pedestrian infrastructures and facilities are another crucial scope to consider in this study. For this study, the researcher observed and assessed the condition of pedestrian infrastructure and facilities at several primary schools in Shah Alam. These elements will be considered in the built environment, including the availability of sidewalks, the existing condition of pedestrian facilities, the surrounding physical environment, and the overall walking environment.

Pedestrian infrastructure and facilities provision refer to the planning, design, construction, and maintenance of infrastructure and amenities that support safe and convenient pedestrian travel. All these facilities are essential for promoting walking to school as a mode of transportation, enhancing pedestrian safety, and creating pedestrian-friendly environments in school zones. Some critical components of pedestrian infrastructure and facility provision include sidewalks and footpaths, crosswalks and pedestrian crossings, traffic calming measures, street lighting, shade and shelter, seating and rest areas, wayfinding signage, accessibility features, and, lastly, maintenance and upkeep.

By analysing current provisions and identifying gaps in existing facilities, this study will contribute to the development of a comprehensive standard guideline to enhance walkability for people, particularly schoolchildren. Overall, adequate provision of pedestrian infrastructure and facilities plays a crucial role in encouraging children to walk to school, promoting active transportation, creating walkable communities, enhancing public health, and improving students' quality of life.

Thus, collaboration among urban planners, transportation engineers, policymakers, stakeholders, and advocacy groups is essential to prioritise the needs of pedestrians, particularly schoolchildren, and to implement pedestrian-friendly design principles in the built environment.

1.6.3 Safety Conditions Affecting Walking Schoolchildren

The safety of schoolchildren walking to school is a critical concern in urban environments. Understanding the safety factors that influence children's walking habits is paramount as they increasingly use active transportation to school. In addition to studying demographic and built environment factors that affect children's decisions to walk to school, this research focuses on schoolchildren's safety while walking, examining the various elements that may contribute to their safety during active commuting.

Based on the research findings, actionable recommendations will be proposed to enhance the safety of walking schoolchildren, particularly in Malaysia. These may include enhancing pedestrian infrastructure, implementing traffic management strategies around schools, fostering community engagement in safety initiatives, and outreach programs involving the school and community.

1.6.4 Review of Existing Policies, Guidelines, and Design Standards for Pedestrian Infrastructure

In this study, the researcher reviewed existing policies, guidelines, and design principles for the provision of pedestrian facilities and infrastructure, including the Design Implementation Guide for Safe City, the Basic Guidelines on Pedestrian Facilities, and the Design Guidelines for Safety Facilities for Schools. In a case study of Shah Alam City, documents such as the Selangor State Structure Plan and the Shah Alam City Council Local Plan will be referenced.

Based on the researcher's knowledge and findings, there is minimal emphasis on providing pedestrian walkways outside school areas in any significant design guidelines or policy documents. Additionally, there are no specific design guidelines for providing pedestrian facilities in certain areas, such as schools, hospitals, or shopping centres. Pedestrian provision must be appropriate to the users and the conditions of the place. It cannot adopt the same design for all areas. In this case, more child-centric guidelines for pedestrian facilities in school zones are needed, taking into account the characteristics of young pedestrians.

Reviewing existing policies, guidelines, and design principles related to walking to school involves examining pedestrian safety, infrastructure, community engagement, and environmental considerations. Overall, a comprehensive review of existing policies, guidelines, and design principles for walking to school should address key aspects to promote safe, accessible routes for students. The researcher will use the content reviewed to develop a standard guideline for the primary school zone, taking into account current developments and children's needs.

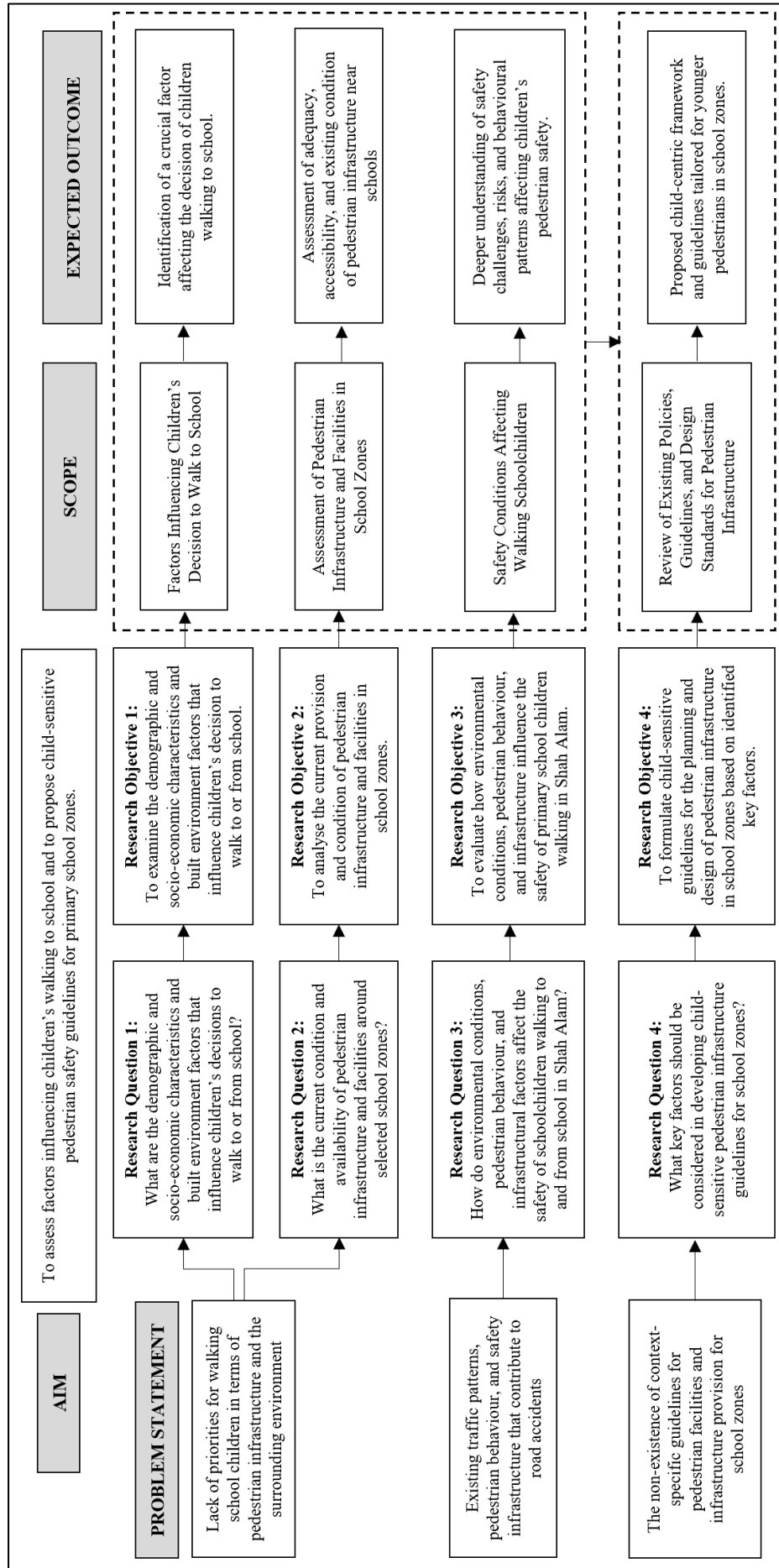


Figure 1.1 Relationship between the Research Aim, Problem Statements, Research Questions and Objectives, Scopes, and Expected Outcomes

1.7 Research Methodology

This section provides a brief explanation of the research methodology employed in this study. The detailed explanation will be presented in Chapter Three, Research Methodology. This study was primarily designed to identify, through a case study of primary school children in Shah Alam City, a critical factor influencing children's decision to walk to school. Therefore, the following paragraphs provide a brief explanation of the methodological approach employed in this study.

1.7.1 Introduction to Methodological Approach

This study employs a mixed-methods research approach, combining qualitative and quantitative methods to provide a comprehensive understanding of the factors influencing children's walking to school in Shah Alam City. This approach involves collecting, analysing, and integrating qualitative and quantitative data. The mixed-methods design was chosen for its flexibility and ability to capitalise on the complementary strengths of qualitative and quantitative research.

Quantitative methods based on questionnaire surveys allow the collection of numerical data, providing insights into the prevalence and patterns of walking to school among primary school children. This approach enables the identification of trends and correlations among related variables, offering a broad perspective on the study topic.

On the other hand, qualitative methods provide in-depth insights into the experiences and perceptions of pedestrian facilities and infrastructure provision among schoolchildren, parents, and school staff, as well as the factors influencing active commuting to school through in-depth interviews. Field observation was also conducted at the six selected primary schools to assess the availability and condition of pedestrian facilities. This approach helps to contextualise the quantitative findings, providing a richer understanding of the complex dynamics involved.

Based on the brief explanations of the two methods above, this mixed-methods approach is particularly relevant to this study because it allows for triangulation. Explicitly mentioned as a method for comparison, findings from both methods can be compared and contrasted to enhance the validity and reliability of the results. The explanation for the triangulation method used in this study will be discussed in detail in Section 3.2.1 of Chapter Three, Research Methodology.

Additionally, the mixed-method approach offers the flexibility to adapt the research design as needed, ensuring that the study captures the phenomenon's breadth and depth in answering the research questions. By integrating both data types, this study aims to provide a comprehensive understanding of the factors influencing children's walking to school, ultimately informing strategies to promote active transportation, particularly among primary school children.

1.7.2 Stages of the Study

Four stages in the research process were performed to achieve the aim and objectives of this research. This section outlines the flow from the initial to the final stage, providing a basis for organising this research.

1.7.2.1 Stage 1: Preliminary Study

The preliminary study is a crucial phase in the research process, laying the groundwork for a comprehensive investigation into the factors influencing children's walking to school in Shah Alam City. Conducting a preliminary study is essential in understanding the dynamics of pedestrian behaviour among schoolchildren. This stage involves identifying the problem, examining the research aim, research questions and objectives, determining the research scope, and planning research methodologies.

This stage also involves a comprehensive review of the existing literature, including previous studies, research papers, and reports that examine factors influencing children's walking to school. These will provide valuable insights into the current state of knowledge and identify gaps or areas requiring further investigation. The specific factors the researcher aimed to explore and understand regarding children's walking to school were identified, including demographic and socioeconomic characteristics, built environment features, and safety concerns.

The preliminary study stage has provided a solid foundation for identifying the factors influencing schoolchildren's walking to school. This stage has highlighted key areas for further exploration and informed the development of research objectives and research questions for the main study. In summary, this stage serves as the foundation and framework for the entire research.

1.7.2.2 Stage 2: Data Collection

Stage 2 is the data collection phase, a critical step in the study that involves gathering both primary and secondary data to address the specified research objectives. This stage was designed to efficiently and effectively collect all necessary data.

For primary data collection, this study employed four methods: questionnaire surveys, field observational studies, in-depth interviews, and secondary data. A structured questionnaire was administered to a sample of schoolchildren in six primary schools in Shah Alam City. The survey aimed to collect quantitative data on students' responses and perceptions regarding their demographic and socio-economic backgrounds, physical and environmental factors, and safety factors that influence schoolchildren's decisions to walk to school. Observational studies were conducted around six selected schools to assess the existing physical environment and infrastructure. This involved noting the presence and condition of pedestrian facilities, traffic conditions, and other safety features. In-depth interviews were conducted to gather qualitative insights into their experiences and perceptions of active commuting to school. These interviews provided detailed narratives on existing pedestrian facilities, safety concerns, and related aspects.

For secondary data, a documentary review of relevant policies, standards, and guidelines related to pedestrian planning in school zones was conducted. This included examining official documents from government agencies and international organisations to understand the regulatory framework and best practices for creating safe school-zone environments.

By combining these data collection methods, the study aimed to assemble a comprehensive dataset that would provide a nuanced understanding of the factors influencing children's walking to school in Shah Alam City, Malaysia.

1.7.2.3 Stage 3: Analysis and Research Findings

Stage 3, the analysis and findings stage, involved systematically examining and interpreting the data collected during the previous stages. This phase was crucial for identifying patterns, trends, and associations that explain the factors influencing children's walking to school in Shah Alam City. Data analysis is divided into two approaches: quantitative and qualitative.

In this stage, quantitative data were analysed using statistical software, employing descriptive statistics, correlation analysis, and regression analysis to identify significant relationships between variables. The statistical software helped quantify the prevalence of walking behaviours, the impact of demographic and socio-economic background, and perceptions of the built environment and safety.

Qualitative interviews were conducted to complement and support the quantitative findings. Rather than transcribing the interviews in full, a selective note-taking approach was used to extract only key points, themes, or quotes relevant to the research objectives. These insights were used to reinforce or justify specific findings, particularly about children's walking behaviour and the built environment. Also, field observations were analysed to assess the condition and availability of pedestrian infrastructure around schools, highlighting areas for improvement.

Quantitative and qualitative methods were integrated at this stage to gain a comprehensive understanding of the complex factors influencing children's walking to school. This integration enabled data triangulation, thereby enhancing the validity and reliability of the results.

1.7.2.4 Stage 4: Recommendations and Conclusion

The final stage, Stage 4, involved synthesising the findings to develop actionable recommendations and drawing conclusions based on the research in Chapters 4, 5, and 6. This stage aimed to translate the analysis and research findings into practical strategies to enhance pedestrian infrastructure and automatically promote active commuting to school among primary school children.

Based on the study's findings, several key recommendations were formulated, including (1) developing and implementing standard design specifications for primary school zones, (2) implementing enhanced safety measures, (3) fostering community engagement, and (4) advocating for policy reforms.

Currently, there are no specific guidelines in place for providing pedestrian facilities in school areas in Malaysia. The establishment of this design specification should address all the issues and problems mentioned earlier, and prioritise the safety of schoolchildren among pedestrian users. Considering the research findings in the analysis chapters, the guidelines were strengthened with justifications drawn from overseas practices suitable for the Malaysian context, thereby supporting the idea. Additionally, several practical approaches are recommended to improve strategies and policies.

This study contributes to understanding the complex factors influencing active commuting to school in Shah Alam City. Developing and implementing standardised guidelines for pedestrian infrastructure in school zones can create environments that support and encourage active school commuting. The recommendations outlined in this stage provide a framework for policymakers, educators, and community leaders to collaborate to promote active schools among children.

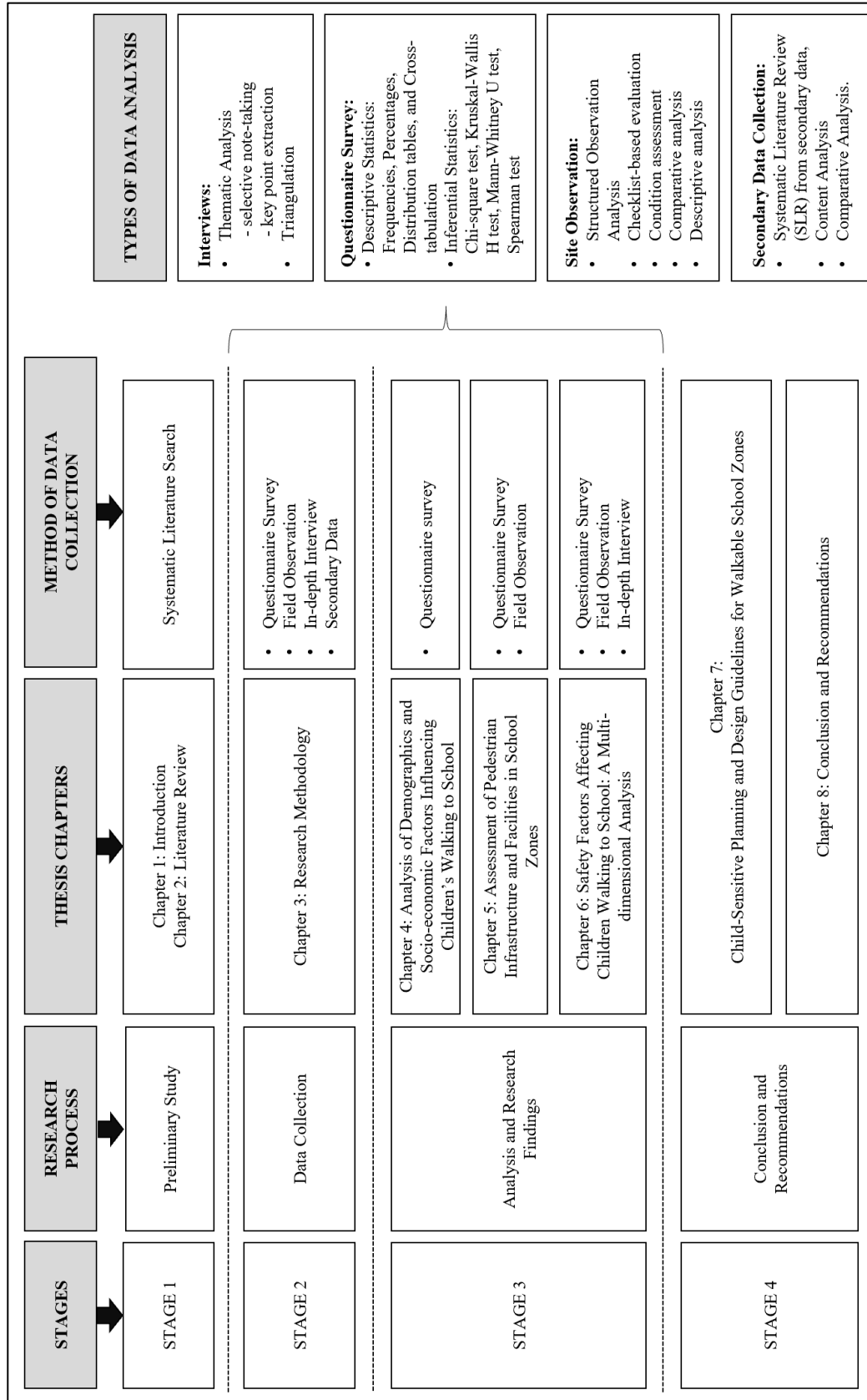


Figure 1.2 Research Framework

1.7.3 Data Collection Methods

Four data collection methods were employed: a questionnaire survey, field observations, in-depth interviews, and secondary data. The following section provides a brief description of the data collection methods. A detailed discussion will be presented in Chapter 3, Section 3.7.

1.7.3.1 Questionnaire Survey

The primary data collection method for this study is a questionnaire survey conducted among a sample of primary school children in Shah Alam. A pilot survey was also conducted before the primary research to ensure the clarity and reliability of the questionnaire (detailed explanation in 3.7.1). A structured sampling and screening process was applied to ensure the selection of relevant study sites and respondents. The questionnaire survey method will be discussed in detail in Section 3.7.2 of Chapter Three, Research Methodology.

1.7.3.2 Field Observation

Field observation is a second method of data collection to assess the physical environment and infrastructure in the vicinity of six primary school zones in Shah Alam City. A detailed explanation of the field observation method will be discussed in Section 3.7.3 of Chapter Three, Research Methodology.

1.7.3.3 In-Depth Interview

In-depth interviews were conducted with various stakeholders, including government agency representatives, parents, and school authorities, to gather insights into the provision of pedestrian facilities and perceptions of active travel to school. A detailed explanation of the in-depth interview method will be discussed in Chapter Three, Research Methodology, Section 3.7.4.

1.7.3.4 Secondary Data

In addition to primary data collection methods, this study utilised secondary data to gain a comprehensive understanding of the frameworks and guidelines related to pedestrian facilities in school zones. Through this data collection method, a review of existing policies and guidelines was conducted to identify relevant standards, best practices, and regulatory frameworks that inform the planning and design of pedestrian infrastructure around schools, as well as to understand the deficiencies and gaps within the current provisions that need to be addressed in the proposed guideline. A detailed explanation of the secondary data collection method will be provided in Section 3.7.5 of Chapter Three, Research Methodology.

1.8 Significance of the Study

As mentioned earlier, this research aims to identify the critical factors influencing children's decisions to walk to school and to evaluate their safety levels. This research significantly impacts pedestrian planning in Malaysia by applying the Quadruple Helix model, which describes the interactions among government, academia, industry, and society to provide adequate and effective pedestrian facilities for users. Figure 1.3 shows how pedestrian planning can influence each component of the Quadruple Helix:

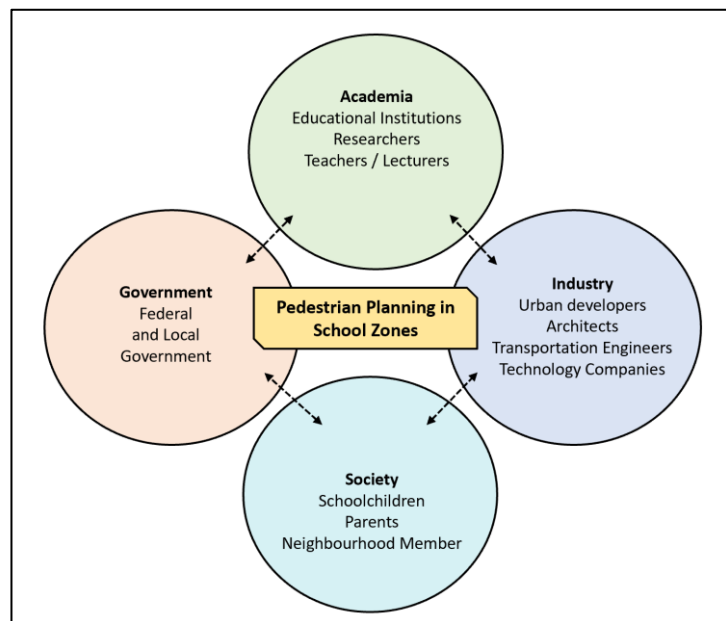


Figure 1.3 Quadruple Helix Model

First, governments play a crucial role in setting policies and regulations related to urban and transport planning, transportation infrastructure, and pedestrian safety. The government is responsible for implementing policies prioritising pedestrian-friendly environments, such as zoning regulations promoting mixed land use and pedestrian-oriented development. Besides, governments allocate funding for transportation infrastructure projects, including sidewalks, crosswalks, pedestrian bridges, and other amenities that enhance pedestrian safety and accessibility. Within regulatory frameworks, governments enforce regulations related to pedestrian planning, such as building codes mandating the inclusion of pedestrian facilities in new developments and traffic laws protecting pedestrians' rights, including in school zones.

Secondly, on the academic side, the focus is on research and knowledge. For example, in the research and data analysis, educational institutions will study pedestrian behaviour, preferences, and safety concerns. They collect and analyse data on pedestrian movements, traffic patterns, accident statistics, and urban design principles to inform evidence-based pedestrian planning strategies. In terms of education and training, academia will offer programs for urban planners, transportation engineers, architects, and policymakers involved in pedestrian planning. The academia will offer courses, workshops, and professional development programs to equip professionals with the knowledge and skills to design pedestrian-friendly environments in school zones.

This study significantly expands knowledge by providing insights into urban planning, public health, education, and social behaviour. It addresses gaps in the literature by focusing on parental attitudes and underexplored factors, including demographics, the built environment, and safety concerns. New research can deepen understanding of influences on children's walking behaviour.

From the industry perspective, it will emphasise the innovation and implementation stages. The industry partners, including urban developers, architects, transportation engineers, and technology companies, will develop innovative solutions to enhance pedestrian infrastructure and safety. These solutions may include the design and construction of pedestrian-friendly streetscapes, smart crosswalks, wayfinding systems, and mobility apps that promote walking to school. These include technologies and design solutions to encourage schoolchildren to use active transportation. Additionally, considering the roles of Public-Private Partnerships (PPPs), the industry may collaborate with the government and academia to finance, design, and implement

pedestrian planning projects outside the school area. These partnerships leverage private-sector expertise, resources, and investment to complement public-sector initiatives and accelerate the implementation of pedestrian-friendly infrastructure in school zones.

Last but not least, on the community side, understanding the social and behavioural aspects of walking to school can provide insights into broader behaviour patterns and community dynamics. This knowledge can inform studies on social cohesion, community safety, and parental attitudes toward children's independence and autonomy. Besides, walking to school can foster a sense of community among children and parents, leading to stronger neighbourhood connections and social cohesion. This topic of study can help identify how community factors influence walking behaviour and how policies can enhance these community benefits.

By leveraging collaborations among government, academia, industry, and society, pedestrian planning can benefit from a holistic approach that integrates policy development, research-based strategies, and innovative solutions. Collaboration among these stakeholders fosters creativity, efficiency, and effectiveness in addressing the complex challenges of pedestrian mobility and safety in urban school zone environments.

The primary focus of this study is to provide specific standard guidelines for primary schools regarding the provision of pedestrian facilities. These guidelines address crucial aspects, including safety, infrastructure, accessibility, community involvement, traffic management, environmental considerations, signage and wayfinding, maintenance, and upkeep. This study provides a valuable reference for authorities seeking to implement these recommendations to enhance the overall safety and functionality of pedestrian facilities in primary school settings.

In conclusion, it is crucial to conduct this study. It addresses the current situation and benefits several related parties by providing insights into the factors influencing children's school travel mode choices, identifying potential interventions to promote AST, and informing urban planning initiatives to create more walkable environments.

1.9 Limitations of the Study

While this study provides valuable insights, it also has limitations that the researcher should acknowledge. The main restriction the researcher faces during the research process is the COVID-19 pandemic. Several challenges were faced during the pandemic. First, it had a significant impact on data collection. The Malaysian government's stay-at-home orders significantly reduced mobility, making it difficult for the researcher to conduct surveys or gather in-person data. This limitation has forced the researcher to delay data collection beyond the scheduled date and to postpone it until the situation becomes stable.

The school closure during the Movement Control Order (MCO) significantly affected the researcher's access to participants, forcing them to find alternative ways to collect data. With the schools temporarily closed, assessing the target population (walking schoolchildren) became challenging. This situation limited the researcher's ability to collect data directly from schools or through school-based surveys. The necessity to use alternative methods, such as online surveys, might have introduced biases if not all potential participants had equal access to technology or were comfortable using it.

Even after MCO was lifted, schools might have maintained strict protocols to prevent the spread of COVID-19, making it difficult to conduct surveys on school premises and limiting the researcher's ability to collect data in naturalistic settings. Furthermore, organising school surveys requires coordination with school administrators, which has been more complicated due to ongoing health concerns and safety measures.

Due to the COVID-19 pandemic, the research timeline has been extended, resulting in a limited timeframe for data collection, analysis, and writing. This could have resulted in a rushed analysis or less comprehensive data collection. The researcher faced challenges accessing specific data or literature due to pandemic-related restrictions and other constraints, such as institutional access limitations.

Also, the COVID-19 pandemic has indirectly changed daily routines. The pandemic disrupted daily routines, potentially affecting how respondents perceived and reported their walking-to-school behaviours.

Addressing these limitations requires careful consideration of study design, data collection methods, and analytical approaches. By acknowledging these limitations and

taking steps to mitigate them, the researcher can enhance the validity and reliability of studies on identifying factors influencing children's walking to school.

Other than that, the research sample was limited to primary school students aged 7 to 12, excluding teachers and school staff. While students can offer valuable insights into their walking experiences, including teachers and school staff, could have enriched the findings by highlighting other aspects, such as institutional practices, school policies, and safety measures, which may impact students' travel behaviours. The exclusion of these groups will limit the findings, reflecting primarily students' experiences rather than the broader school community.

Besides, this study specifically targeted primary school children, rather than involving secondary school students. The justification for this choice is that younger children are generally more vulnerable in terms of safety, independence, and mobility, and parental decisions and environmental influences often shape their walking behaviour. Focusing on primary school contexts enables a more detailed understanding; however, the results may not apply to secondary school environments, where students typically enjoy greater autonomy and different mobility patterns. Consequently, the applicability of the findings is limited only to primary school populations.

Additionally, the study design allowed students to complete the questionnaire with parental assistance rather than requiring them to complete it independently. This approach was adopted to accommodate respondents' cognitive abilities and comprehension, ensuring that their answers accurately reflected their actual experiences without being affected by literacy or comprehension barriers. However, parents' involvement in completing the questionnaire may have introduced bias. Parents could unintentionally influence how children interpret or respond to the questions. Despite this limitation, parents' participation was considered essential to maintain the validity and reliability of the responses, especially given the range of age groups involved.

In summary, all the limitations mentioned above result from deliberate methodological choices intended to ensure data quality and feasibility. However, these approaches may limit the scope and generalizability of the findings. Therefore, future research could address these gaps mentioned by involving multiple stakeholders, expanding the study to include secondary school, and creating tools that enable children to respond more independently without involving other parties.

1.10 The Structure of the Thesis

This thesis is systematically organised into eight (8) chapters. Figure 1.4 illustrates the sequence of chapters presented in the thesis.

Chapter 1	Introduction
Chapter 2	Literature Review
Chapter 3	Research Methodology
Chapter 4	Analysis of Demographic and Socio-economic Factors Influencing Children's Walking to School
Chapter 5	Assessment of Pedestrian Infrastructure and Facilities in School Zones
Chapter 6	Safety Factors Affecting Children Walking to School: A Multi-dimensional Analysis
Chapter 7	Child-Sensitive Planning and Design Guidelines for Walkable School Zones
Chapter 8	Conclusion and Recommendations

Figure 1.4 The Chapter Sequence in Thesis

Figure 1.4 illustrates the thesis's structure, beginning with Chapter 1: Introduction, which provides an overview of the research area and its significance. This chapter clearly defines the problem in current research that the thesis aims to address, outlines specific research questions, states the study's main objectives, and represents the scope of the study. This chapter provides a brief explanation of the research methodology, outlines the study's stages, and explains why this research is essential and its potential contributions. Additionally, this chapter acknowledges any limitations the researcher faces along the process.

Chapter 2: Literature Review follows, discussing the main theories and concepts related to the research topic. This chapter summarises relevant studies that have addressed similar issues with active commuting to school, highlights areas where current research is lacking, and outlines the theoretical framework that guides the research study.

Chapter 3, Research Methodology, explains the research design used in this study (mixed-method). This chapter provides a detailed description of the data collection methods involved and describes how the data were collected. This chapter also outlines the sampling aspect and the data analysis techniques used. Additionally, this chapter addresses any ethical issues that arise and how the researcher addresses them.

Chapters 4, 5, and 6 present the analysis chapters, which contain the findings of the data analysis. The findings are presented in tables, figures, and photographs to illustrate key points and highlight the most significant results of this study. Each chapter includes a discussion that interprets the findings in the context of the literature review. This section also compares the results of this study with those of previous studies.

The most important part is the set of guidelines for pedestrian facilities in primary school zones, which will be included in Chapter 7. This chapter presents a framework and standard design guidelines for providing pedestrian facilities, specifically in school zones, based on the findings from the analysis chapters.

Chapter 8: Conclusion and Reflections summarises the key findings and discusses how the study's objectives were met. This chapter also suggests areas for future studies and discusses potential practical research applications.

1.11 Summary

Chapter 1 introduces the framework for the entire research, beginning with the study's background. The problem statement is clearly defined, followed by the research gaps, research aim, research questions, and objectives, which outline the study's direction. This chapter also includes the scope and research methodology to guide the researcher in conducting the survey. The four stages involved in the research process were briefly explained. The study's significance has been described, underscoring its potential to yield new insights into this research topic. The study's limitations have also been delineated to ensure a focused and feasible research implementation. At the end of this chapter, the thesis structure, including a title for each chapter in sequence, is presented. In summary, this foundational chapter sets the stage for a comprehensive literature review in the following chapter, further contextualising the research within the broader academic landscape.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The journey to school is critical in children's daily lives, influencing their physical health, social interactions, and overall well-being. In recent years, there has been a growing interest in understanding the factors that affect children's decisions to walk to school. This phenomenon is particularly relevant in urban settings, such as Shah Alam City, Malaysia, where rapid urbanisation and changing lifestyles significantly impact children's mobility to school.

Thus, this chapter elaborates on the factors that influence children's walking behaviour on their way to school. By reviewing existing research and theoretical frameworks, this chapter provides a comprehensive overview of the key elements shaping Children's Independent Mobility (CIM) and their decision-making regarding active transportation to school.

The first part discusses the concept and importance of walking to school, comprising definitions and terminologies related to the study, global trends and significance, and the benefits of practising AST among schoolchildren. Secondly, this chapter examines the theoretical foundations of AST, drawing on the Socio-Ecological Model (SEM), and then discusses their application in AST studies. Additionally, this study examines children's independent mobility within urban planning contexts, describing several key dimensions and the relationship between CIM and AST practice.

The vital part of this chapter explains the key factors influencing AST, consisting of demographic and socio-economic background, built environmental factors, and safety factors. This chapter also presents a critical synthesis of universal and context-specific predictors.

Additionally, Chapter 2 explores the policy and planning perspectives, examining global and regional policies that promote physical activity, as well as design guidelines and planning strategies for walkable school zones. This section also explores the existing school travel plans and the Safe Routes to School programme, which have been implemented in other countries and can be applied in Malaysia. On the other hand,

this chapter discusses the current situation in Malaysia. This chapter closed with the summary of Chapter 2.

The literature review seeks to do more than existing research; it also critically assesses, compares, and synthesises findings from various contexts. It identifies the gaps and limitations in previous studies and establishes the foundation for the conceptual framework developed in this research. By linking global evidence with the specific realities of Malaysia, this chapter highlights how theoretical models can be applied to comprehend and enhance children's active travel behaviours to school.

2.2 Concept and Importance of Walking to School

This section presents the study's definition and terminology and examines global trends and their significance. Additionally, the benefits of AST for children will be explored with relevant themes.

2.2.1 Definition and Terminologies

Walking to school is categorised under the broader Active School Travel (AST) or Active Commuting to School (ACS). Both refer to non-motorised travel modes, such as walking and cycling, specifically for school journeys. This concept has expanded in transportation and public health research, emphasising the behavioural, environmental, and health dimensions of children's walking to school.

Active commuting to and from School (ACS) is defined in a systematic review as the use of non-motorised modes of travel to and from school, including walking, cycling, skateboarding, or other human-powered methods, that require energy expenditure during the commute (Ruiz-Hermosa et al., 2019a). Active School Commuting is described in a global narrative review as daily active travel by schoolchildren, typically aged 6 to 12 years, using human-powered modes (mainly walking and cycling). It focuses on the benefits of physical activity, behavioural patterns, and environmental mediators (Lam et al., 2023).

The term AST is widely used in public health and transport research to refer to all forms of unpowered or human-powered travel, such as walking, cycling, and scootering. This mode is used by children to travel to school, encompassing both daily commuting behaviour and the environmental, social, and infrastructural contexts

influencing it (Lam et al., 2023). Lastly, active transport, also known as active travel, is a general term referring to any non-motorised mode of transportation, including walking, cycling, skateboarding, and micro-mobility (e.g., scooters). It emphasises integrating physical movement into children's daily routines (Ruiz-Hermosa et al., 2019a).

However, definitions of AST vary across studies: some include all non-motorised modes, while others restrict the term to walking alone. This inconsistency in terminology can create challenges for international comparisons and policy alignment (Larouche et al., 2018). As a result, this research adopts the inclusive definition of AST to reflect the diversity of children's active travel behaviours, with a primary focus on walking.

2.2.2 Global Trends and Significance

Global trends indicated that walking to school has declined sharply over recent decades, especially in high-income countries. Youth walking or biking has dropped from roughly 50% in 1969 to 10-11% in recent years in the US (Kweon et al., 2023). Research across Europe and Australia also shows similar trends, demonstrating a decline in AST over time (Srivastava et al., 2025). This trend has prompted an immediate policy focus, as countries, including Australia and parts of Europe, are investing in built environment upgrades and implementing Active Transport to School programs to reduce reliance on cars and mitigate associated risks.

In comparison, several Asian and Scandinavian countries report walking rates above 50%. This trend is primarily due to well-designed urban spaces, strong pedestrian facilities, and cultural acceptance of active mobility (Nguyen et al., 2022). The contrast between these regions highlights how social, cultural, environmental, and policy factors influence AST participation. While Western societies often focus on individual freedom and independence, Asian cultures tend to prioritise a higher value on safety and parental supervision, revealing culturally determinants that affect children's mobility.

2.2.3 Evolution of Active School Travel (AST): Global and Malaysian Context

AST has evolved significantly over the past few decades, contributing to broader changes in urbanisation, transportation systems, and public health. Globally, AST became a dominant mode of school travel, but recently, there has been a steady decline observed, particularly in developed countries, due to increasing reliance on private vehicles, urban sprawl, and safety concerns (McDonald et al., 2013; Timperio et al., 2025). As a result, many countries have implemented structured initiatives and programs to promote active commuting among schoolchildren.

In high-income countries such as the United States, the United Kingdom, and Australia, a comprehensive programme such as Safe Routes to School (SRTS) has been widely supported. Infrastructure improvements, traffic-calming measures, policy enforcement, and community engagement are among the initiatives implemented to create safer walking and cycling environments for children (World Health Organisation [WHO], 2024). Based on the empirical studies conducted by Timperio et al. (2025) have discovered that well-designed pedestrian infrastructure, reduced traffic speeds, and supportive policy frameworks have significantly increased the likelihood of children walking to school. Furthermore, these countries are taking the initiative to incorporate child-friendly urban design principles into broader planning strategies to ensure that school environments are accessible, safe, and conducive to active mobility.

On the other hand, in developing and upper-middle-income countries, particularly in Malaysia, AST practices remain slow to adopt. Despite awareness of the benefits of active travel already spreading, practical implementation within urban planning and transport policy remains limited (Ibrahim et al., 2024; Shabadin et al., 2022). According to the Malaysian Institute of Road Safety Research [MIROS] (2020), school travel in Malaysia is predominantly motorised, with most children being chauffeured by parents or using school transport services such as school vans. This trend of school travel is influenced by several factors, including parental safety concerns, inadequate pedestrian infrastructure, and increasing home-school distances (Nasrudin et al., 2023; Wangzom et al., 2023).

In the Malaysian context, from a policy perspective, Malaysia has established several frameworks related to transportation and urban development, including the National Transport Policy and the National Urbanisation Policy. Nevertheless, there is a lack of specific emphasis on child-centred mobility and AST in these policies

(Economic Planning Unit, 2021; Ministry of Transport Malaysia, 2019). On the contrary, existing guidelines for pedestrian infrastructure, namely the Uniform Building By-Laws (UBBL), are primarily designed for general users and do not account for the characteristics of schoolchildren (Muhammad, 2015). Consequently, the provision of pedestrian facilities in school zones is often inconsistent, fragmented, and misaligned with international best practices.

In recent years, Malaysia has implemented several initiatives to enhance road safety in school zones, including enforcing speed limits and implementing traffic calming measures (World Health Organisation [WHO], 2024). In addition, efforts by government agencies and non-governmental organisations, such as the Safe School Zone, an initiative of Majlis Keselamatan Jalan Raya Malaysia, have helped promote safer, more walkable school environments (MKJR, n.d.). However, these initiatives are sporadic and lack a comprehensive, standardised framework, unlike global models such as SRTS. It shows that the initiatives implemented to promote AST in Malaysia remain weak and have not received a favourable response from the community.

In conclusion, a comparison between global and Malaysian contexts exposes several key differences. From a global perspective, AST is well supported by integrated policies, consistent infrastructure provision, and a strong institutional framework. In contrast, Malaysia faces challenges related to fragmented implementation, limited enforcement, and a lack of child-specific planning guidelines. In contrast to global research, which extensively incorporates behavioural, environmental, and policy dimensions, local studies in Malaysia are comparatively limited in both scope and depth (Ibrahim et al., 2024).

Although global studies emphasise structured, multidimensional interventions to promote AST, Malaysia remains in the early stages of incorporating child-friendly mobility into urban planning. This situation underscores the necessity for context-specific research and the formulation of comprehensive guidelines suited to the Malaysian context. Bridging these gaps is crucial to fostering safer, healthier, and more sustainable school travel behaviours among children.

2.2.4 Benefits of Active School Travel (AST) for Children

AST has been widely recognised for its multifaceted benefits to children's development and well-being. These benefits include physical health, psychological resilience, social engagement, cognitive development, and environmental outcomes. It contributes to children's daily physical activity and helps them fulfil the WHO-recommended 60 minutes of MVPA per day.

This section presents evidence from recent literature that demonstrates the value of promoting AST among schoolchildren.

2.2.4.1 Physical Health Outcomes

Walking to school can significantly increase children's daily physical activity while addressing concerns about sedentary lifestyles and rising rates of childhood obesity. Previous studies have indicated that just 20 minutes of walking each day can improve mental health by reducing depression and boosting energy levels (Sirard et al., 2008). Furthermore, children who actively walk or bike to school are more likely to maintain and adopt an active lifestyle as they grow older. Numerous studies highlight a positive association between active school commuting and improved physical health in children.

A randomised controlled trial conducted by Johnson et al. (2024) evaluated the impact of a structured Walking School Bus program across several school sites. The results revealed that children in the intervention group exhibited significantly greater MVPA than those in the control group. These findings confirmed that structured active transportation programs can enhance children's daily physical activity levels. In South Korea, researchers found that children who actively commuted to school had lower BMI z-scores and reduced body fat percentages (Lavery et al., 2021). This evidence supports the notion that regular physical activity, such as walking, contributes to healthier body composition.

2.2.4.2 Mental and Social Well-Being

In addition to affecting physical health, AST has been reported to impact children's mental and emotional well-being. Based on the WISH Study, a peer-led walking intervention in Irish secondary schools has been reported to have led participants to perceive improvements in their mental health, mood, and social connections. Walking to school has created social interactions and a sense of autonomy, which played a crucial role in improving self-esteem and reducing feelings of isolation (Murphy et al., 2024a).

Additionally, neighbourhoods that facilitate walking are reported to enhance social cohesion and perceptions of safety, especially among younger children. Environmental concepts such as green and pedestrian-friendly spaces promote unstructured play and outdoor interaction, which are essential for social learning and emotional resilience among schoolchildren who walk. In other studies, comprehensive reviews illustrate how urban green spaces serve as social hubs, facilitating positive interactions, trust, and perceived safety among residents (Qi et al., 2024).

The relationship between greenness, walkability, and safety is prominent, as in Norway, where higher levels of greenness and walkability in neighbourhoods are associated with increased physical activity and perceived safety (Juul & Nordbø, 2023). Gemmell et al. (2023) note that for younger children, an environment with safe sidewalks, low-speed streets, and accessible green and open spaces provides greater freedom for unstructured outdoor play, thereby enhancing their social learning and emotional well-being.

Therefore, these findings demonstrate that children's ability to walk in green, walkable neighbourhoods promotes physical activity and fosters a socially cohesive, emotionally supportive environment that amplifies children's confidence, independence, and community connectedness.

2.2.4.3 Cognitive and Academic Benefits

Active travel is also related to cognitive development and academic performance in children. Children who regularly practice active commuting to school tend to be more alert and engaged, benefiting from the mental stimulation of physical activity, particularly in the morning. According to Ding & Feng (2022), a study

conducted in urban China found that children with shorter, active commutes reported higher levels of academic achievement and psychological well-being, particularly when the walking route comprised natural or interactive environments. There is also increasing evidence linking active commuting to improved academic performance, attention span, and greater self-efficacy (Ruiz-Hermosa et al., 2019b).

Additionally, the Walking School Bus programme, one of the most popular programmes implemented in many countries to promote active commuting to school, has also shown secondary benefits for attendance and punctuality. These findings suggest that group-based AST programs can promote school readiness and a focus on learning, as noted by Johnson et al. (2024).

2.2.4.4 Environmental and Community Impact

In addition to the benefits mentioned above, AST promotes broader environmental sustainability. For example, initiatives such as reducing car use during school runs help lower carbon emissions and air pollution, especially in school zones where traffic congestion is high. It automatically contributes to better air quality and lower carbon footprints. This impact primarily occurred in urban areas, where motorised vehicles are major contributors to pollution.

Based on a 2020 Belgian behavioural study, informing families about cleaner walking routes was reported to result in significant changes, especially in school travel behaviour, with 77% of participants reducing exposure to roadside air pollution (Ahmed et al., 2020). It also promotes environmental awareness by reducing carbon emissions and enhances social interaction and cognitive development through hands-on learning and understanding of their surroundings.

Additionally, increased pedestrian activity benefits health, the environment, and society, enhancing neighbourhood safety through greater social interaction and community cohesion. Many programs implemented by various organisations to promote active transport to school, such as “Walk to School Month,” have raised global awareness of the importance of walkable communities.

Nevertheless, these benefits are unevenly distributed across the population due to socio-economic differences, infrastructural gaps, and varying levels of urban safety. Therefore, the potential of AST cannot be realised without creating supportive environments that prioritise safety, accessibility, and parental trust.

2.3 Theoretical Foundation of Active School Travel (AST)

This section presents the theoretical foundation guiding this study of the factors influencing children's walking to school. Given that walking to school is categorised as a complex behaviour shaped by diverse individual, social, environmental, and institutional forces, this study is well-suited to adopt the Social Ecological Model (SEM) as its core theoretical framework. The following section provides a detailed elaboration of SEM.

2.3.1 Socio-Ecological Model (SEM)

SEM is completed by built environment frameworks and child-development considerations, which are integrated at relevant levels of the model. This theoretical foundation is adopted in this study because it facilitates a holistic understanding of how various factors are interconnected in influencing children's decisions to walk to school.

This theoretical approach aligns well with AST, as it highlights the interplay between children's personal characteristics (age, gender, self-efficacy), social influences (parental attitudes, peer norms), physical environment (infrastructure, land use), and institutional systems (policies, school programs). Unlike single-level behavioural theories, the SEM underscores the need for coordinated interventions across multiple areas to promote behavioural change.

2.3.2 Application of SEM in AST Studies

The SEM has increasingly been applied in AST studies due to its ability to capture the multi-layered factors or determinants that influence children's mobility and travel behaviour (Pont et al., 2009). According to Sallis et al. (2015), SEM defines behaviour as the result of active interactions among individual characteristics and broader environmental, social, institutional, and policy contexts. The hierarchical structure of SEM is well-suited to understanding school travel behaviour, which is driven not solely by individual choices but also by interpersonal relationships, neighbourhood design, and school practices. The variables from this study are summarised and organised by SEM level in Table 2.1.

Table 2.1
Variables Included in the Questionnaire and Secondary Data Categorised by the Social Ecological Model (SEM)

	Level	Application of Variables in this Study
Individual	Demographic and Physical Characteristics	<ul style="list-style-type: none"> - Age of child (Q1) - Gender (Q2) - Ethnicity (Q3) - Weight and height (Q4)
	Attitudes, Perceptions & Preferences	<p>The child:</p> <ul style="list-style-type: none"> - Prefers walking over using vehicles. (Q19) - Believes walking saves time. (Q20) - Prefers walking for short distances. (Q21) - Feels relaxed when walking. (Q23) - Finds walking to school enjoyable. (Q24) - Believes walking is healthy. (Q25) - Finds walking easy and comfortable. (Q26) - Walks due to short home-school distance. (Q27) - Not discouraged by hot weather. (Q28) - Perceives no major walking barriers. (Q29) - Enjoys walking for 20 minutes. (Q40) - Not affected by vehicle exhaust. (Q42)
	Behaviour	<ul style="list-style-type: none"> - Frequency of walking to school per week. (Q16)
	Safety Awareness and Experiences	<ul style="list-style-type: none"> - Stays alert to vehicles while walking. (Q48) - Feels safe walking alone. (Q49) - Nearly hit by a vehicle. (Q50) - Involved in a walking-related accident. (Q51)
	Household Characteristics	<ul style="list-style-type: none"> - Parent or guardian age. (Q5) - Parent or guardian education level. (Q6) - Parent or guardian occupation. (Q7) - Household income. (Q8) - Driver's license status of parents or guardians. (Q9) - Number and types of vehicles at home. (Q10) - Parent or guardian frequency of exercise. (Q11)
	Social Influence	<ul style="list-style-type: none"> - Usually walks with family or friends. (Q17) - Parents encourage walking to school. (Q30)

Community and Built Environment	Travel Characteristics	<ul style="list-style-type: none"> - Distance from home to school. (Q14) - Time taken to walk to school. (Q15)
	Infrastructure Availability and Use	<ul style="list-style-type: none"> - Pedestrian facilities are available. (Q32) - Uses pedestrian facilities. (Q35) - Paths are clean and well-maintained. (Q36) - Lighting along walking routes is adequate. (Q37) - Good design makes walking enjoyable. (Q39) - Dirty or damaged paths discourage walking. (Q41)
	Perceptions of Environment	<ul style="list-style-type: none"> - The neighbourhood is safe for walking. (Q22, Q54) - Pedestrian facilities are perceived as safe. (Q53) - Prefers walking on grass or road over paths. (Q33, Q34) - Enjoys well-maintained pedestrian facilities. (Q38)
	Environmental Barriers	<ul style="list-style-type: none"> - Roads to school are dangerous. (Q46) - Drivers speed in the neighbourhood. (Q47)
	Community Safety Concerns	<ul style="list-style-type: none"> - Has experienced harassment by strangers. (Q43) - Attacked by stray animals. (Q44) - Aware of theft incidents near the school. (Q45) - Neighbourhood lacks pedestrian safety features. (Q55)
Institutional	School Policies and Institutional Support	<ul style="list-style-type: none"> - The school encourages walking to school. (Q31) - Traffic is controlled in front of the school. (Q52)
Policy	Policy and Guidelines	<ul style="list-style-type: none"> - Urban planning policies - Pedestrian infrastructure standards - Design guidelines

Numerous previous studies have employed SEM as a theoretical framework. In the context of Cuenca and Ibarra, Ecuador, studies conducted by Orellana et al. (2024) investigated dimensions across children (individual), household (interpersonal), and urban environment (community or built environment).

Empirical studies employing SEM in AST research demonstrate that individual characteristics (age, gender, ethnicity) often interact with environmental factors (distance, sidewalk quality) to influence children's likelihood of walking. However, some critics argue that many SEM-based studies tend to be descriptive, mapping factors without rigorously examining interactions across levels (J. Panter et al., 2013).

Recent developments suggest that aligning SEM with behavioural frameworks, including the Theory of Planned Behaviour (TPB) and Self-Determination Theory (SDT), can help explain the motivational processes that drive walking decisions (Sims & Bopp, 2020). For instance, SEM highlights external constraints, while TPB provides insights into the cognitive aspects, such as attitudes, perceived control, and subjective norms, that shape the intention to walk. This combination improves both predictive accuracy and policy relevance.

In this study, SEM serves as the primary framework for classifying variables and conceptual links. At the same time, its integration with other models, such as Children's Independent Mobility (CIM), offers a more child-focused interpretation of AST behaviour.

2.4 Children's Independent Mobility (CIM)

Children's Independent Mobility (CIM) refers to children's freedom to travel and play in public spaces without adult supervision (Hillman et al., 1990). It also encourages children to participate in physical activity through active transportation (walking or cycling). CIM, in the specific context of children's mobility to school, is essential because commuting between home and school is a significant issue in active transport and reflects the degree of autonomy children have in navigating their neighbourhood.

2.4.1 Dimensions of CIM

CIM consists of spatial, temporal, and social dimensions. Spatial freedom pertains to how far a child is allowed to travel; temporal freedom refers to the duration and timing of independent movement; and social freedom concerns the people who accompany them while travelling. This concept encompasses several dimensions that consider both parental licensing and actual autonomous behaviour. Based on the literature review, four leading indicators of CIM have been consistently identified across most previous studies.

The first dimension, mobility licenses, refers to the permissions that parents grant their children to engage in specific independent activities. These activities encompass a range of behaviours, including crossing roads alone, walking to school,

travelling to nearby shops, or playing outdoors unsupervised. Standardised indices measure cumulative license scores based on 'yes' or 'no' permissions across multiple domains (Riazi et al., 2022).

In addition, the concept of territorial range refers to the geographic boundaries within which children are permitted to roam independently. This range is often defined as a radius. For example, a distance of 1 km from home typically correlates with the types of destinations that children can access unsupervised, such as parks or friends' homes (Riazi et al., 2022).

Moreover, behavioural autonomy captures the distinction between permission and actual behaviour, emphasising whether children travel independently, for example, by walking, cycling, or taking public transportation. Previous research in this area highlights the critical distinction between licence and realised behaviour, noting that actual independent mobility is a key aspect of children's autonomy (W. Y. Huang et al., 2024; Schoeppe et al., 2014).

Finally, the temporal and activity context encompasses various distinctions, including weekday versus weekend mobility and travel patterns associated with school and leisure destinations (Riazi et al., 2022). Each context offers varying levels of autonomy and supervision, further shaping children's independent mobility experiences and opportunities for exploration.

Research conducted in the Western region has revealed a consistent decline in CIM since the 1980s, attributed to rising parental safety concerns, increased traffic volume, and changes in urban form (Shaw, 2015). The dichotomy has broader implications for children's social development, health, and spatial learning capacity. On the other hand, evidence from Asian cities indicates that cultural norms regarding parental supervision further limit CIM, even in areas with moderate traffic (Ibrahim et al., 2024). These differences underline that CIM is not solely a function of infrastructure but is also influenced by cultural norms, parenting styles, and perceptions of community safety.

2.4.2 Relationship Between CIM and Active School Travel (AST)

Children's Independent Mobility refers to the freedom or ability of children to move around their surrounding neighbourhood without being supervised by adults (Ibrahim et al., 2024; Sharmin, 2020). This theoretical framework is grounded in principles of child-friendly urbanism and draws on environmental psychology, transportation planning, and social ecology. The relationship between Children's Independent Mobility (CIM) and Active School Travel (AST) has been well established in recent empirical research. This research consistently indicates that children granted greater freedom to travel without adult supervision are significantly more likely to engage in physical activity, such as walking or cycling to school.

An extensive cross-sectional study conducted in Canada, involving 1,699 children across multiple cities, including Ottawa, Vancouver, and Trois-Rivières, found that each 1-point increase in a child's CIM score was associated with a 9% increase in active travel trips. Additionally, it reported a 19% increase in overall travel volume, approximately 147 more steps per day (Riazi et al., 2019). These findings, independent of socio-economic status and urban density, highlight the critical role of mobility autonomy across contexts.

This is similar to a national Canadian study among 7- to 12-year-olds, which found that those living in neighbourhoods with greater green space, park density, and intersection density were significantly more likely to engage in both independent mobility and active commuting (Duffy et al., 2024). The study reported odds ratios ranging from 1.47 to 2.77, emphasising that urban form and access to outdoor amenities strongly supported both autonomy and physical movement (Duffy et al., 2024). Thus, these findings highlight that the built environment reinforces healthy routines and facilitates independent travel, allowing children to explore and move on their own.

Based on evidence from the Asian context study, it was found that in Hong Kong, children whose parents allowed them to travel independently reported significantly higher levels of MVPA on school days (W. Y. Huang et al., 2024). This result proves that CIM supports both transport autonomy and broader physical well-being. Additionally, recent systematic reviews have shown that children with greater independent mobility engage in more daily physical activity than their peers who are always accompanied.

It can be concluded that CIM strongly correlates with the likelihood that children will participate in AST. Children with higher levels of mobility autonomy are significantly more likely to walk or bike to school, regardless of distance or urban density (Fyhri et al., 2009).

In conclusion, these findings suggest that CIM can be viewed as both an enabler and a consequence of AST. As children are already trusted to travel independently, they are more likely to use active modes of travel for their daily commute to school, thereby reinforcing their confidence and physical competence. Therefore, the above literature emphasises the importance of developing policies and strategies that promote safe, connected, and walkable environments to support children's mobility and autonomy.

2.5 Theoretical Integration of the Social Ecological Model (SEM) and Children's Independent Mobility (CIM)

SEM provides a comprehensive framework for understanding the multiple levels of factors influencing children's walking behaviour, emphasising the interaction between individual, interpersonal, environmental, and policy factors. Across these levels, the idea of CIM introduces a complementary, child-centred dimension that explains how ecological factors affect actual walking behaviour. While SEM identifies which layers of influence operate, CIM clarifies how autonomy, freedom, and parental permission function as mechanisms that shape children's engagement with their surroundings.

According to McMillan (2007), SEM at the individual level focuses on personal characteristics such as age, gender, and self-efficacy that shape children's capacity to walk independently. The variables mentioned influenced CIM, as children grow older and become more aware and competent in travel, likely granting greater freedom to walk alone and unaccompanied (Carver et al., 2014). Therefore, independent mobility reflects the child's readiness to seize the opportunities available in their surroundings. Veitch et al. (2017) agreed that CIM at this level is associated with higher physical activity levels and a greater likelihood of active travel to school.

Next, SEM highlights the importance of family, peers and social norms at the interpersonal level. Parents' role as gatekeepers of children's mobility decisions involves mediating between environmental affordances and behavioural outcomes (Shaw et al., 2015). Also, according to Mitra (2013), parental perceptions of traffic

danger, personal safety, and social trust influence the degree of autonomy granted to children. Hence, CIM acts as a mediator in shaping parental risk assessment outcomes within the broader social context. For instance, walking behaviour remains unpopular even in well-designed neighbourhoods because parents perceive the environment as unsafe, especially for unaccompanied walking trips.

On the other hand, at the community and built environment levels, SEM considers physical infrastructure, connectivity, and surrounding land use as key determinants of walking. However, the presence of pedestrian-friendly infrastructure does not automatically lead to increased walking rates among children. CIM mediates this relationship by influencing whether children are allowed and encouraged to use the available spaces independently. Villanueva et al. (2012) noted that a well-designed environment, supported by safe crossings, traffic calming, and continuous sidewalks, may facilitate active mobility. Still, CIM is needed to determine whether that potential translates into actual behaviour. Thus, this relationship highlights the essential connection between urban design and behavioural freedom.

Additionally, at the institutional and policy level, SEM shape encompasses broader systems that influence mobility conditions, including urban design standards, road safety regulations, and school travel policies. In many developed countries, initiatives such as “Safe Routes to School” and child-friendly city planning have demonstrated their ability to enhance CIM by reducing parental concerns and fostering environments that support independent travel. Therefore, it is notable that institutional measures and policies operate indirectly through CIM by cultivating parental confidence and ensuring structural safety, thereby allowing children to walk independently.

To summarise, CIM can be conceptualised as a mediating mechanism within the SEM framework that links contextual and environmental factors to children’s active travel behaviour. While SEM outlines the ecological structure that organises multilevel influences, CIM illustrates how children perceive and negotiate these influences through their autonomy and freedom of movement. From this integrated viewpoint, the built environment impacts CIM by influencing aspects such as safety and accessibility, which, in turn, affect walking behaviour by determining whether children can and do exercise that mobility.

This synthesis highlights that encouraging children to travel to school actively requires attention to both structural factors (safe infrastructure, urban design, and

supportive policies) and developmental enablers (independence, confidence, and parental trust). Incorporating CIM into the SEM may strengthen theoretical understanding and facilitate more comprehensive interventions that address the interconnected physical and psychosocial determinants of AST.

2.6 Key Factors Influencing Children in Walking to School

Multiple personal, family, and environmental factors shape children's decision to walk to school. Among the most significant are demographic and socio-economic characteristics, built environment factors, and safety concerns, all of which are covered in this study. The following paragraphs discuss several factors that influence students' engagement in AST, based on previous research.

2.6.1 Demographic and Socio-economic Background

AST is influenced by a complex interplay of demographic and socio-economic factors, and recent research has highlighted key trends and areas requiring further investigation. Demographic characteristics include age, gender, and ethnicity. Meanwhile, socio-economics encompasses household income, parents' education levels, parental employment status, vehicle ownership, and parental physical activity. The following findings are based on prior research on demographic and socioeconomic backgrounds.

2.6.1.1 Age and School Grade Level

Age and grade level are consistently associated with children's likelihood of walking to school. Research conducted in Spain among children aged 3 to 5 demonstrated that older preschool children had higher odds of active commuting than their younger peers (OR = 1.21, $p < 0.001$). These findings suggest that as children grow older and gain independence, their participation in walking to school tends to increase (Herrador-Colmenero et al., 2021).

Older students, particularly adolescents, are often more drawn to active modes of transportation than their younger counterparts (Frisbee, 2024; Kontou et al., 2020). This inclination can be attributed to their increasing independence and physical abilities,

which allow them to navigate their surroundings with confidence and ease. The thrill of walking empowers them and fosters a sense of freedom as they explore their neighbourhoods and engage with their peers.

As children grow older, they often become confident explorers of their neighbourhoods, gradually gaining the independence to travel to school without adult supervision. A longitudinal study in the UK revealed a notable trend: independent mobility for school travel increases with age. Over time, students have significantly increased the number of times they walk or cycle to school without adult accompaniment (Carver et al., 2014). This increase in independence can be partly credited to parents' growing trust in their children's ability to navigate potential risks and manage traffic safely as they mature into responsible individuals.

Barriers to AST change as children age. For younger children, parental restrictions and safety concerns are significant obstacles to learning. However, these concerns tend to lessen as children grow older and parents become more comfortable with their children's independent mobility (Carver et al., 2014; Kingsly et al., 2020). The transition to independent AST is not guaranteed for everyone. Research conducted by Rutgers University (2022) indicates that children who start active commuting early are much more likely to maintain this habit into adolescence, highlighting the importance of early interventions to encourage lasting behaviours.

However, a reverse finding was found in a study of Canadian youth. Children in lower secondary grades (grades 6 to 8) were significantly more likely to walk or cycle to school than those in higher grades (grades 9 to 10) (Lavergne et al., 2023). The results indicate that younger adolescents tend to exhibit greater independent mobility than older students. This might be attributed to shorter travel distances, more substantial parental influence, or shifting preferences for different modes of transportation as they age.

2.6.1.2 Gender Differences in Walking Behaviour

Recent research offers a nuanced perspective on gender differences in walking to school, with some studies suggesting that boys are more likely than girls to do so. In contrast, others find little or no significant difference.

Numerous studies suggest that boys are more likely than girls to walk to school, although the discrepancies are often modest. For example, McDonald (2012) found that boys tended to walk to and from school more frequently than girls, with the gap

typically ranging from 1 to 2 percentage points and statistically significant only in certain years. On the other hand, studies conducted in California revealed that boys were significantly more likely than girls to walk or bike to school, particularly among those in third to fifth grades, with rates of 27% for boys compared to 19% for girls (McMillan et al., 2006; Rosenberg et al., 2006). Additionally, caregivers' walking behaviour can influence these differences.

An HBSC Study conducted across four diverse European countries uncovered intriguing insights into the impact of gender-specific social and environmental factors on children's active travel to school Brindley et al. (2023). The findings revealed a clear trend: boys are generally more inclined to engage in active commuting, such as walking or cycling. However, the extent of this preference varies significantly across countries and contexts, reflecting a complex interplay of cultural norms, infrastructure, and attitudes toward physical activity.

Similarly, a built environment study in Shiraz, Iran, reported that boys generally showed a stronger willingness to walk, although distance sensitivity varied by gender (Javadpoor et al., 2023). Additionally, a parallel study conducted in China has indicated that boys engage in more transportation-related physical activity, as socio-economic disparities influence physical activity levels more strongly for boys than for girls (Zhang et al., 2025).

A large-scale study conducted in 2021 involving over 11,000 Spanish students found that walking is the most prevalent mode of transportation to school for both boys and girls, with only a slight gender difference in walking rates (54.3% of all students walked, with similar percentages for each gender) (Castro-Lemus et al., 2021). However, girls were more likely than boys to use motorised transport. Additionally, for extracurricular activities, girls were more likely to participate in walking when the activity was nearby, indicating that proximity is a key factor influencing female participation. Similarly, no statistically significant differences in walking rates were found between genders in high-density areas. For example, 33.3% of females and 34.6% of males in the Bronx walked to school (McDonald, 2012a). These findings suggest that in specific urban environments, the gender gap in walking may be minimal or non-existent.

2.6.1.3 Ethnicity and Cultural Influence

The next aspect, ethnicity and cultural form, interacts with other elements, including parental expectations, gender norms, and risk perceptions, which strongly influence whether children are permitted to walk to school.

Ethnicity influences school selection and residential settlement patterns, thereby affecting the feasibility of walking to school. In Malaysia, parents usually choose schools based on several criteria, including the language of instruction, perceived reputation, and community ties. This may lead children to attend non-local or vernacular schools, which are likely farther from home, reducing the likelihood that they will walk to school. It demonstrates that ethnicity-linked schooling preferences alter the built environment context, including distance and route complexity, thereby making active commuting less practical, and neglecting those parents who culturally support walking in principle (Ibrahim et al., 2024).

Malaysia comprises a plural society with multiple languages, religions, diverse family practices, and differing educational preferences, all of which interact with parental concerns regarding safety and independence. These patterns influence both direct decisions (such as the parent's decision to let the child walk) and indirect determinants (school selection and residential location), producing measurable differences in the feasibility and uptake of AST (Ibrahim et al., 2024; Tristram et al., 2024).

One possible approach is through parental licensing and societal expectations related to gender. Recent Malaysian context work highlights that parents are often more protective of their daughters than of their sons, restricting solo outdoor travel due to concerns about personal safety, reputational norms, and gendered social expectations. This protective practice reduces independent mobility and active commuting among girls, particularly when the objective route conditions allow for walking (Ibrahim et al., 2024). Studies comparing different countries indicate that cultural beliefs regarding gender and supervision greatly diminish girls' autonomy and AST when parents view social risk as elevated (Timperio et al., 2025; Tristram et al., 2024).

Additionally, social capital, local community cohesion, and shared language are also pivotal aspects to consider, as each plays a protective role in the community. Typically, children come from families surrounded by strong neighbourhood networks, where neighbours know one another and parents coordinate drop-offs or walking in

groups. As a result, these children are more likely to be allowed to travel independently. On the other hand, families, including some migrant or minority households, that feel local support is lacking or are concerned about discrimination and safety issues, may adopt a more protective stance, restricting their children's opportunities to walk independently (Ibrahim et al., 2024; Tristram et al., 2024). Based on these findings, it can be concluded that ethnicity and cultural influences operate through parental attitudes, school choices, and community ties to shape AST patterns in Malaysia.

2.6.1.4 Household Income and Education Level of Parents

The Socio-Economic Status (SES) of a household is typically measured by examining household income and parents' educational levels. Both backgrounds are consistent predictors of children's school travel mode. Usually, children in lower-income families with lower parental education levels are more reliant on non-motorised travel, such as walking, cycling, and public transport, due to limited access to private vehicles and cost constraints on motorised travel. In contrast, families with higher incomes tend to own cars and adapt chauffeuring to school, as this mode is more convenient and perceived as safer. Based on the studies conducted by Timperio et al. (2025) and Wang et al. (2022) indicate this pattern, which lower SES tend to increase walking out of necessity, compared to the higher SES, where they can either increase active travel (depending on urban contexts where physical activity is promoted) or reduce it (high car ownership), depending on local conditions and school catchment patterns.

In the Malaysian context, emerging empirical work suggests that both income and parental education influence parents' decisions about whether to let their children walk to school. A Malaysian study on children's independent mobility highlights parents' concerns regarding traffic and safety. The findings note that families with greater financial means and higher levels of education tend to chauffeur their children to and from school (Ibrahim et al., 2024). This is primarily because they can afford both the vehicle and the time it takes, and because more educated parents are cautious about traffic and stranger-related risks. In contrast, lower-income families, particularly those without a car, often have no choice but to walk, thereby increasing AST rates in these groups.

Parental education and income interact to shape attitudes and behaviours in various ways. Generally, higher levels of parental education are associated with a better understanding of the health benefits of physical activity and a more proactive approach to adopting healthy habits. However, this higher level of education is also associated with increased car ownership and safety concerns, which can unintentionally limit children's ability to move independently. Numerous studies conducted in certain regions, including Asia, and pooled analyses have revealed that while parental education may lead to more active commuting when supported by investments in walkable neighbourhoods, it can also result in decreased walking when combined with car ownership and lengthy school commutes. This trend is evident in urban Malaysian areas, where school choice (national, vernacular, or private) tends to push children farther from home (Maulida et al., 2023; Michail et al., 2021).

The relationships among SES, school selection, and distance greatly influence walking habits in Malaysia. Parents with higher SES are more likely to choose a specific school based on perceived quality, language instruction, or social networks, regardless of whether the school is located further from their homes. This increased distance automatically, which poses a notable challenge for walking. In contrast, lower-income families often have to enrol in the nearest school due to a lack of transportation, resulting in shorter distances to school and higher walking rates (Ibrahim et al., 2024; Y. Wang et al., 2022). As a result, research and local planning efforts in Malaysia highlight how SES, school selection, and the distance from home to school interact, suggesting policy changes. This includes revising school catchment areas and enhancing existing pedestrian infrastructure, particularly in lower-income neighbourhoods, which could improve safety and promote fairness in walking opportunities.

Lastly, a literature review revealed that SES influences parental time availability, supervision practices, and lifestyle modelling. Parents who work long, irregular hours, which is often the case in lower-income households, may be unable to accompany their children to school, even if they would prefer to. In contrast, parents with more flexible work schedules, typically from higher SES, may choose to chauffeur their children. Additionally, parental education levels are correlated with traffic risks, danger from strangers, and acceptable independence, which affects the level of permission children are given to walk independently (Ibrahim et al., 2024; Timperio et al., 2025). Recent pooled and national studies highlight that initiatives aimed at increasing walking must consider SES. Simply promoting active travel to school

without enhancing route safety or addressing school-choice distance could exacerbate inequalities in exposure and safety.

2.6.1.5 Parental Working Status and Vehicle Ownership

Parental work patterns and household vehicle availability significantly influence the mode of transportation children in Malaysia use to travel to school. Parents with full-time or inflexible work schedules often choose the most convenient option, typically driving because morning drop-offs are closely tied to their commutes and time constraints. Research conducted in Bangsar and Shah Alam City, Malaysia, suggests that parents' occupational status is a significant factor in determining whether children engage in active transportation. Specifically, the likelihood of using active transport was reported as lower among full-time workers than among unemployed individuals, demonstrating that parents' work conditions affect their children's daily travel to school (Harumain et al., 2022). Full-time working parents, particularly those who travel long distances from home, are more likely to use motorised transport for their children due to time constraints, convenience, and the need to align school drop-offs with their commutes.

Besides, high vehicle ownership influences transportation choices toward chauffeuring. In Malaysia, urban mobility is currently heavily car-oriented. Due to the increase in household income, which has led to higher car ownership, the likelihood of walking for routine trips has decreased, perhaps to shorter distances (Harumain et al., 2022). Additionally, research conducted in Malaysia highlights that parents often choose to drive, especially when they perceive traffic risks and time pressure as salient, even for short distances (Ibrahim et al., 2024). In a study examining children's independent mobility to school, it was found that parents are "twice as likely to drive their child to school" due to concerns about unsafe neighbourhoods (Masoumi et al., 2020).

Parental commute mode also plays a significant role, as parents who drive to work are more likely to drive their children as well. In contrast, families without a car or whose parents typically walk or use public transportation are more likely to have their children walk. This connection between parental and child transportation choices is evident in recent global studies. These studies examine how parents perceive their environments and how adolescents engage in active school transport across 14

countries, where distance and perceived safety strongly influence whether families permit walking (Timperio et al., 2025). These trends are consistent with findings from Malaysia, where parental risk perceptions and convenience are key factors during the morning rush hour (Ibrahim et al., 2024; Harumain et al., 2022).

2.6.1.6 Parental Physical Activity and Lifestyle Modelling

Parental physical activity and lifestyle modelling are essential in influencing children's AST behaviours. Parents who regularly engage in Physical Activity (PA) often transmit positive attitudes and norms regarding an active lifestyle to their children, either directly through their actions or indirectly by providing logistical and emotional support for these activities. A recent longitudinal study conducted by Saunders et al. (2024) revealed that although parents' PA levels had a minimal direct impact on their children's PA, they significantly enhanced supportive actions, such as encouragement, co-participation, and providing instrumental support, which were linked to higher levels of PA among children over time. Even though the study focused on PA in general rather than AST specifically, the identified behavioural pathways, particularly the importance of parental facilitation, are relevant to walking to school.

Hosokawa et al. (2023) reported that parental use of community resources and provision of logistical support are positively correlated with children's participation in walking and moderate-intensity activities. In the context of school travel, this support can involve parents walking with their children to school, coordinating drop-off routines that incorporate walking, and fostering a household environment that regards walking as an essential norm.

Recent assessments of CIM in Malaysia reveal that parental decision-making, influenced by work schedules, safety perceptions, and cultural norms, plays a crucial role in determining whether children are allowed to participate in AST (Ibrahim et al., 2024). The 2022 Malaysia Report Card on Physical Activity for Children and Adolescents rated active transportation as low, citing inadequate parental encouragement and a preference for motorised transport, even for short distances (Active Healthy Kids Malaysia, 2023). These findings suggest that, in Malaysia, a car-centric, safety-focused environment, parents' daily routines, their willingness to accompany their children, and lifestyle choices significantly influence children's likelihood of walking to school.

2.6.2 Built Environment Characteristics

The built environment plays a profound role in how children engage in AST. Built environment attributes around school zones play a crucial role in shaping the likelihood that children walk to school. These characteristics, ranging from proximity and infrastructure quality to traffic control measures and environmental amenities, all contribute to how parents and children perceive the safety, convenience, and attractiveness of walking. Below, each key sub-theme is discussed with supporting evidence.

2.6.2.1 Distance from Home to School

Trip distance is one of the key factors to consider. The distance a student must travel to reach school is the most significant factor influencing their decision to choose AST. Walking is the preferred and most common mode of transportation for journeys of one mile or less. However, when the distance exceeds 1.6 kilometres (1 mile), enthusiasm for active travel declines sharply, leading fewer students to choose a healthy and engaging mode of commuting (Frisbee, 2024; Nyström et al., 2023).

According to PLANMalaysia (2017), for children aged 7 to 12, the estimated travel distance within a 5- to 10-minute walking period ranges from 300 to 400 meters. This range reflects typical walking speeds and stamina among primary school-aged children and is commonly used to determine walkable school catchment zones in Malaysia.

2.6.2.2 Availability and Width of Sidewalks/Walkways

Pedestrians are among the most vulnerable road users, facing significant dangers when navigating roadways. According to the Ministry of Transport Malaysia (2022), pedestrians are the third-highest fatality group after motorcyclists and car drivers or occupants in Malaysia, with an average of about 542 pedestrian deaths per year, equivalent to about 45 persons every month, highlighting the urgent need for authorities to prioritise pedestrian safety.

One essential measure to enhance safety is the provision of footpaths, which improve accessibility, ensure pedestrian comfort, and maintain the flow of road traffic.

Dewan Bahasa dan Pustaka (2011) defined a pedestrian path as a designated space that allows pedestrians to walk from one location to another. Therefore, local authorities must be attentive to pedestrian needs by establishing dedicated routes.

The 'width' feature measures the adequacy of sidewalk width to accommodate pedestrian volume and accessibility needs, which is commonly recommended to be 1.8m, including in school zones. The walking zone should be at least 1.8 to 3.0 meters wide, or wider, to accommodate higher pedestrian volumes. This width allows pedestrians to walk side by side and enables those moving in opposite directions to pass each other comfortably (Levenson Boodlal, 2003). Additionally, the minimum width of the walking zone should be 1.2 meters to ensure accessibility for people with disabilities, including those who use guide dogs, crutches, walkers, or wheelchairs. Wheelchair users typically require about 1.5 meters to turn around and 1.8 meters to pass other wheelchairs (Levenson Boodlal, 2003). According to JKR Malaysia (2015), the Design Guideline on Safety Facilities for Schools recommends a minimum clear sidewalk width of 2.0 m in a school zone.

As recommended by JPBD, data on human body shape are essential for planning pedestrian facilities. This includes considering a body's width, size, height, and thickness while walking in various styles. Walking requires enough space for individuals to swing their limbs comfortably. Typically, pedestrians need 2.5 feet (0.762 m) of space for each person when walking near others. However, when pedestrians walk together, only 2.2 feet (0.671 m) of space per person is required.

Walkways that meet or exceed the 1.8-meter minimum can accommodate higher pedestrian volumes and encourage walking, contributing to a safer, more accessible environment. Narrow walkways can lead to various issues, including decreased pedestrian comfort and safety, especially for groups, children, and individuals with disabilities. They increase the risk of pedestrians spilling into adjacent vehicle lanes during busy times. Also, it makes it challenging for wheelchair users or those with mobility aids to manoeuvre and pass each other. A minimum width of 1.5 meters is necessary for turning, while a width of 1.8 meters is required for passing. Indeed, the effectiveness of pedestrian walkways is closely tied to the quality of the infrastructure provided. Well-designed, sufficiently wide walkways are associated with higher pedestrian traffic and greater user satisfaction.

Additionally, to ensure pedestrian paths are convenient and safe, Fruin (1971) developed a theory of pedestrian flow capacity. The standard for pedestrian

convenience includes the freedom to walk at one's own speed, the ability to overtake slower pedestrians, and the ease of crossing and turning back. Pedestrian flow can be divided into six condition levels or service levels based on flow capacity and the qualitative evaluation of pedestrian comfort. It consists of Service Level A for low flow rates, which provides high comfort for pedestrians, and Service Level F for the highest flow rates, which often cause congestion (see Table 2.2). To ensure pedestrian comfort, the minimum Service Level proposed is Service Level C for existing or to-be-built paths. This level is also recommended for determining the design requirements for the pedestrian walkway. Therefore, any pedestrian facility provision in Malaysia must ensure it fulfils the minimum Service Level (Service Level C), providing high comfort and convenience for pedestrian users.

Table 2.2
Level of Service (LOS) Conditions for Pedestrian Flow

LOS Level	Density (ft ² per pedestrian)	Flow Characteristics	Pedestrian Comfort and Behaviour
A	> 15	Free flow, very low density	Pedestrians can walk at their desired speed without restrictions, feeling very comfortable.
B	10 – 15	Stable flow, low density	There are slight restrictions; pedestrians can move freely with minor adjustments.
C	7 – 10	Stable flow, moderate density	Some restrictions require pedestrians to occasionally adjust their speed and path.
D	4 – 7	Approaching unstable flow, high density	Movement becomes restricted, and pedestrians must frequently adjust their speed and path to accommodate others.
E	2 – 4	Unstable flow, very high density	Flow at capacity; movement is slow and uncomfortable, with frequent stops.
F	< 2	Breakdown flow, extreme density	Flow breakdown, stop-and-go conditions, pushing and crowding occur

Source: Fruin (1971)

2.6.2.3 Condition and Maintenance of Pedestrian Paths

Factors such as the presence of safe sidewalks and well-maintained footpaths encourage schoolchildren to walk to school. Well-maintained footpaths that have smooth surfaces, free from potholes and obstacles, reduce the risk of falls, improve perceived safety, and reduce travel time for children. In Malaysia, issues such as degraded surfaces, interrupted pavements and blockages from parked vehicles or utility poles discourage walking and can deter walking and force children into the roadway, which increases their exposure risk to traffic conflicts near schools (Bakhtiar et al., 2022; Gebremariam et al., 2024; Shabadin et al., 2022). These conditions are particularly critical in school zones, as site observations in Selangor indicate that obstructed pathways and poor surface quality are directly associated with increased pedestrian-vehicle conflicts during peak hours (Shabadin et al., 2022; Zahidy et al., 2024). Malaysia, with its tropical climate, also requires proper drainage and debris removal after rain. Poor drainage leads to water pooling, forces detours and discourages walking, especially among schoolchildren (Ibrahim et al., 2024; Ramlee et al., 2024).

2.6.2.4 Street Connectivity and Intersection Design

An inviting built environment promotes physical activity and fosters a sense of connection and safety, making the journey to school a more enjoyable and engaging experience for young travellers. Another aspect to consider is street connectivity and intersection design.

Street connectivity plays a crucial role in directness, travel time, and parents' perception of walking feasibility. According to, well-connected street networks can shorten home-school distances, making walking a viable option over motorised vehicles in Malaysian urban areas (Ibrahim et al., 2024).

Nevertheless, increased connectivity may lead to more intersections and potential points of conflict; hence, safe intersection designs are necessary. Research conducted in Malaysia and comparable tropical cities suggests that safety features, such as signalised zebra crossings, reduced curb radii, and pedestrian refuge islands, significantly enhance driver yielding rates and improve child pedestrian safety (Ramlee et al., 2024). Conversely, poor intersection design is characterised by long crossing distances, absence of signals, or faded road markings, which have been associated with

an increased crash risk for school pedestrians (Shabadin et al., 2022; Speed Management Hub | GRSF, n.d.-b). Therefore, it is essential to consider a balance between connectivity and protective features to enable children to walk to school safely and independently.

2.6.2.5 School Zone Infrastructure and Traffic Management Features

School zone infrastructure and traffic management features are another crucial element influencing active travel to school. The infrastructure within school zones is critical for controlling vehicle speeds, managing pick-up and drop-off chaos, and ensuring safe pedestrian crossings. Malaysian research consistently indicates that traffic calming devices, raised crosswalks, clear signage, and the presence of crossing guards reduce near-miss incidents involving schoolchildren (Shabadin et al., 2022). Malaysia, through the Ministry of Transport, prioritises the Star Rating for Schools (SR4S) tool to identify and enhance high-risk areas around school zones, with an emphasis on speed management and safety at school crossings (Ministry of Transport Malaysia, 2022). The absence of these measures may contribute to unregulated parking, disorganised vehicle movements, and excessive speeds, creating hazardous conditions that deter walking (Zahidy et al., 2024). Therefore, tailored traffic management plans, especially during peak school times, have been shown to significantly boost parents' confidence, enabling their children to actively commute to school, particularly when integrated with visible enforcement.

2.6.2.6 Land Use Patterns and Environmental Quality

Neighbourhood land-use patterns and environmental quality significantly affect children's ability to engage in active commuting to school. As noted by Harumain et al. (2022), residential and community spaces that encourage active travel due to the shorter distances and the natural surveillance effect. Busy arterial roads with high traffic volumes and commercial units often create obstacles to safe walking; therefore, quiet, mixed-use streets are more conducive to pedestrian activity among children (Ibrahim et al., 2024).

Additionally, air pollution, noise levels, and heat stress are critical factors affecting environmental quality. As discussed in their study, Ramlee et al. (2024)

reported that insufficient shading, lack of landscaping, and exposure to traffic contribute to heat discomfort among children walking to school in tropical climates.

2.6.2.7 Presence of Amenities (shading, seating, lighting, signage)

The presence of amenities such as shading, seating areas, dedicated pedestrian lighting, and signage plays a vital role in enhancing the comfort, safety, and attractiveness of walking routes. This is especially important for primary schoolchildren in Malaysia, where the climate is hot and humid. Based on research conducted at Universiti Malaysia Kelantan (UMK), its empirical findings reveal that shaded walkways, clearly marked signage, and rest spots are essential elements of Pedestrian Safety and Comfort, as well as Amenities and Environmental Factors, which promote walking by alleviating thermal stress, improving navigation, and providing places to rest (Ramlee et al., 2024).

Further afield, global research reinforces that pedestrian comfort is influenced by environmental quality and visibility, comprised of features such as shaded pathways, aesthetic wayfinding, and seating, which not only improve physical comfort but also elevate mental well-being and perceived safety, which is crucial, especially among younger pedestrians (Basu et al., 2023). By incorporating all these elements into school walking routes, active commuting to school becomes not only feasible but also enjoyable for children and their caregivers, especially in Malaysia's tropical setting.

2.6.2.8 Inclusive and Universal Accessibility Features

In Malaysia, the provision of pedestrian infrastructure in school zones is guided by the Malaysian Standard MS 1184:2014, which mandates universal design features to ensure accessibility for everyone, including children, individuals with mobility aids, and those with visual impairments. According to the Department of Standards Malaysia (2016), the minimum width for pedestrian walkways should be at least 91.4 cm for single users and ideally 121.9cm for two people walking side by side, and should be equipped with kerb ramps, tactile paving, handrails, and slip-resistant surfaces free from obstacles. These features are considered crucial to install, as they help children navigate school zones safely and comfortably. They are particularly effective when integrated with clear crosswalks, signage, and visual buffers, such as bollards, to discourage

vehicle encroachments. Additionally, the presence of accessible exits and ramps minimises barriers, especially for wheelchair users and parents with strollers, in promoting inclusive access along school routes.

2.6.3 Safety Factors and Risk Conditions

Safety is a crucial factor influencing children's walking to school and is shaped by the quality of infrastructure, including sidewalks and safe crossings. Behavioural factors, such as parental perceptions of traffic danger, often lead to restrictions on children walking to school. Environmental elements, such as lighting and neighbourhood cohesion, also affect safety perceptions, with the fear of crime potentially deterring walking. Furthermore, roads near schools have higher incident rates, underscoring the need for Vision-Zero strategies that integrate traffic calming and enforcement, ideally to protect schoolchildren walking to school.

2.6.3.1 Physical Safety

Several key aspects, including speed management, safe crossing provisions, and the overall quality and continuity of pedestrian facilities, significantly influence physical safety in school zones. Research conducted globally indicates that lowering operating speeds to 30km/h (20 mph) can lead to significant decreases in severe injuries. Long, uninterrupted routes and higher traffic volumes are built environment attributes that can be implemented to increase 85th-percentile speeds, but this can jeopardise safety unless mitigated by measures such as traffic calming and visual narrowing (curb extensions, raised tables, or median refuges). Recent evaluations of school zones have identified key design strategies, including wider and continuous footpaths, controlled crossings along designated routes, conspicuous school-zone gateways and signage, and managing turning speeds at intersections, as the most effective and scalable measures (Schepers et al., 2025). Swami et al. (2024) in their study related to "School Streets" involving restriction on vehicle access during peak school times, they indicate improved perceived crossing safety and increased active travel among school children, demonstrating that reallocating street space during peak hours can enhance safety as well as encourage a shift in travel modes (Dowling et al., 2025).

2.6.3.2 Behavioural and Perceived Safety

Crash risk near schools often arises from children's exposure to unsafe driving behaviours, such as speeding and failing to yield, as well as their developing judgment skills while on foot. Studies conducted by Osuret et al. (2024) around primary schools indicate that unsafe crossings are increasing in areas with heavy traffic, and the installed infrastructure is inadequate. From the parents' perspective, traffic danger and neighbourhood safety significantly influence their choice of mode of transportation. Research conducted across 14 countries indicates that perceptions of traffic safety, walkability, accessibility, and mixed land use are positively associated with children's active travel, particularly for short distances. Conversely, low perceptions of safety hinder walking, even in moderate conditions (Timperio et al., 2025; Xing et al., 2025). Additionally, perceived personal security is a crucial factor, as girls and women often alter their routes or timings due to fear of harassment in public spaces and near transit, which tends to discourage independent travel to school. Therefore, both design improvements, such as lighting and passive surveillance, and social measures are necessary to address these issues (Ceccato & Loukaitou-Sideris, 2022; Ison et al., 2025).

2.6.3.3 Environmental and Social Safety

In addition to roadway design, various environmental and social factors must be considered, including lighting, frontage activity, informal surveillance, and social cohesion, which affect the perception and use of safe routes to schools. A recent review suggests that the perceived safety of a neighbourhood, including concerns about traffic and personal safety, influences the relationship between the built environment and students' active travel to school, which underlines the importance of integrating physical traffic-calming strategies with community oversight and safe route initiatives (Wangzom et al., 2023). Referring to global road-safety guidance for children, which highlights compounding risks present in low- and middle-income areas, underscores that boys are more likely to suffer fatal road injuries, compared to girls who often report feeling more unsafe due to harassment, suggesting that equitable safety requires addressing both crash and personal security risks along school trips (Vincenten et al., 2022). According to Ellizar et al. (2023), participatory audits conducted with students, parents, and teachers can identify specific local hazards, such as blocked sightlines and

informal parking, and also foster community involvement in enhancing safety in school zones.

2.6.3.4 Incidents and Accident Risk

In addition to the above safety aspects, the risk of incidents and accidents is considered higher in school zones, particularly during peak hours. Numerous studies demonstrate that pedestrian conflicts and injury rates increase significantly in school zones when traffic speeds and volumes are elevated, particularly in the absence of pedestrian crossings (Swami et al., 2024). Recent evaluations of targeted safety measures have shown encouraging results, with School Streets and related “safe-access” programmes associated with improved safety perceptions and increased walking rates among students. Additionally, strengthening enforcement in school zones and penalty regimes can positively influence road-user behaviour, such as lowering speeds and improving compliance with yielding, when supported by an appropriate design standard (Dowling et al., 2025). As highlighted by Swedler et al. (2024) on broader injury data, it confirms that active mobility users, including child pedestrians and cyclists, experience a significant share of road-related trauma, justifying a Vision-Zero strategy that focuses on managing speeds in school zones, crossing on desire lines, and traffic separation from turning vehicles.

2.7 Critical Synthesis: Universal and Context-Specific Influencing Factors

A synthesis of the previous literature reveals that although many factors influence children’s walking to school, their importance and mechanisms vary according to geography, culture, and governance structures. Drawing on the Social Ecological Model (SEM) and Children’s Independent Mobility (CIM) frameworks, these determinants can be broadly divided into two groups: universal predictors, which consistently shape walking behaviour across settings, and context-specific predictors, which depend on local conditions such as culture, socioeconomic structure, and policy enforcement. Both groups are explained in the following section.

2.7.1 Universal Predictors

Previous research across high-, middle-, and low-income countries indicates that four predictors are dominant and relatively universal for walking to school: distance, traffic safety, pedestrian infrastructure quality, and the child's age.

- Distance is consistently the most significant factor influencing walking habits, and the likelihood of walking declines sharply as school distance exceeds one or two kilometres (Mitra, 2013; Pont et al., 2011).
- Concerns about traffic safety are a universal issue, with parents worldwide worrying about speeding vehicles, dangerous crossings, and heavy traffic volumes (J. R. Panter et al., 2010).
- Pedestrian infrastructure, such as continuous sidewalks, safe crossings, adequate lighting, and shade, promotes walking in urban environments (Villanueva et al., 2012).
- The age or grade level of children also plays a consistent role. Older children, who possess greater cognitive skills and receive parental trust, tend to have greater freedom to walk independently (Carver et al., 2014; Veitch et al., 2017).

Within the SEM, these factors operate across individual (age), interpersonal (parental permission), and environmental (distance, infrastructure, safety) levels. Meanwhile, from the perspective of CIM, they directly affect a child's freedom to navigate independently. Therefore, these universal predictors provide the foundational ecological conditions for walking behaviour across settings.

2.7.2 Context-Specific Predictors

Various factors, including gender, socioeconomic status, ethnicity, cultural norms, and local policy implementation, are highly context-dependent, highlighting the role of social and institutional environments in mediating walking behaviour.

- Gender: In Western countries, differences in walking behaviour between genders are generally minor, as both boys and girls enjoy relatively high independent mobility (Shaw, Bicket, Elliott, Fagan-Watson, Mocca, Mayer Hillman, et al., 2015). In contrast, in many Asian societies, including Malaysia,

girls usually have less freedom to walk alone due to cultural expectations surrounding safety and protection.

- **Socioeconomic Status (SES):** In high-income contexts, affluent families may promote walking as part of a healthy, eco-friendly lifestyle. Conversely, in Malaysia and other developing countries, walking often becomes a necessity for lower-income families with limited access to vehicles. This difference illustrates how the same behaviour can arise from contrasting motivations, either choice or necessity.
- **Ethnicity and Cultural Norms:** In Malaysia, school selection often reflects language and religious preferences, such as Malay-, Chinese-, or Tamil-medium education, and schools may be located farther from home. Spatial and cultural dynamics can reduce the feasibility of walking, even when schools are available locally.
- **Local Policy and Enforcement:** In developed countries, initiatives such as SRTS have improved safety and increased walking rates through coordinated implementation and evaluation (Whitney et al., 2023). In Malaysia, however, similar policies have struggled to achieve long-term success due to limited enforcement, fragmented governance, and inconsistent monitoring.

These context-specific predictors demonstrate how interpersonal, community, and policy levels of the SEM interact with cultural and institutional factors to shape children's independent mobility. From the perspective of CIM, cultural norms and weak enforcement limit children's freedom, even when the necessary physical infrastructure is in place.

2.8 Policy and Planning Context

Promoting active travel to school among children is not merely a matter of individual choice but also one of policy and urban planning, involving transportation, education, public health, and governance. Over the past two decades, many countries have implemented integrated programmes, including Safe Routes to School (SRTS), Walkability Audits, and Child-Friendly City initiatives, to foster safer, more supportive environments for children's active travel. These initiatives align with the Sustainable

Development Goals (SDGs), particularly SDG-11, which focuses on sustainable cities and communities, and SDG-3, which aims for good health and well-being.

In Malaysia, several national and local policies, such as the National Transport Policy 2019-2030, National Physical Plan (NPP3), and Low Carbon City Framework (LCCF), pursue similar goals, aiming to enhance walkability and encourage non-motorised modes of travel. Nonetheless, despite these policy aspirations, the actual number of Malaysian children participating in active travel remains low, revealing a critical gap between planning intentions and real-world behaviour.

2.8.1 International Initiatives: Safe Routes to School (SRTS)

The Safe Routes to School (SRTS) initiative, introduced in the United States and Europe in the early 2000s, is one of the most influential global strategies for promoting children's active travel. SRTS has evolved from a set of local pilot projects into a widely adopted initiative, combining infrastructure improvements such as sidewalks, crossings, and traffic calming with education, enforcement, and community engagement to address both physical and behavioural barriers to walking. Its fundamental components include 6E's: engineering, education, encouragement, enforcement, engagement, and evaluation. 6E's aiming to combine physical infrastructure improvements with programming and policy initiatives to reduce road danger and encourage active travel (walking and cycling) to school (K. Johnson et al., 2024). According to Whitney et al. (2023), research from multiple states and cities indicates that when SRTS is implemented as integrated, sustainable programmes (integrating engineering efforts with active community participation and ongoing evaluation), SRTS can increase active commuting while also reducing the risk of accidents. This is supported by assessments of SRTS in the U.S., U.K., and Australia, which indicate significant reductions in child pedestrian injuries and increases in walking rates, particularly in communities with sustained funding and cross-sector collaboration.

Recent research highlights that SRTS functions as a complex intervention, integrated within broader transportation and community frameworks. Modelling and empirical studies from 2020 to 2023 suggest that short-term infrastructure alone leads to lasting increases in walking only when accompanied by long-term monitoring, school engagement, and enforcement strategies that enhance parental confidence (Whitney et

al., 2023). Conversely, evaluations of program implementation frequently identify common challenges, including lack of sustained funding, insufficient staff capacity, and inconsistent performance measurement. These issues undermine program fidelity and diminish long-term effectiveness. These implementation barriers are increasingly documented across contexts and play a key role in explaining mixed outcomes of programs.

A wave of evaluations and reviews conducted from 2024 to 2025 has discovered how SRTS operates within various governance structures. A systematic review and recent programme syntheses indicate that the most significant impacts of SRTS occur when: (i) multiple agencies (transportation schools, local government, police) collaborate in a formalised manner, (ii) community involvement and school-based education are ongoing instead of sporadic, and (iii) evaluation and monitoring frameworks assess both the delivery of infrastructure and the outcomes (walking rates and safety perceptions). In situations where these conditions are absent, particularly when engineering projects are tackled in isolation, walking rates often return to previous levels within a few years. Hence, these findings highlight the critical role of institutional and social supports alongside physical design.

International experience provides valuable insights for countries like Malaysia. They demonstrate that fostering sustained behavioural change requires more than physical infrastructure. Moreover, it relies on strong institutional coordination, consistent policy enforcement, and social acceptance of children's mobility. Successful SRTS programmes generally feature multi-agency partnerships, well-defined performance indicators, and child-centred planning, engaging urban citizens rather than passive dependants.

2.8.2 Malaysian Policy and Planning Framework

The policy framework in Malaysia increasingly acknowledges the necessity for sustainable and active transport options. The National Transport Policy (2019-2030) outlines strategic thrusts to enhance safety, inclusivity, and green mobility, including promoting walking and cycling for short-distance trips. Similarly, the National Physical Plan 3 advocates compact urban development, transit-oriented development, and integrated pedestrian networks to enhance accessibility and reduce car dependency (Federal Department of Town and Country Planning, 2017). At the local level, several

authorities, including the Shah Alam City Council, have introduced Low Carbon City Action Plans and Safe City Programmes to foster non-motorised travel and improve pedestrian safety near schools (Rashid et al., 2024).

Despite these initiatives, many policies have a top-down approach, with limited mechanisms to ensure local implementation. The lack of a national framework specifically addressing children's mobility, similar to SRTS, has led to fragmented efforts that depend heavily on local councils' capabilities and priorities. Moreover, child-specific considerations are often overlooked in urban design standards and planning guides, resulting in pedestrian facilities that cater to adult functionality but fail to address the safety and independence requirements for children.

2.8.3 Critical Evaluation of Policy Implementation in Malaysia

Despite Malaysia's implementation of various sustainable mobility frameworks, the results have been limited due to challenges in governance, enforcement, and cultural attitudes.

Firstly, a key obstacle is institutional fragmentation. In Malaysia, current practices involve various agencies, such as the Ministry of Transport, the Ministry of Education, local councils, and the police, overseeing transport infrastructure, school safety, and urban design, yet lacking an effective mechanism for coordination or accountability. This fragmented approach results in overlapping jurisdictions, inconsistent law enforcement, and limited integration of child mobility within broader urban policy.

Secondly, the mechanisms for enforcement and monitoring are inadequate. For example, traffic regulations near school zones, such as speed limits and no-parking rules, are often poorly enforced, undermining the safe environment needed for walking. Furthermore, many pedestrian improvement initiatives labelled as "Safe City" or Low Carbon" are executed as one-time infrastructure projects without thorough post-implementation evaluations. This lack of systematic follow-up leads to rapid deterioration and reduced public trust. Without institutionalised maintenance budgets and performance indicators, long-term behavioural impacts remain limited.

Thirdly, cultural and behavioural norms significantly impact the effectiveness of policies. The urban culture in Malaysia is predominantly centred on cars, driven by suburban sprawl, affordable fuel, and high rates of private vehicle ownership. Walking

is commonly viewed as unsafe, inconvenient, or unattractive, especially among children. Factors such as parental overprotection, fears of crime, and uncomfortable weather further deter independent mobility. As a result, parents often prefer chauffeuring their children, even when infrastructure is available, undermining the intended outcome of walking-promotion policies. These situations reflect deeper cultural dimensions that discourage autonomy and risk-taking among children. This reinforces dependency and limits the social acceptance of child-friendly planning principles.

Finally, planning standards and governance priorities tend to prioritise vehicle efficiency over pedestrian accessibility. It can be observed through various local development plans that still emphasise road widening, parking provision, and car-oriented design, neglecting pedestrian improvements. While some cities in Malaysia, such as Shah Alam and Putrajaya, have adopted green mobility strategies, these efforts often focus on adult commuters and recreational users rather than school-aged children. The absence of a structured national SRTS framework or a comprehensive Child Mobility Plan further restricts the effectiveness of current policies.

2.8.4 Implications for Child Mobility Planning

The limited effectiveness of walking promotion initiatives in Malaysia stems not only from infrastructural inadequacy, but also from various systemic, institutional and cultural barriers. To address these issues, future urban planning should embrace a child-centric governance model that integrates mobility, safety, and independence into the core of urban design and policy implementation. This requires coordinated action among multiple sectors, including urban planning, education, transport, and public health, supported by sustained funding, community involvement, and evidence-based evaluation mechanisms. By incorporating measurable indicators of children's active travel into national and local policies, Malaysia could monitor progress and establish walking as both a transport and a public health priority.

2.9 Research Gap and Conceptual Framework Development

Several critical gaps remain, particularly related to child-centred urban planning, contextual application, and methodological integration (refer to Section 1.3). In the global context, research has demonstrated that a complex interplay among socio-demographic, environmental, and behavioural factors influences AST. However, recent studies indicate that due to increasing reliance on motorised transport and safety concerns, a continued global decline in children's participation in active commuting (Wangzom, 2025), highlighting the need for more context-sensitive and implementation-oriented research.

In a global perspective, AST research has been extensively developed in high-income countries, where structured programs such as Safe Routes to School (SRTS) and well-established pedestrian infrastructure are commonly installed. Empirical evidence from the study done by Timperio et al. (2025) suggest that factors such as distance to school, land-use mix, accessibility, and perceived safety significantly influence children's walking behaviour across diverse urban contexts. However, these findings may not be transferable to developing or upper-middle-income countries, particularly Malaysia, due to differences in urban form, infrastructure provision and socio-cultural dynamics.

Specifically, in the Malaysian context, existing studies regarding this topic have remained relatively limited and fragmented. While existing research has explored children's independent mobility (CIM) and its relationship with active transportation, the focus has primarily been on general mobility instead of school-specific travel behaviour (Ibrahim et al., 2024). Additionally, most previous studies have often relied on quantitative survey approaches, neglecting the importance of conducting field-based assessments and stakeholder perspectives. This approach clearly creates a gap in understanding the actual physical conditions of pedestrian infrastructure and the real experiences of schoolchildren.

Four key research gaps are identified based on the literature review. First, a design and policy gap is evident in the absence of child-specific pedestrian planning guidelines tailored to school zones. A user perspective gap persists, as children's and parents' perceptions are often underrepresented in transport and urban planning research. Third is a contextual gap, as few empirical studies have been conducted in Malaysian urban environments, limiting the applicability of global findings to local

conditions. Finally, a methodological gap exists due to the lack of integrated mixed-methods approaches that combine quantitative and qualitative methods.

To address the listed gaps above, this study develops a conceptual framework grounded in the Socio-Ecological Model (SEM) and Children's Independent Mobility (CIM). SEM allows examination of multilevel influences on children's walking behaviour. At the same time, CIM provides a child-centred perspective, emphasising autonomy, perceptions of safety, and spatial freedom in children's daily mobility.

This study proposed a conceptual framework which links key determinants of AST into five primary domains, namely i) Demographic and Socio-economic Background, ii) Social and Behavioural Factor, iii) Built Environment Factor, iv) Policy and Institutional Factor, and v) Safety Perceptions and Risks. The domains are further influenced by other aspects, including parental perceptions, forming an interconnected system that shapes children's decision-making regarding walking to school. The explanation of the development of the Conceptual Framework is further explained in Section 3.4.

By synthesising global theoretical perspectives with local considerations, this framework provides a comprehensive framework for analysing children's walking behaviour in urban contexts, particularly in Malaysian cities. It bridges identified research gaps by combining several data sources, including empirical data, user perspectives and environmental assessments. This approach contributes to the academic understanding of AST and to the development of practical, child-sensitive planning guidelines for safer, more walkable school environments.

2.10 Summary

In summary, this chapter indicates that several factors influence whether children walk to school, including various demographic and socioeconomic traits, safety concerns, aspects of the built environment, and children's independent mobility (CIM). Key factors such as age, gender, household income, parental education, and vehicle ownership significantly shape travel decisions. Additionally, factors such as parental employment status, perceptions of safety, and lifestyle choices significantly influence active commuting behaviours. The built environment factor, which includes distance, sidewalk conditions, traffic safety, connectivity, and local amenities, plays a crucial role. Shorter, safer, and more accessible paths lead to increased walking rates. While CIM is associated with greater walking, its development in Malaysia is hindered by cultural expectations and safety issues. To effectively encourage children to walk to school, a comprehensive strategy is necessary. This strategy should consider parental views, supportive infrastructure, and socio-cultural factors, which will form the basis for the theoretical framework and analysis in this study.

Therefore, this study addresses the challenges faced by urban areas in Malaysia, using Shah Alam City as a case study. Shah Alam's Low Carbon City Action Plan and pedestrian friendly design provide an ideal testing ground for examining how built environment features, safety perceptions, and parental perceptions interact within existing planning structures. Understanding these dynamics will help identify practical interventions to bridge the gap between policy and practice, ultimately fostering safer and more walkable school environments for Malaysian children.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

Chapter Three, Research Methodology, was vital to the study. It detailed the systematic process for conducting research, collecting data, and analysing results. Selecting the appropriate methodology was critical to ensuring the validity and reliability of the findings. This chapter guided the research by outlining the steps taken to achieve the results, answer the research questions, and address the objectives. By presenting a detailed, transparent account of the methodology, this study aimed to fill existing research gaps.

The research methodology chapter provided a systematic framework that described the case study's research design and strategy, conceptual framework, and rationale. The choices made were justified by the research questions and objectives, ensuring a rigorous approach, as detailed in the research framework section. Following this, the chapter presented the case study, explaining the practice of sustainable city in Shah Alam and the reasoning for selecting Shah Alam City as the case study.

This chapter also explained the data collection methods and techniques for sample size determination. In addition, it detailed the analysis approaches and ethical considerations. Taken together, this comprehensive overview provided readers with a clear understanding of the processes used to generate and analyse data, helping establish the credibility and trustworthiness of the research outcomes.

With a robust methodology, this study aimed to collect precise data and generate meaningful insights into the factors influencing children's choices to walk to school in Malaysia.

3.2 Research Design

Following the chapter overview, the research design section underscored its pivotal role in shaping this study's approach and structure. Given the research topic, the researcher employed a case study and mixed-methods design, selected for their suitability.

According to (Kumar, 2019), the case study design assumes the case being studied is typical. Thus, a single case can reveal insights into events and situations common within a particular group. In this research, six primary schools in Shah Alam City were selected as case studies, providing a basis for a thorough, holistic, and in-depth exploration of active transport in schools. The researchers aimed to investigate these aspects through the selected schools.

These research designs combined a qualitative and quantitative approach to offer a comprehensive view. Qualitative methods included expert interviews, site observations, and secondary data collection. These methods explored the perceptions, attitudes, and experiences of schoolchildren, parents, school authorities, and other stakeholders regarding walking to school in Shah Alam City. This approach helped identify the key factors and challenges related to travel behaviour among primary school children.

The quantitative method used a questionnaire survey to collect numerical data on distance to school, perceptions of safety, pedestrian infrastructure, and demographic and socio-economic factors. Because these factors may have influenced children's walking patterns and behaviour, the quantitative data were analysed statistically to identify patterns, correlations, and associations among these variables.

By combining qualitative and quantitative data through triangulation, this study aimed to provide a thorough understanding of the key factors influencing children's use of active transport to school in Shah Alam. The mixed-methods approach helped triangulate data sources, validate findings, and deliver rich insights into the topic.

To summarise, using both a case study and a mixed-methods design, this research sought to offer insights. These insights may help shape policies and interventions to promote active transportation and enhance children's school travel experiences in Malaysia.

3.2.1 Method Triangulation

The researcher employed the triangulation method in this study. According to Patto (1999), triangulation refers to the use of multiple methods or data sources in qualitative research to develop a comprehensive understanding of a phenomenon. This method is considered a qualitative research strategy for assessing validity by converging data from multiple sources. However, this method was also commonly applied in quantitative research.

Based on four types of triangulation (a) method triangulation, (b) investigator triangulation, (c) theory triangulation, and (d) data source triangulation, the researcher decided to apply method triangulation during the data collection process. The triangulation method combines multiple data-collection methods to study the same phenomenon. This type of triangulation, commonly employed in qualitative research, encompasses data collection methods such as field notes, interviews, and observation. The following paragraphs provide a detailed explanation of how the researcher used triangulation in this research.

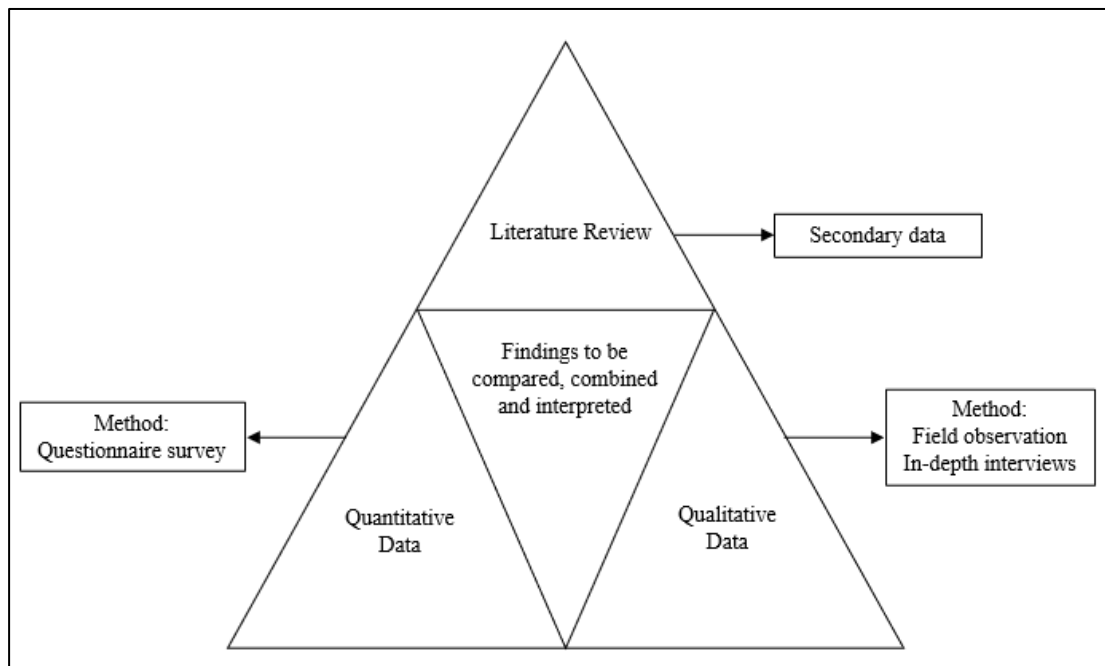


Figure 3.1 Triangulation Method Applied in the Study

Figure 3.1 clearly shows the combination of methodologies used in this research. In many studies, most researchers employ triangulation to gain a more holistic perspective on specific research questions. Triangulation also enhances the credibility and validity of the findings.

The Literature Review involved systematically examining and analysing existing research, publications, and scholarly works relevant to the topic of this thesis (refer to Figure 3.1). The secondary data were gathered from various sources, such as the internet and official reports from government bodies. The literature review was conducted in a step-by-step manner, encompassing the definition of scope and objectives, the development of a research strategy, the screening and selection of relevant studies, the extraction and synthesis of data, the critical evaluation and integration of findings, the writing of the literature review, and the final step, which involved revision and finalisation. The software used during the Literature Review process was Atlas. Ti 8. By following all these steps, the researcher conducted a comprehensive literature review that synthesises existing knowledge, identifies gaps, and provides a solid foundation for this thesis.

The second method is quantitative data, which includes closed-ended information to measure variables such as attitudes, behaviour, and performance. This data analysis will utilise the Statistical Package for the Social Sciences (SPSS) software used to analyse the quantitative data. The questionnaire survey findings were used to identify the critical factors influencing children's decisions to walk to school, observe trends in children's travel behaviour, assess parental concerns, and examine the relationship between pedestrian infrastructure and walking frequency.

On the other hand, qualitative data collection involves gathering open-ended information through field observation and in-depth interviews. The qualitative data analysis was presented in written form, then aggregated into information categories and submitted, showcasing the diversity of ideas gathered during data collection. Therefore, these combined methods assess the factors that influence children's walking to and from school.

3.3 Research Strategy

This research will employ an explanatory sequential mixed-methods strategy. The sequential explanatory strategy is a research design approach that combines quantitative and qualitative methods. It aims to provide a more comprehensive and in-depth understanding of the study topic. Using this strategy, the researcher will first collect and analyse quantitative data, then collect and analyse qualitative data to further explain and interpret the quantitative findings. Creswell & Creswell (2018) defined the explanatory sequential mixed-methods approach as a research design in which the researcher first conducts quantitative research, analyses the results, and then builds on them to explain the findings in more detail through qualitative research. The study is considered explanatory because the initial quantitative data are further elaborated upon using qualitative data. This type of research design is popular in fields that rely heavily on quantitative methods, as it begins with quantitative research. However, it presents challenges, such as identifying which quantitative results to explore further and addressing unequal sample sizes across study phases. The sequential explanatory strategy aims to enhance the validity of the research findings by integrating both types of data.

In the context of this research topic, the sequential explanatory strategy will involve an initial phase of data collection using quantitative methods, specifically a questionnaire survey. This phase will support the analysis stage by identifying patterns, trends, and correlations in children's school travel behaviour, including distance to school, safety concerns, and demographic and socio-economic factors.

After the quantitative data have been analysed, the qualitative phase will be initiated. This phase involves several data collection methods, including in-depth interviews, field observations, and secondary data collection. Qualitative data collection will enable a deeper exploration of the findings, including the underlying reasons, motivations, and experiences that influence schoolchildren's decisions to walk to school. Additionally, this phase aims to provide context, explanations, and insights that complement and enhance the validity of the quantitative findings.

This type of research design enhances the study's benefits by seeking to bridge the gap between quantitative and qualitative understanding. Employing a sequential strategy may offer a more holistic perspective on the practice of active transport to school among primary school children. In addition, it may enhance the validity and

reliability of the research findings, enabling in-depth interpretation of the complexities of primary school children's travel patterns, particularly in Shah Alam City and, more broadly, in Malaysia.

3.4 Conceptual Framework of Active School Travel (AST)

AST, defined as walking or cycling to and from school, is influenced by complex interactions among individual, social, environmental, and policy-level factors. As a guide for this study, a conceptual framework was constructed based on two well-established models: the Model of Children's Active Travel (M-CAT) and the PASTA Conceptual Framework.

According to Pont et al. (2011), the Model of Children's Active Travel (M-CAT) outlines how children's participation in active travel is shaped by objective factors (demographic, socio-economic and built environment) and subjective perceptions (parental concerns, perceived safety, and social norms). The concept distinguishes among the attributes of children, parents, and the broader environment, highlighting that the decision-making process is influenced by how both children and their caregivers interpret these attributes. The outcomes are seen in the children's travel behaviour and experiences.

Complementing this, the Physical Activity through Sustainable Transport Approaches (PASTA) initiative in Europe has developed the PASTA Conceptual Framework, which integrates public health and transportation to understand and promote active travel. Using a multi-level socio-spatial lens, this approach considers contextual factors at the individual, community, and urban infrastructure levels. It conceptualises travel behaviour as a function of contextual circumstances (built environment and policy), behavioural drives, and contextual settings (cultural norms and socioeconomics), arranged across social and spatial scales.

Based on these two models, the researcher developed a contextualised conceptual framework for Malaysia's urban environment, with particular emphasis on Shah Alam. Five important domains are integrated into this framework:

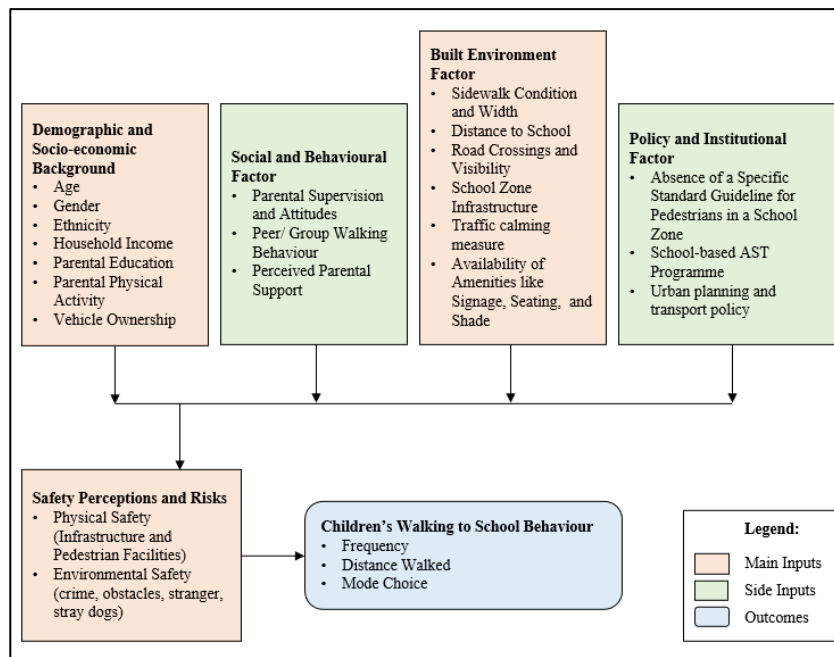


Figure 3.2 Conceptual Framework for Understanding the Influencing Factors on Children's Walking to School

The conceptual framework presented in Figure 3.2 highlights how children's walking-to-school behaviour is influenced by multiple interrelated factors, namely demographic and socio-economic background, social and behavioural factors, built environment factors, and policy and institutional factors. Each of these factors plays a role, either directly or indirectly, in determining children's walking-to-school behaviour, including the mode of travel, how often they walk, and the distance they cover.

To begin with, demographic and socio-economic factors such as age, gender, family income, and vehicle ownership impact both parental choices and children's freedom to walk. For example, younger children or those from wealthier families may often be driven to school. In contrast, those from lower-income households or families with only one vehicle may walk more frequently. Next, social and behavioural factors, including parental supervision, peer walking behaviour, and perceived parental support, play a key role in shaping both parents' and children's confidence and motivation toward walking. Positive social norms and peer modelling can encourage walking, whereas overprotective attitudes may restrict it.

Additionally, the built environment plays an essential role in walking decisions by shaping pedestrian facilities, road safety features, and the overall comfort of the

walking experience. Well-maintained sidewalks, adequate crossings, and traffic-calming measures increase perceived safety and make walking a more viable option. Finally, policy and institutional factors, such as the presence of school-based active travel programs, local planning policies, and pedestrian design standards, create enabling or constraining conditions for safe and accessible walking environments around schools.

While these four factors individually influence children's walking behaviour, their effects are partially mediated through Safety Perceptions and Risks. Parents and children form safety judgments based on environmental and social cues, such as traffic danger, the presence of strangers, stray dogs, or inadequate infrastructure, which, in turn, affect their willingness to walk. A high perception of risk tends to discourage walking, even in physically walkable areas, whereas perceived safety increases the likelihood of walking, even in less favourable socio-economic conditions.

In summary, Safety Perceptions and Risks act as a mediating factor, helping to convey the effects of demographic, social, environmental, and policy-related elements into actual walking behaviour. Therefore, improvements in any of these four main factors can indirectly foster children's walking to school by enhancing their perceptions of both physical and environmental safety.

3.5 Research Framework

The framework serves as the theoretical foundation guiding the research on the factors influencing children's walking to school in an urban context in Shah Alam City, Malaysia. Creating a strong research framework is vital to establishing a structured approach for exploring, analysing, and interpreting the multifaceted travel behaviour of primary school children.

In the context of this research, the framework consists of a problem statement, research questions and objectives, scope and data collection methods. All these elements aim to provide a comprehensive understanding of the key determinants influencing children's decision-making about walking to school. Integrating various theoretical perspectives, supported by empirical evidence, into the research framework enables the researcher to scrutinise the complex interplay of factors shaping children's travel behaviour in Shah Alam City. Figure 3.4 shows the research framework for this study.

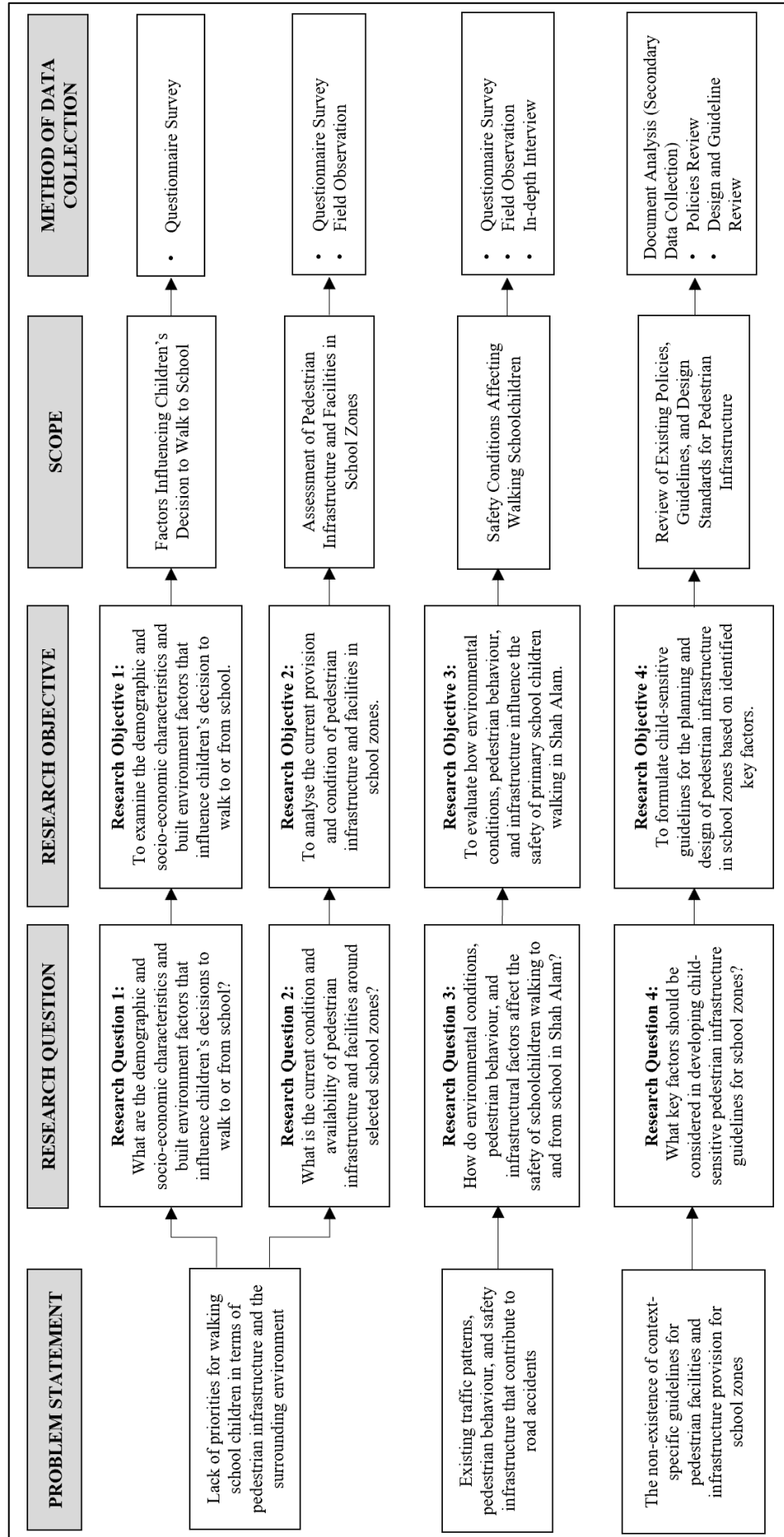


Figure 3.3 Research Framework

3.6 Case Study

Shah Alam, the capital of Selangor, Malaysia, is a significant urban centre in the Klang Valley. Shah Alam is situated between Klang and Petaling Jaya. This city can be divided into two districts: the Petaling District and part of the Klang District. It comprises 56 sections and covers 290.3 km² of land, mainly occupied by residential and industrial development.

The general location map (see Figure 3.4) provides an overview of the study area within the broader context of Shah Alam, the state capital of Selangor, Malaysia. All six schools involved in this study are located within Shah Alam City, which is governed by the Shah Alam City Council and is under the Klang and Petaling District. Petaling District is one of the most urbanised and densely populated areas in the Klang Valley region, known for its rapid development and diverse land uses.

The map in Figure 3.5 emphasises the geographical distribution of schools in Shah Alam, illustrating their positions relative to key administrative boundaries. Shah Alam is a planned city that features a mix of residential, commercial, mixed-use, institutional, and public facilities, reflecting a complex urban environment in which pedestrian infrastructure is crucial.

Furthermore, Figure 3.4 also highlights significant transportation features, including highways, public transit lines, and other transportation corridors, that impact accessibility and pedestrian movement around the schools. These transportation networks are crucial for shaping the pedestrian environment and influencing traffic volume, safety, and connectivity.

Overall, Figures 3.4 and 3.5 clearly show that schools situated within a comprehensive urban and administrative framework provide essential context for understanding the pedestrian facilities observed in the study. It enables readers to recognise the environmental and infrastructural factors that influence pedestrian behaviour and infrastructure quality across various areas of Shah Alam.

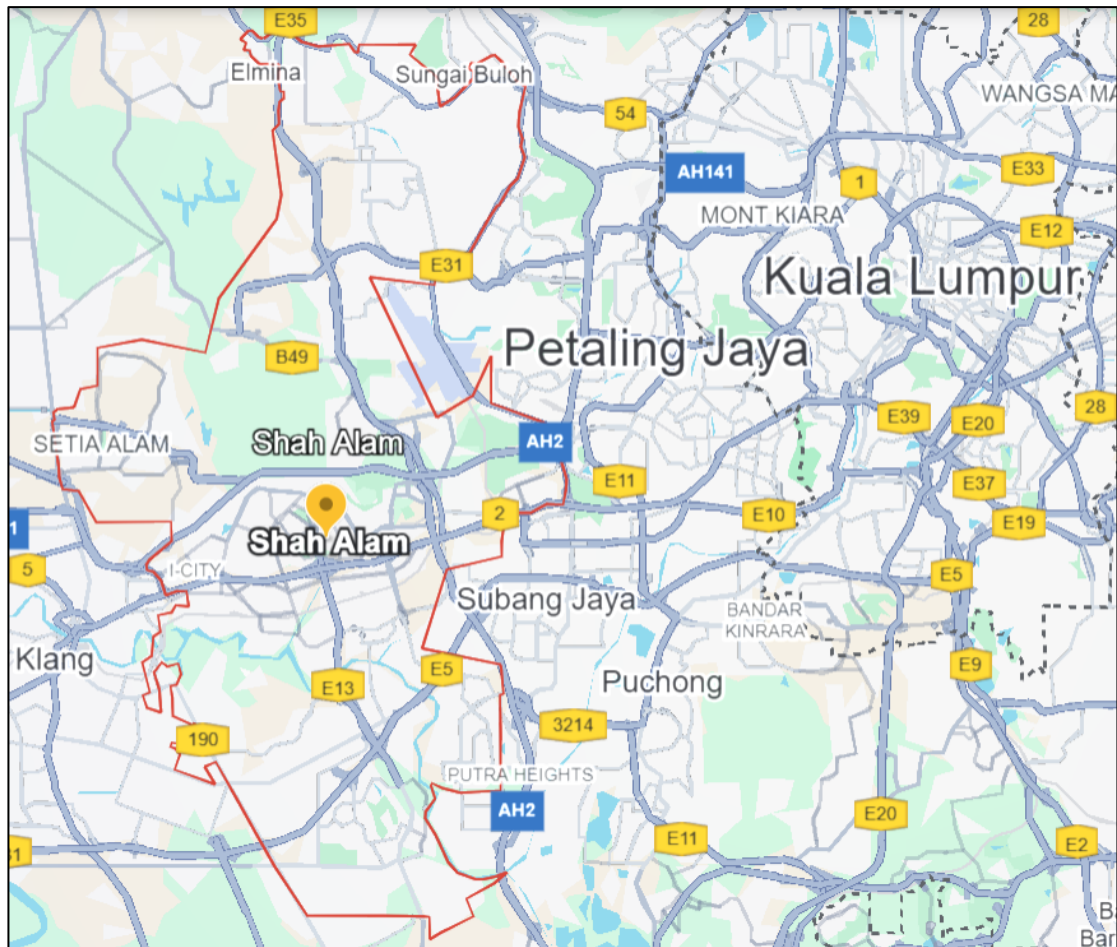


Figure 3.4 Location Map of Shah Alam, the Study Area

3.6.1 The Practice of Sustainable City in Shah Alam

Shah Alam was established as a planned city and developed into a vibrant administrative and residential hub with a population characterised by diverse socio-economic backgrounds. This city is governed by the Shah Alam City Council (SACC), a local authority pivotal to urban planning, development, and sustainability initiatives.

In recent years, Shah Alam has actively integrated green transport planning into its Low Carbon City (LCC) initiative, aiming to reduce carbon emissions and improve urban livability. The Shah Alam Low Carbon Action Plan 2035 outlines a comprehensive strategy to promote sustainable mobility, emphasising transit-oriented development and non-motorised transport modes such as walking and cycling (Hamdan et al., 2025). There are several key components of Shah Alam's green transport planning.

Shah Alam City also prioritises development around public transit hubs through “Transit-Oriented Development (TOD)” to reduce dependency on private vehicles. This approach encourages residents to use public transport, lowering traffic congestion and emissions around the city centre. Besides, Shah Alam promotes pedestrian-friendly urban design and cycling infrastructure through the “City for Walking and Cycling” elements initiative. The plan includes the development of dedicated bicycle lanes, pedestrian walkways, and shared mobility services, such as bicycle-sharing systems. These initiatives aim to create a safe, attractive environment for walking and cycling, thereby directly encouraging children to walk to school.

Additionally, there is an initiative to promote energy-efficient vehicles and public transportation in Shah Alam City, supporting the adoption of electric cars and other energy-efficient modes. This idea is also supported by free shuttle bus services and carpooling initiatives, which become part of the strategy to reduce single-occupancy car trips. Other initiatives in implementing green transportation planning in Shah Alam City include restricting petrol and diesel vehicles. Proposals have been made to restrict the entry of petrol and diesel vehicles into certain areas at specific times to reduce carbon emissions further and promote cleaner transport modes.

Despite these efforts, challenges remain in fully engaging the community and ensuring the widespread adoption of green transport options. Previous studies highlight the need for increased awareness and participation, especially among families and school-age children, to maximise the benefits of walking and cycling as sustainable modes of school travel. Regarding the topic of this study, Shah Alam’s green transport initiatives provide a supportive framework for examining factors influencing children’s walking to school, including infrastructure, safety, and environmental quality. The city’s integrated approach to sustainable mobility provides a valuable case for understanding how urban planning and policy can foster AST in a rapidly urbanising Malaysian context.

3.6.2 Rationale for Choosing Shah Alam City as the Case Study

Shah Alam City was selected as the case study for this thesis due to its unique and strategic position within Malaysia's urban and sustainability landscape. As the first planned city established in Malaysia after independence, Shah Alam City is renowned for its well-organised urban layout, ample green spaces, and deliberate efforts to integrate modern infrastructure with environmental considerations. These characteristics make it an ideal urban setting for exploring the relationship between urban planning, transport infrastructure, and sustainable mobility behaviours, such as walking to school.

Shah Alam exemplifies leadership in sustainability through its proactive adoption of the Low Carbon City (LCC) framework and commitment to the United Nations Sustainable Development Goals (SDGs) (Abdullah et al., 2022). The Shah Alam City Council (SACC) has implemented a comprehensive Low Carbon City Action Plan that focuses on sustainable transportation, green infrastructure, and community engagement as essential components. These initiatives include developing pedestrian and cycling networks, improving public transit, and implementing educational programs to promote a culture of sustainable mobility among residents, including schoolchildren.

Furthermore, Shah Alam's involvement in the Malaysia SDG Cities network and its Voluntary Local Review (VLR) process underscores the strong commitment of local institutions and the active engagement of stakeholders, promoting sustainable urban development (Urbanice Malaysia, 2021). The city's policies and programs create a solid framework for examining how urban governance, infrastructure, and community awareness influence the travel behaviours of school-aged children.

Therefore, six primary schools in Shah Alam City were carefully selected to ensure they were comparable and relevant to examining the factors influencing children's walking to school. Three key criteria were used in the selection process: socio-economic characteristics, land-use patterns, and geographical proximity.

3.6.2.1 Socio-economic Characteristics

The schools were selected from neighbourhoods with similar socio-economic profiles to account for socio-economic variability. This method helps minimise confounding issues such as income differences, parental education levels, and access to private transportation, all of which can significantly affect children's travel behaviour. By choosing schools serving communities with comparable socio-economic backgrounds, the study aims to focus on the impact of environmental and infrastructural factors on walking behaviour rather than on differences stemming from economic status or lifestyle.

To gain a deeper understanding of the socio-economic backgrounds of the student population, informal interviews were conducted with school administrators at each selected primary school. During these conversations, administrators were asked to share their insights regarding the general economic status of families within the school community. They drew on their experiences and knowledge of parental occupations, income levels, and the patterns of financial assistance requests. Key topics discussed included the typical employment sectors or job types of parents, the proportion of students receiving government or school-based financial aid, observed trends in parental involvement or support for school activities, and notable changes in the socio-economic profile of the school community in recent years.

The interview was supported by data from the Department of Statistics Malaysia (2024), which provided state- and constituency-level details.

Table 3.1
Socio-Economic Profile of State Constituencies (Kota Anggerik and Batu Tiga)
Supporting School Site Selection in Shah Alam

Socio-Economic Profile		State Constituency	
		Kota Anggerik (SK Seksyen 7 & SK Jalan U3)	Batu Tiga (SK Seksyen 27, Seksyen 19, Seksyen 24 & SK Padang Jawa)
	Population	292,653	146,092
Age Group	Working	74.3%	73.5%
	Children	20.1%	20.9%
	Elderly	5.6%	5.6%
Ethnicity	Bumiputera	71.9%	80.1%
	Chinese	20.0%	10.7%
	Indian	7.7%	8.6%
	Others	0.4%	0.7%
Employment Status	Working	70.3%	75.4%
	Out of the Labour Force	26.8%	21.8%
	Unemployed	2.9%	2.8%
	Household Income	RM12,195	RM8,002
	Population density	2,567/km ²	5,619/km ²
	Average household size	3.3	4.0

Source: Department of Statistics Malaysia (DOSM), (2024)

Table 3.1 presents the socio-economic context across the two distinct state constituencies where the six schools were located: Kota Anggerik and Batu Tiga. These constituencies display notable differences in specific socio-economic characteristics, strengthening the validity of the study's comparative analysis.

Kota Anggerik, where SK Seksyen 7 and SK Jalan U3 are located, has a more affluent population. The average monthly household income is RM12,195, which is significantly higher than the recorded figure in Batu Tiga, representing a lower to middle-income demographic. Additionally, in terms of population density, Batu Tiga recorded a higher figure with 5,619 persons/km² compared to Kota Anggerik (2,567 persons/km²), due to the high-rise residential development in that area. This data indicates a more compact urban environment that may be more conducive or necessary for walking.

Moreover, the data on ethnic and household composition also differ. Batu Tiga reports a higher percentage of Bumiputera residents and a larger average household size. In contrast, Kota Anggerik has a higher proportion of Chinese residents (20%) but a smaller household size (3.3 persons). This data demonstrates that variations in these factors are crucial for understanding how income, household size, ethnicity, and urban density influence parental decisions and children's active travel behaviours. Therefore, the deliberate selection of school sites across these constituencies supports a more holistic analysis of the factors influencing children's walking to school.

3.6.2.2 Geographical Proximity

Another important factor considered in the study was the geographical proximity of the selected schools. These schools are located within a relatively compact area of Shah Alam, which facilitates a comparative analysis under similar climatic, topographical, and urban development conditions. This proximity also enables efficient data collection and observation, ensuring consistent timing and environmental conditions during site visits. Furthermore, clustering the schools geographically accounts for shared transport networks and community resources that may influence walking behaviour.

Google Maps was an essential tool in the site selection process, ensuring that the selected school sites were geographically similar. Initially, the locations of all prospective schools were plotted on Google Maps to visually assess their spatial distribution within Shah Alam. This approach accurately evaluated the distances between schools and their relative positions within the city's established zones, namely the Northern, Central, and Southern zones. By referencing these zones, it became possible to select schools within comparable urban environments, thereby avoiding those isolated by significant physical barriers or situated in distinctly different city sectors.

Figure 3.5 illustrates the location of each selected school using the educational facilities plan.

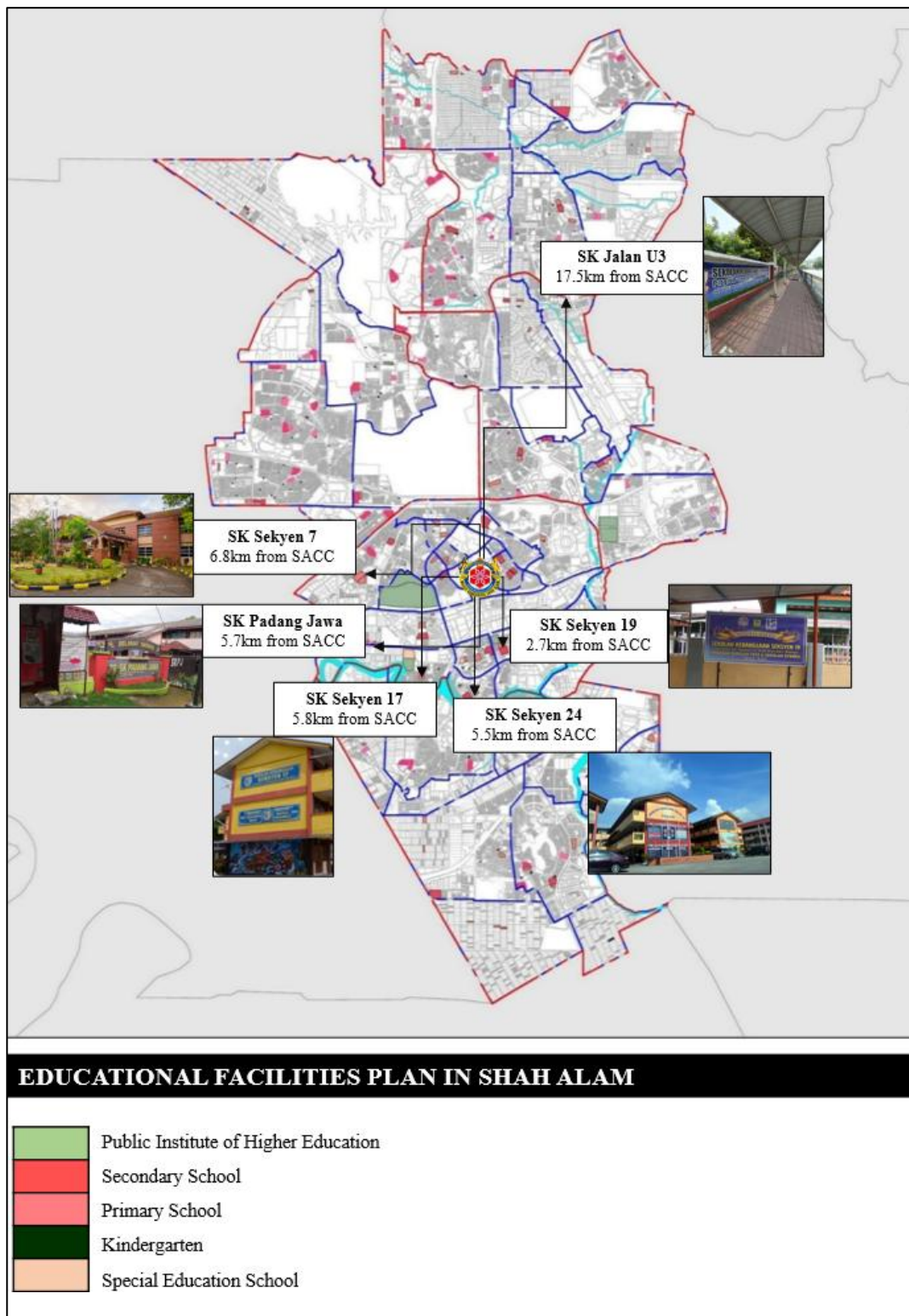


Figure 3.5 Map of Shah Alam indicating the Locations of All Selected Schools, with Distance Markers from SACC

Source: Google Maps (n.d)

The distribution of the six schools that participated in the survey, along with the distance of each location from SACC, a local authority in Shah Alam, is illustrated in Figure 3.5. Five of the six schools were within 10 km of SACC, while SK Jalan U3 was 17.5 km away. The city map further demonstrates their spatial distribution across the northern, central, and southern areas of Shah Alam, thereby ensuring the previously mentioned geographic diversity.

The six schools are geographically dispersed across Shah Alam City, encompassing a diverse range of urban contexts. Four schools, SK Seksyen 7, SK Seksyen 17, SK Seksyen 19, and SK Seksyen 24, are located in the Central Zone, which is situated in the city's established administrative and residential heart. Whereas SK Padang Jawa is situated in the southern zone, the area represents industrial and emerging neighbourhood characteristics. North Zone, a region characterised by newer suburban and transit-adjacent development, is home to SK Jalan U3. This spatial distribution demonstrates that the study encompasses diverse geographical settings, ranging from central urban areas to peripheral north and south zones.

3.6.2.3 Land Use Patterns

Additionally, the selected schools are predominantly located in residential areas with a mix of land uses, including housing, commercial zones, and public amenities. This context is essential because it influences the walkability of school routes, the availability of pedestrian infrastructure, and traffic conditions. Schools in similar land-use settings offer a consistent urban environment for evaluating how spatial design and land use affect children's walking patterns. Also, these areas represent typical suburban settings in Shah Alam, making the findings relevant to a broad segment of the city's population.

The Land Use Map from the Shah Alam Local Plan 2035 was examined to analyse the predominant land use surrounding each school site. This map provided detailed information on existing land uses, including residential, commercial, industrial, and recreational areas, as well as green spaces and water bodies. Schools in predominantly residential areas with similar land-use patterns were selected, as indicated on the land-use map, thus ensuring consistency in the built environment and neighbourhood context.

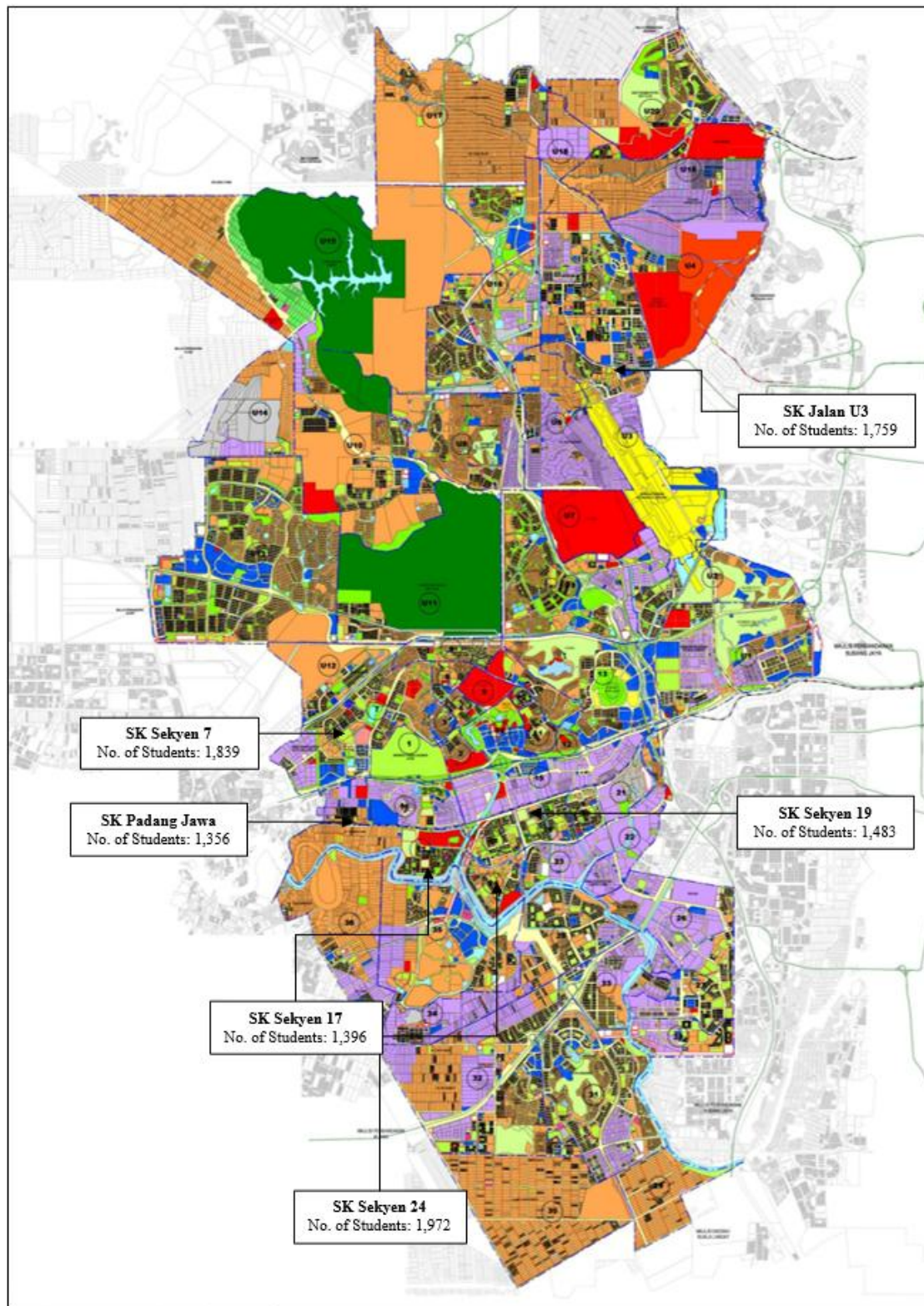


Figure 3.6 Land Use Map Showing the Spatial Distribution of Selected Primary Schools in Shah Alam Study Area

By applying these criteria, the study ensures that the selected schools form a coherent, comparable sample, enabling a focused investigation into how urban design, infrastructure, and community factors influence children's willingness to walk to school. This careful selection process enhances the validity and reliability of the research findings. Ultimately, it supports the development of targeted recommendations for promoting AST in Shah Alam and similar urban environments.

3.6.2.4 Current Situation of Pedestrian Provision in Shah Alam

Shah Alam, the capital of Selangor, has undergone significant urban growth and suburban development since its founding in the 1960s. Initially designed as a car-centric township, the area's planning history continues to influence its transportation network (Rashid et al., 2024). Although the Shah Alam City Council (SACC) has recently adopted development strategies that prioritise sustainable mobility, the availability and quality of pedestrian infrastructure vary significantly between different neighbourhoods.

Currently, in Shah Alam, pedestrian walkways are generally better established in commercial centres, institutional zones, and along major roads. However, most areas with pedestrian facilities lack connectivity, continuity, and integration with residential areas. On the other hand, in suburban housing areas, pedestrian walkways are inconsistent, discontinuous in some places, narrow, and obstructed by parked vehicles, trees, or utility poles. This situation compels pedestrians to navigate alongside motor traffic. Additionally, pedestrian crossings at intersections are often insufficient, prioritising vehicle movement over pedestrian safety.

A significant challenge is the lack of a citywide standard tailored specifically to vulnerable groups, such as children. Although SACC has rolled out pedestrian-friendly initiatives under the Safe City and Low-Carbon City frameworks, their implementation remains inconsistent. According to Rashid et al. (2024), most enhancements are implemented in prominent urban areas. In contrast, it remains undeserved in many school zones and local neighbourhoods. A study by Kim et al. (2024) found that these areas suffer from poor signage, inadequate traffic calming measures, and poor sidewalk maintenance.

Feedback from public consultations conducted by local authorities indicates that residents view pedestrian pathways as unsafe. This is due to heavy traffic, inadequate lighting, and limited surveillance in specific areas, as stated by Rashid et al. (2024). All the safety considerations deter walking, particularly among schoolchildren and parents, who prioritise safety and accessibility aspects. As a result, reliance on private vehicles remains prevalent in daily travel behaviour, further reinforcing the city's car-centric mobility culture.

While Shah Alam demonstrates a commitment to sustainable transport and creating liveable urban spaces, pedestrian infrastructure remains inconsistent and requires greater prioritisation. Addressing these gaps is crucial to promoting walking as a safe and practical mode of travel, particularly among schoolchildren, who are among the most vulnerable pedestrian groups. Thus, the current situation in the case study area justifies selecting Shah Alam as a suitable case study, as it reflects both the challenges and opportunities for improving pedestrian facilities, particularly in rapidly urbanising Malaysian cities.

3.7 Method of Data Collection

For this research, four methods were employed during data collection: a questionnaire survey, in-depth interviews, field observations, and secondary data collection. All procedures were explained as follows:

3.7.1 Pilot Survey

Before conducting the main study, a pilot survey was conducted to test the validity and reliability of the prepared questionnaire. This preliminary step involved administering the questionnaire to a small, representative sample of participants to assess its clarity, comprehensiveness, and ability to capture the desired information.

For this study, 30 primary school children who walked to school were selected, representing the target group studied in May 2023. The questionnaire was distributed randomly to walking schoolchildren at SK Telok Panglima Garang, located in the Kuala Langat District of Selangor. The school was chosen for its convenient location and proximity to the researcher's residence. The questionnaire was randomly distributed to students at the school gate during dismissal time, after obtaining prior permission from

the school administration, to ensure inclusivity and practicality. The respondents brought home the printed survey form, allowing them to answer with assistance from their parents or guardians, thereby enhancing the accuracy and clarity of their responses. Respondents returned the completed forms to the school's security guard the following day before going home. This approach aims to minimise disruption to the students' academic schedule.

This process aimed to assess the clarity of the questions, the logical flow, the time required to complete the survey, and the instrument's overall reliability. Additionally, informal feedback was collected verbally from both the children and their parents regarding any difficulties they experienced in understanding the terminology, the questionnaire length, and the suitability of the response options. By conducting a pilot survey, the researcher improved the data-collection instrument, thereby increasing confidence in the results of the full-scale study. This structured approach yielded valuable insights for refining the final questionnaire before its use in the main study. This preliminary testing phase ensured that the questionnaire effectively captured the factors influencing children's walking to school in Shah Alam City, Malaysia.

3.7.2 Questionnaire Survey

A questionnaire survey was conducted to support quantitative analysis of a sample of schoolchildren from six primary schools. This survey was conducted to gather students' preferences and opinions on AST. The questionnaire survey method was chosen for this study due to its effectiveness in collecting standardised data from a large sample, enabling the identification of key factors influencing children's walking behaviour to school in Shah Alam.

The questionnaire was developed by analysing existing literature and integrating elements from other questionnaires. The variables used in the questionnaire are presented in Table 2.1. The questionnaire was designed to include both closed-ended and open-ended questions, addressing crucial aspects such as demographic and socio-economic background, built environmental factors, and safety. This questionnaire comprises five sections (Part A to Part E) and includes 55 questions covering specified themes. These themes include the demographics and socio-economic backgrounds of respondents; details about students' journeys to school on foot; attitudes and perceptions while walking; perceptions of pedestrian infrastructure and facilities; and

safety aspects. It employs multiple-choice, single-select, or multi-select questions, as well as Likert scales, to measure respondents' opinions and behaviours. Care was taken to word the questions clearly and neutrally, with improvements informed by a pilot test conducted early in the process. A detailed explanation of sampling matters will be provided in subsections 3.7.2.1-3.7.2.4.

The questionnaires were distributed through schools for several reasons. Schools provide direct access to a large and relevant population, namely, the students who are the primary subjects of the study. This ensures that the questionnaires reach the intended respondents efficiently and effectively. Additionally, administering questionnaires through schools can yield higher response rates than other methods, such as direct or online-only distribution. Schools can allocate specific times for completing the questionnaires and send reminders, which increases participation. Using schools as distribution points also reduces the time spent, travel costs, and the need for extensive fieldwork, making the process more economical, especially when targeting a large sample. Moreover, schools often have established protocols for research participation, including consent procedures and ethical oversight. This can simplify the research process and ensure compliance with ethical standards.

The questionnaire survey was conducted over three weeks from April 15th to May 3rd, 2024, across six selected primary schools in Shah Alam City. The timeline was planned systematically in coordination with school administrators to prevent conflicts with exam weeks, school events, or holiday breaks that might impact participation. Questionnaires were distributed to students on scheduled dates at each school, with three days allocated for them to complete and return the forms. This staggered form distribution allowed the researcher and the assigned teachers to manage the process effectively, monitor response rates, and provide reminders if needed. This approach facilitated consistent data collection across all participating schools while respecting the school calendar constraints. The following paragraph offers a detailed outline of the stages involved in a questionnaire survey.

Stage 1: Ethical Approval and Administrative Clearance

To ensure minimal disruption to the school schedule, the researcher followed all required administrative and ethical procedures. Before conducting this survey, the researcher obtained official permission from the relevant educational authorities, as is standard procedure for studies involving school parties. An application was first submitted to the Ministry of Education (MOE) through the e-Research Approval System (eRAS), outlining the research objectives, methodology, target respondents, and instrument used in this study. Upon MOE approval, a subsequent application was submitted to the Selangor State Education Department (Jabatan Pendidikan Negeri Selangor, JPNS) to gain access to selected primary schools within Shah Alam City. The approval process included submitting a research proposal, an instrument form, an institutional support letter, and an approval letter from the MOE.

Also, the study obtained approval from the Research Ethics Committee (REC) of UiTM. REC UiTM approved the instrument and protocol used for this study after reviewing the application form, questionnaire, parental informed consent form, child assent form, and other relevant information. To ensure the privacy and confidentiality of all participants, strict measures will be implemented. The survey data will not include personal identifiers, such as names and addresses. All collected information will be coded and stored securely, with access limited to the researcher. Copies of approval letters for ethical procedures obtained and the questionnaire form are attached in Appendices 5, 6 and 7.

Stage 2: Coordination with Schools

After formal approval was granted, the researcher contacted the principals of the selected schools to seek permission to conduct the survey. Once consent was obtained from the headmaster, the researcher provided a detailed briefing to the teacher-in-charge on the survey method, target participants, and the procedures for distribution and collection.

Stage 3: Survey Distribution

During distribution, students were first assembled, and the teacher in charge introduced the study, explained its purpose, and provided basic instructions. A survey form was brought home with the students, accompanied by three documents: a parental informed consent form, a child assent form, and an information letter explaining the study's aim and importance. This attachment was to ensure that participation was entirely voluntary and based on informed consent. A contact number was provided and stated in the questionnaire for respondents to use if they had any questions.

Stage 4: Completion and Parental Involvement

This form requires a little information about the students' and parents' demographic and socio-economic background. Parents or guardians must accompany their children while answering the questions. According to Raoniara (2019), referring to McMillan's framework, parents decide which mode their children should use. In many previous studies on similar topics, a questionnaire survey was conducted among the parents to understand the decision-making process of mode choice. For this research, school children were asked to complete the survey form with their parents' assistance, as parents contribute to their decision-making. The respondents were asked to return the survey form within three days of its distribution.

Stage 5: Collection and Follow-Up

To manage response rates, the responsible teacher will issue reminders, while the researcher will provide incentives, such as tokens, to those who complete and submit the questionnaire. Individuals who do not submit the form by the specified deadline will be considered non-respondents and excluded from the survey.

3.7.2.1 Population and Sampling Frame

Sampling is a crucial process in research methodology that involves selecting a subset, or sample, from a larger group known as the population. The primary goal of sampling is to enable researchers to infer conclusions about the larger population from analysing the chosen sample. The details of the sampling process are presented in the following subtopic.

The target population for this study consists of primary school children aged 7 to 12 years, corresponding to Standards 1 through 6. This age group was selected because children at this stage begin to develop independent mobility to and from school, often walking accompanied by friends, parents, or guardians. Their walking patterns, independence, and environmental perceptions are still evolving, making them ideal respondents for understanding the factors influencing walking behaviour to school.

According to statistics released by SACC, Shah Alam has a total of 96 primary schools, including *Sekolah Kebangsaan*, *Sekolah Pendidikan Khas*, *Sekolah Jenis Kebangsaan (Tamil)*, and *Sekolah Jenis Kebangsaan (Cina)*, which collectively account for 48.4% of the total educational facilities area in the city (Majlis Bandaraya Shah Alam, 2017). Shah Alam City Council divides the city into five Small Planning Blocks (*Blok Perancangan Kecil*), and one school was selected from each planning block to represent the area. Due to time and resource constraints, six primary schools were ultimately chosen to participate in the survey. These schools were selected because they share similar socio-economic and geographical characteristics and were accessible to the researcher. The distribution of six schools was presented in the previous section (see Figure 3.6). The schools are:

1. Sekolah Kebangsaan Seksyen 7;
2. Sekolah Kebangsaan Seksyen 17;
3. Sekolah Kebangsaan Seksyen 19;
4. Sekolah Kebangsaan Seksyen 24;
5. Sekolah Kebangsaan Padang Jawa; and
6. Sekolah Kebangsaan Jalan U3.

The sampling frame was established by identifying children in these schools who met the age criteria and regularly walked to and from school at least twice a week. This ensured that the sample accurately reflects the target population's characteristics

and experiences relevant to the study's objectives. By focusing on this defined group, the research explores factors such as the distance to school, pedestrian facility quality, and the surrounding environment that may affect children's decisions to walk to school.

School principals were contacted to facilitate the study and to allow the survey to be conducted at their schools. The selection process prioritised schools that could provide a representative sample within the defined case study area, balancing practical considerations with the need for meaningful data collection.

3.7.2.2 Types of Sampling Methods

Initially, this study employed a probability sampling technique, specifically cluster random sampling, to select six schools. Within those schools, all students who indicated they walked to school were invited to participate in the questionnaire using purposive criterion sampling, a nonprobability sampling method. This method helped focus on the specific target population while ensuring random selection at the cluster level. The target respondents are primary school children who walk to school at least twice a week, a particular subgroup within the larger population. This method ensures that the sample comprises participants with direct experience and knowledge of walking to school, which is essential for collecting meaningful data on factors influencing this mode of travel, such as pedestrian facilities and environmental conditions. These two-level sampling techniques were used to select respondents who met specific criteria relevant to the research objectives.

3.7.2.3 Detailed Description of Sampling Technique

This study employed purposive criterion sampling, a nonprobability sampling technique in which not every student had an equal and independent chance of being selected. Only those students who walk to or from school at least two days per week are eligible to participate in the survey. This is a specific inclusion criterion for this study, guided by the research objectives and focused on exploring the factors that influence primary school children's decisions to walk to school.

The distribution of questionnaires was conducted during the morning and evening school assemblies, when all students are gathered. Firstly, the teacher briefed the students on the purpose of the survey and explained the procedure involved. The

teacher then asked students to raise their hands if they walked to or from school at least two days per week. This step identifies eligible survey participants, ensuring that only students with regular walking experience are selected as respondents, which aligns with the investigation of students' walking behaviour. Following this, the survey forms were distributed to the identified group of students.

In summary, using a sampling technique allowed the researcher to conveniently access the target group, which embodies the key characteristics necessary to explore the factors influencing children's walking to school. This ensured that the sample aligned with the study's objectives and facilitated the collection of rich, relevant data.

3.7.2.4 Sample Size Determination

The sample size was determined by the availability of eligible participants in the selected schools and the need to gather enough responses for meaningful analysis. As a case study approach was used, the emphasis was placed on the depth and quality of the data rather than on achieving statistical representativeness. Four hundred primary school children who met the inclusion criteria (see 3.7.2.5) were invited to participate in the study. This decision balanced practical considerations such as time, resources, and access with the need to capture diverse perspectives across various age groups and school environments.

The total number of primary school children in Shah Alam is 66,508, according to statistics released by the Ministry of Education (as of June 30, 2022). Given the total population is known, the sample size for this study is 381, determined using Krejcie and Morgan's (1970) method. The table for determining sample size from a given population, shown in Table 3.2, indicates that for a population of 50,000, the sample size is 381.

Table 3.2

Table for Determining Sample Size from a Given Population

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	246
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	351
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	181	1200	291	6000	361
45	40	170	118	400	196	1300	297	7000	364
50	44	180	123	420	201	1400	302	8000	367
55	48	190	127	440	205	1500	306	9000	368
60	52	200	132	460	210	1600	310	10000	373
65	56	210	136	480	214	1700	313	15000	375
70	59	220	140	500	217	1800	317	20000	377
75	63	230	144	550	225	1900	320	30000	379
80	66	240	148	600	234	2000	322	40000	380
85	70	250	152	650	242	2200	327	50000	381
90	73	260	155	700	248	2400	331	75000	382
95	76	270	159	750	256	2600	335	100000	384

*Note: “N” is the population, and “S” is the sample size

Source: Krejcie and Morgan (1970)

Additionally, the researcher considered using the Raosoft Sample Size Calculator to calculate the sample size. Figure 3.7 shows that the sample size obtained is 382. This result indicates that at least 382 respondents are required to achieve 95% confidence that the actual value lies within $\pm 5\%$ of the survey value.

Raosoft

What margin of error can you accept? %
5% is a common choice

What confidence level do you need? %
Typical choices are 90%, 95%, or 99%

What is the population size?
If you don't know, use 20000

What is the response distribution? %
Leave this as 50%

Your recommended sample size is **382**

Figure 3.7 Sample Size Calculation Using Raosoft Sample Size Calculator
Source: Sample Size Calculator by Raosoft, Inc., (n.d.)

Based on the calculated sample size, the researcher decided to round up to 400 respondents. A total of 400 respondents were targeted for this questionnaire survey. To ensure proportional representation of students across the six selected schools, the sample was distributed according to each school's enrollment size relative to the total student population of the six schools (9,805 students). Using proportional allocation, schools with higher enrollment contribute more respondents, while those with the fewest enrollments contribute the fewest, maintaining balance and equity in data representation. Therefore, the final sample size for each school is presented in Table 3.3.

Table 3.3
Sample Size for each School

School	Number of Students' Enrollment	Percentage of Total (%)	Sample Size
SK Seksyen 7	1,839	18.75	75
SK Seksyen 17	1,396	14.24	57
SK Seksyen 19	1,483	15.12	60
SK Seksyen 24	1,972	20.12	80
SK Padang Jawa	1,356	13.83	55
SK Jalan U3	1,759	17.94	72
Total	9,805	100	400

3.7.2.5 Screening Criteria

To ensure the data collected were relevant and reliable, specific screening criteria were established for the study. The selection of respondents followed a structured screening process to ensure data relevance and reliability. The inclusion criteria were as follows:

- ✓ Respondents were required to be enrolled in the selected schools;
- ✓ Respondents had to be between 7 and 12 years old;
- ✓ Respondents were required to have prior experience travelling to or from school at least twice a week; and
- ✓ Parental consent was required prior to participation.

These criteria ensured that only respondents with direct experience of school travel were included in the study.

3.7.2.6 Advantages and Limitations

The study's findings may not apply to all primary school children or other regions with different environmental or cultural contexts, as the sample is non-random and limited to a specific geographic area. Additionally, the use of purposive criterion sampling and the involvement of school staff in identifying eligible participants may introduce selection bias, potentially leading to particular groups of children being overrepresented or underrepresented. Furthermore, the data rely on children's self-reported experiences and perceptions, which may be influenced by factors such as memory, understanding, or social desirability, potentially compromising the accuracy of their responses.

3.7.3 Field Observation

The field observation method directly evaluated the physical, environmental, and behavioural factors influencing children's walking to school in Shah Alam. The researcher also observed the surrounding land use of the school area, which became a crucial aspect of the built environment. This approach enables the researcher to observe real-world conditions, verify survey results, and capture contextual elements that participants may overlook or fail to report.

3.7.3.1 Stage 1: Observation Tools and Documentation

Observation checklists were used for sidewalk quality, traffic volume, and crossing facilities. This method also uses open field notes to systematically document physical features and children's behaviours, including individual and group walking, route deviations, responses to environmental obstacles, and all relevant phenomena. Data from structured observations were carefully collected, and the notes were reviewed for recurring themes and contextual factors. The observations were conducted covertly, with subjects unaware they were being observed, to minimise potential impact on natural behaviour. Remote observation was also performed by watching children walk from a distance to observe their navigation, wayfinding behaviours, and interactions with the environment.

3.7.3.2 Stage 2: Site Selection and Focus Areas

Field observations were conducted along selected school routes, focusing on factors including the availability and quality of sidewalks, traffic density and speed, the presence and condition of pedestrian crossings, environmental cleanliness and attractiveness, safety hazards, and the social environment. Several pedestrian elements were also measured to compare on-site conditions with the design guidelines and assess compliance with the specified standards. The tools used during these observations included a checklist, field notes, a digital measuring wheel, and a digital recording device (camera), which were used to systematically document the findings. During the site observation, the researcher captured and recorded photos and videos of the pedestrian facilities outside the school for analysis.

3.7.3.3 Stage 3: Observation Schedule

Field observations were conducted over four weeks, from May 5th to June 5th, 2024, at six selected primary schools in Shah Alam City. Data collection was conducted during peak travel times: from 6:45 a.m. to 7:30 a.m., before school started, and from 12:30 p.m. to 1:15 p.m., after school ended. For the evening session, the observation took place from 12:30 p.m. to 1:30 p.m., before school started, and then continued from 5:00 p.m. to 6:30 p.m. These specific time frames were intentionally chosen to represent the busiest periods for pedestrian activity among walking schoolchildren and peak vehicle traffic in school zones. This allowed the researcher to report the real challenges children encounter on their daily journeys, such as congestion, difficulty crossing streets, and their peers' walking behaviours. Additionally, conducting assessments on various weekdays helped the researcher account for changes in traffic conditions, weather impacts, and children's walking habits, ensuring that the collected data accurately reflected typical school-day scenarios.

3.7.3.4 Stage 4: Study Sites and Participants

Six schools took part in this observational study. The observation sites were selected based on the schools where questionnaires were distributed, ensuring that the collected data would be representative of the overall population. Observations were

conducted during peak hours, specifically before and after school, on various days, to account for fluctuations in behaviour and environmental conditions. The researcher aimed to study students' daily routines, typical circumstances in the school area, and walking behaviours on their way to school.

3.7.3.5 Stage 5: Ethical Considerations

Ethical considerations regarding the observation of walking schoolchildren were unnecessary, as the method was conducted remotely and ensured that children's privacy was not compromised. However, the school authorities are already aware of this data-collection method, which involves the researcher conducting observational studies outside the school grounds at specific times.

3.7.3.6 Stage 6: Data Validation and Integration

This observational method provided direct, contextual insights that enhanced survey findings, although potential observer bias and the influence of observation on behaviour were acknowledged. Repeated visits and triangulation with other data sources were employed to minimise these limitations. These observations provided valuable insights into the impact of the built environment on children's walking behaviours. By integrating observational data with survey findings, the study sought to develop a comprehensive understanding of the factors influencing children's decisions to walk to school. This approach was instrumental in identifying barriers and facilitators to walking, thereby informing strategies to promote active transportation among children in Shah Alam City.

3.7.4 In-Depth Interview

This study utilised in-depth interviews to examine the factors influencing children's walking to school in Shah Alam. Participants were selected purposefully to ensure a diverse range of perspectives, including those of parents, school staff, and representatives from a government agency. The interview sessions were conducted to gather the opinions and viewpoints of representatives from various organisations regarding the provision of pedestrian facilities and infrastructure. Additionally, the

researcher aimed to understand the current designs and guidelines for providing pedestrian facilities in school zones. The views and insights of school authorities were also sought, with participation from principals and student affairs teachers during the interviews. Their opinions and perspectives differ from those of other parties.

3.7.4.1 Stage 1: Sampling Strategy

The sample size for the in-depth interviews was determined using a ‘rules of thumb’ approach, a widely recognised guideline in qualitative research. This approach helps select an adequate number of participants when the goal is to capture diverse perspectives rather than achieve statistical generalisation or data saturation (Sharma et al., 2024). Specifically, one representative was chosen from each of the major stakeholder groups: parents, school personnel, and government agencies. This method ensures that the voices and experiences of each group are reflected in the analysis, providing a balanced view of the factors influencing children’s walking to school in Shah Alam. Emphasising stakeholder representation aligns with best practices in qualitative research, as it highlights the importance of including diverse viewpoints to enhance understanding of the phenomenon under investigation.

Table 3.4
Profile of the Stakeholders Involved in the Interview Sessions

Stakeholder	Designation	Year of Experience	Setting	Date	Duration
Parents	Entrepreneur	10 years	Bus Stop SK Seksyen 7	20 th May 2024	35 minutes
	Housewife	-	Jalan Petola	21 st May 2024	20 minutes
School	Senior Assistant for Student Affairs	5 years	School Office SK Seksyen 19	30 th May 2024	1 hour
Government Agencies	Civil Engineer	14 years	Tingkat 1, Bahagian Bangunan, JKR Selangor	10 th June 2024	45 minutes

Although the sample size is relatively small, this aligns with the traditions of qualitative research, where the depth and quality of data take precedence over quantity. The decision to interview only one or two individuals from each group is grounded in purposive sampling theory and qualitative sample-size justification frameworks, both of which are supported by the methodological literature. This indicates that small, purposively selected samples can still be sufficient when exploring key issues across

distinct categories, rather than generalising findings to a larger population. Reid & Mash (2014) confirm that typically 5 to 15 in-depth interviews are considered adequate for qualitative studies. This strategy is transparent and logical, facilitating a manageable yet meaningful exploration of each stakeholder's perspective, and is justified by established qualitative research guidelines and the study's specific context.

3.7.4.2 Stage 2: Interview Schedule

The interviews were conducted between 20th May and 10th June 2024, at times most convenient for the participants, to minimise disruption to their daily responsibilities and real tasks. For parents, interviews were typically held in the late afternoon (5 p.m. to 6:30 p.m.), after working hours and during the peak travel time back from school, to accommodate their availability. For school staff, sessions were held during mid-morning breaks (10 a.m. to 11.30 a.m.) to avoid interfering with teaching duties or student activities. Meanwhile, the interview with the government agency representative was scheduled during office hours (10:00 a.m. to 12:00 p.m.), aligning with standard administrative working hours. The time slots were deliberately chosen to respect participants' professional and personal commitments, creating a comfortable, focused setting that encouraged open discussion and detailed responses.

3.7.4.3 Stage 3: Interview Protocol and Themes

Interviews were conducted using a semi-structured protocol that included both open-ended and structured questions. These were guided by research questions covering several key themes: factors influencing the mode of transport; safety concerns; pedestrian infrastructure and school surroundings; school initiatives and parental involvement; and environmental and locational considerations. This approach allowed participants to openly share their thoughts and experiences while ensuring that essential research topics were addressed. The flexibility of semi-structured interviews allowed the researcher to follow up with questions, enabling more profound exploration of participants' responses and uncovering unexpected insights. Different stakeholders had tailored sets of questions, which were drafted accordingly. The interview form is attached for reference in Appendix 3 and Appendix 4. Each interview lasted approximately 45 minutes and was audio-recorded with the participants' consent.

3.7.4.4 Stage 4: Data Analysis

The data were then applied to a selective thematic note-taking procedure. Rather than conducting a complete transcription and coding, the recordings were reviewed to identify the relevant themes and essential details. This method of analysis is supported by reflexive thematic analysis frameworks, which endorse flexibility, as noted by McLeod (2024).

3.7.5 Secondary Data Collection

Alongside primary data collection methods, this study employed a comprehensive secondary data collection process to gain a thorough understanding of the frameworks affecting pedestrian facilities in school zones. This approach involved a systematic review of relevant policies, standards, and guidelines for pedestrian infrastructure, school zone safety measures, active school transportation, and initiatives promoting physical activity among children.

The first step in conducting secondary data collection is to identify relevant documents. These official documents were sourced from government agencies, local authorities, and international organisations, encompassing national policies, municipal guidelines, global best-practice documents, and technical standards for pedestrian environments and school zone safety. Following this, a systematic documentary review was conducted to extract information on regulatory requirements, design standards, safety measures, and recommendations for pedestrian infrastructure around schools. This comprehensive review addressed topics such as sidewalk provision, crosswalk design, traffic calming measures, and accessibility features.

The extracted data were benchmarked against both international and local best practices, concentrating on key aspects such as functionality, safety, accessibility, and design. To refine this analysis, case studies from various contexts were examined to identify successful strategies and innovations in providing pedestrian facilities. The findings from the documentary review were then used to contextualise the primary data, revealing the alignment or discrepancies between policy intentions and actual implementation. This process was instrumental in identifying gaps within the current regulatory environment and areas where practice diverges from established standards.

Insights gathered from secondary data played a crucial role in developing recommendations to enhance pedestrian facilities and encourage walking to school. This was explicitly aimed at creating a more child-centric standard guideline for pedestrians in school zones. These recommendations took into account both empirical evidence and the existing policy framework. Secondary data were integrated with primary research results to provide a comprehensive perspective on the factors influencing children's walking to school. This integration ensured that the study's recommendations were grounded in observed realities and thorough policy analysis, resulting in a well-rounded approach to addressing the issue.

3.8 Data Analysis Methods

This study employed a mixed-methods approach, integrating qualitative and quantitative data sources. Each data collection method was paired with an appropriate analytical technique to ensure comprehensive, triangulated findings. Table 3.5 summarises the methods used for data collection, the corresponding data types, analysis approaches, and intended outputs.

3.8.1 Quantitative Data Analysis

Quantitative data obtained from the questionnaire survey were analysed using statistical techniques to identify patterns, relationships, and significant associations between variables. Descriptive statistics were applied to summarise the demographic and socio-economic background of respondents and their travel behaviour patterns. Addressing Research Objective 1 (RO1), this approach contributes a clear overview of the sample profile and provides trends in children's walking behaviour in the study area.

Besides, inferential statistical analysis was conducted to examine the relationships between variables. The chi-square test of independence was used to assess associations between categorical variables (age, gender, household income, and walking frequency). This technique was used to determine whether observed differences between groups are statistically significant and to move the study beyond descriptive patterns, thereby identifying key determinants of the decision to walk to school. Cross-tabulation analysis, also used to explore relationships between travel patterns and demographic or socio-economic factors, provides a detailed comparison of

variable distributions and helps identify trends across groups. This contributes to a deeper understanding of the behavioural patterns of the walking schoolchildren.

3.8.2 Qualitative Data Analysis (In-depth interview)

Qualitative data collected through in-depth interviews were analysed using thematic analysis. This method allows for the systematic identification, organisation, and interpretation of recurring themes and patterns. This analysis was used to explore stakeholders' perceptions, experiences, and insights related to pedestrian infrastructure, safety issues, and planning practices. Specifically, this analysis used selective note coding to capture key information from the interviewee.

The use of thematic analysis enables the study to capture contextual insights that cannot be obtained through quantitative methods alone. This analysis supports Research Objective 2 and Research Objective 3 (RO2 and RO3), providing a deeper understanding of infrastructural conditions and safety concerns based on multiple stakeholders' perspectives.

3.8.3 Qualitative Data Analysis (Field Observation)

Field observation data were analysed using a structured assessment against predefined criteria for pedestrian infrastructure and facilities. The criteria include elements such as sidewalk continuity, crossing facilities, traffic conditions, lighting, signage and accessibility.

This analysis evaluates the condition and adequacy of pedestrian infrastructure across six selected school zones. The findings were then categorised separately and compared across different locations to identify common issues, strengths, and variations in the study area. This method of analysis enables the study to assess real-world conditions and validate findings from the survey and interview methods.

Observational analysis addressed Research Objective 2 (RO2), providing objective evidence on the quality and safety of pedestrian infrastructure and strengthening the methodological robustness of the study through triangulation.

3.8.4 Data Triangulation and Integration

This study adopts a triangulation approach by integrating quantitative and qualitative data to enhance the validity and reliability of the findings. This approach allows for cross-verification of results from different sources and methods, thus ensuring a comprehensive and balanced interpretation.

Findings from quantitative research provide measurable evidence of behavioural patterns. In contrast, qualitative findings from interviews and field observations offer explanatory depth on perceptions and experiences, and provide direct evidence of physical conditions in the study area.

It was notable that the integration between quantitative and qualitative approaches aligns with the Socio-Ecological Model (SEM), emphasising the interaction between multiple factors. By combining multiple analytical techniques, this study captures the complexity of children's walking behaviour, thereby addressing Research Objective 4 (RO4) by proposing a child-sensitive pedestrian design and guidelines for school zones.

Table 3.5
Summary of Data Collection Methods and Corresponding Data Analysis Techniques

Data Type	Data Collection Method	Software or Tool Used	Analysis Method	Purpose or Output
Quantitative	Questionnaire Survey	SPSS	Descriptive statistics, frequency analysis, cross-tabulation	To examine trends, patterns of children's walking behaviour
			Inferential statistical analysis: chi-square test,	To identify relationships and significant associations in walking behaviour,
Qualitative	In-Depth Interview	Atlas. Ti	Thematic analysis / Selective note coding	To support findings with insights from multiple stakeholders
	Field Observation	Camera, Google Maps Application	- Structured Observation Analysis - Checklist-based evaluation - Condition assessment - Comparative analysis - Descriptive analysis	To evaluate the condition and adequacy of pedestrian infrastructure and physical safety
	Quantitative and Qualitative Data	-	- Comparative Analysis.	To develop child-centric guidelines for pedestrian walkways based on the revision of existing policies and guidelines

3.8.5 Summary of Analytical Techniques

In summary, the analytical techniques employed in this study were selected to align with the research objectives specified earlier and the mixed-methods design. The integration of these methods ensures a comprehensive analysis and strengthens the overall reliability of the research findings.

3.9 Summary

In summary, this chapter outlines the research methodology employed in this study, which adopts a mixed-methods approach, aiming to comprehensively investigate the factors influencing schoolchildren's decisions to walk to or from school. The research design of this study combined quantitative and qualitative methods to gain an in-depth understanding of the influence of the built environment on children's walking experiences and of stakeholders' perspectives.

Primary schoolchildren from six schools in Shah Alam were the target population for this survey, selected for their geographic and contextual diversity. The sampling method employed was purposive criterion sampling, targeting individuals who walk to or from school at least twice a week to ensure relevance to the study's objectives. A sample of 400 students was proportionally distributed across the selected schools based on each school's enrolment figures.

Four primary data collection methods were employed, namely: questionnaire surveys, field observations, interviews with school authorities, and secondary data collection. All these methods were aligned with the research questions and enabled the application of triangulation of findings. Additionally, appropriate analytical techniques were applied based on the data type. This structured analysis plan is to ensure that each data source effectively contributes to answering the research questions.

Overall, the methodology used in this study provides a reliable and ethical approach to understanding how various factors influence schoolchildren's walking practices.

CHAPTER 4

ANALYSIS OF DEMOGRAPHIC AND SOCIO-ECONOMIC FACTORS INFLUENCING CHILDREN’S WALKING TO SCHOOL

4.1 Introduction

Chapter 4 is the first chapter of the analysis and presents the findings intended to achieve Research Objective One: to analyse the demographic and socio-economic characteristics and the built environment that influence children’s decisions to walk to or from school. This chapter focuses on demographic and socio-economic factors influencing schoolchildren’s walking behaviour. While built environment factors are recognised as important determinants of Active School Travel, they are examined separately in Chapter 5 to allow for a more detailed and focused analysis.

The questionnaire survey identified the key determinants influencing children’s decision to walk to school, including socio-demographic factors, built environment, and safety factors. Directly engaging with students may capture their perspectives on the barriers and facilities related to walking to school, thereby offering valuable insights into their daily routines and preferences. Through a detailed process in the questionnaire survey, this chapter will highlight the predominant themes that emerged from the responses, which may offer a nuanced understanding of demographic and socio-economic backgrounds, and walking characteristics that may interact to shape the choice of commuting to school among schoolchildren.

The findings will contribute to the existing literature and may inform strategies to promote active transportation among schoolchildren. This chapter will present quantitative data illustrating the multifaceted nature of this issue. Synthesising the insights may yield actionable recommendations for responsible parties, such as the government and stakeholders, interested in fostering a walking culture among primary school children. This approach ultimately contributes to their health and well-being.

4.2 Socio-demographic Factors

Socio-economic factors encompass both demographic and socio-economic backgrounds, as well as various elements that influence an individual's or group's social and economic standing.

For this study, demographic factors include age, gender, and race. These factors help to define the population's composition and may influence behaviours and attitudes. Socio-economic factors refer to socio-economic status and are often measured by educational attainment, employment status, and income level. These factors are crucial for understanding health outcomes, lifestyle choices, and access to resources. The following subtopic provides detailed findings on socio-economic factors from the questionnaire survey.

4.2.1 Demographic Background of Respondents

Demographic background is a crucial factor identified in this study, playing a significant role in determining the mode of transportation to school, with variations discovered across different studies. There are some key findings related to this factor.

Table 4.1
Demographic Background

	Profile	Frequency	Percentage (%)
Respondent's Age	7-8 years	33	8.25
	9-10 years	102	25.50
	11 and 12 years	265	66.25
Gender	Boy	208	52
	Girl	192	48
Race	Malay	385	96.25
	Chinese	4	1.0
	Indian	8	2.0
	Others	3	0.75
BMI	Below 18.5 (Underweight)	247	61.75
	18.5 to 24.9 (Healthy weight)	117	29.25
	25 to 29.9 (Overweight)	28	7
	Above 30 (Obese)	8	2
Parents / Guardian's Age	26 to 30 years	19	4.75
	31 to 40 years	127	31.75

41 to 50 years	190	47.5
Above 50 years	64	16

Of the 400 surveyed respondents, 66.25% are students aged 11 to 12 years old, while the remaining 25.5% and 8.25% are aged 9 to 10 years and 7 to 8 years, respectively. A paediatrician's statement states that parents can trust their children to be independent from ages 8 to 12. In this context, children within that age range have already begun to show maturity and the ability to do daily tasks independently, an essential step in their development. "According to the American Academy of Paediatrics (AAP), kids are not ready to walk to school alone until about fifth grade or around age 10," says Dr Humaira Abid, assistant professor at the Department of Child and Adolescent Psychiatry at the University of Oklahoma College of Medicine. She added that younger kids are impulsive and often do not fully understand potential dangers while walking alone to school. That said, some children as young as six can walk to school if the route is simple and they have friends to accompany them.

Regarding gender, the survey found that boys outnumbered girls among children walking to school, with 52% boys and 48% girls. Many studies suggest that boys participate more in AST than girls do. For instance, a survey of urban adolescents found that more male students engaged in active commuting than females (Chillón et al., 2015; Ozbil et al., 2021). This trend is attributed to various factors, such as social norms and perceptions of safety. Other studies mentioned that girls were more likely to use motorised transport (Brophy et al., 2011). These findings highlight the need for targeted interventions to encourage AST among all children, particularly addressing the barriers girls face.

A survey on race found that most children walking to and from school are Malay (96.3%), followed by Indian, Chinese, and Others (2%, 1%, and 0.75%, respectively). This percentage is influenced by the selection of schools for the survey, which involved six primary schools in Shah Alam. All the schools are Sekolah Kebangsaan (SK), and the majority of admissions are to Malay students.

Additionally, other studies have reported that walking to school may be associated with healthier body weight outcomes, although various socio-economic and environmental factors influence this relationship. As a result, the survey indicated that 61.75% of children are underweight, while 29.25% are in a healthy weight range. Only a minority of them were recorded as overweight and obese, with percentages of 7% and

2%, respectively. This result indicates a positive association between active commuting and schoolchildren's health. Previous research has shown that children who walk or cycle to school tend to have healthier body weights than those driven by vehicles. A study involving over 8,000 children revealed that those who switched from passive transport (vehicle use) to active transport (walking or cycling) between the age range of 7 to 14 years had lower BMI values (0.21 kg/m² less on average) and reduced body fat (0.55% less on average) than their peers who consistently used private transport. This finding suggests that active commuting may help maintain a healthy weight.

Examining the subsequent data, it is clear that most parents or guardians are between 41 and 50 years old, with 47.5% falling within this age range. This range is followed by the 31-40 years range, with a percentage of 31.75%. The data also indicated that the lowest age groups were parents aged 50+ and those aged 26 to 30, with percentages of 16% and 4.75%, respectively. In terms of independence and responsibility, parents' ages may influence how they perceive this transition. The results indicated that younger parents might be more cautious, while older parents may encourage independence sooner based on their experiences. Looking into other perspectives, such as cultural influences, older parents may have different expectations regarding children's autonomy than younger parents, who might prioritise safety over independence.

4.2.2 Socio-economic Background of Parents or Guardian

Socio-economic indicators play a crucial role in shaping children's behaviours, particularly in active commuting, such as walking to school. This subtopic will analyse several socio-economic factors that affect children's walking habits, including parental income, educational attainment, employment status, and family socio-economic status. By examining these factors, this research aims to provide insights into how socio-economic conditions influence schoolchildren's mode choice for school transportation.

Table 4.2
Socio-economic Background

		Frequency	Percentage
Highest Education Level of Parents / Guardian	No Formal Education	5	1.25
	Primary School	20	5
	Secondary School	213	53.25
	Certificate/ Diploma/ Degree	147	36.75
	Masters/ PhD	15	3.75
Employment Status of Parents / Guardian	Employed	357	89.25
	Not Employed	5	1.25
	Housewife	32	8
	Student	1	0.25
	Retired	5	1.25
Driving License Ownership	Father	359	89.75
	Mother	272	68.00
	Guardian	20	5.00
Vehicle Ownership	Car	360	90.0
	Motorcycle	306	76.50
	Van	10	2.50
	Bicycle	169	42.25
	No Vehicle	11	2.75

Parents' highest level of education often correlates with socio-economic factors that can influence children's active commutes to school. Based on the survey, most parents end their education at secondary school (52.25%), followed by those with a Certificate/Diploma and those with a Degree (both at 36.75%). Overall, 59.5% of parents have a lower level of education. Meanwhile, the remaining 40.5% have a higher level of education. This result is consistent with other studies indicating that children from lower-income families, whose parents may have lower educational attainment, tend to walk to school more frequently. This phenomenon is attributed to various factors and barriers faced by families in this category, including limited access to vehicles and greater proximity to schools. According to Su et al. (2013), studies have shown that children whose parents possess higher levels of education are less likely to walk to school. The findings show that the odds of children walking decreased significantly with higher parental education, with an odds ratio (OR) of 0.68 (95% CI, 0.56-0.82) for children with more-educated parents. Thus, the trend suggests that families with higher educational attainment may prioritise other modes of transportation, such as private

vehicles like cars and motorcycles, possibly due to concerns about children's safety and convenience.

Additionally, parents' or guardians' employment status influenced children's likelihood of walking to school, highlighting how socioeconomic factors shape children's active transportation behaviours. Based on the survey results, most children whose parents are employed have the highest percentage at 89.25%, followed by those with unemployed parents at 8% and homemakers at 1.25%. The children of retired parents recorded a 1.25% rate, whereas the children of still-student parents recorded the lowest rate at 0.25%. Compared with previous research, this study suggests that children whose parents are unemployed or not engaged in full-time work are more likely to walk to school. This statement was supported by a study finding that children from families in which the primary caregiver was unemployed had higher walking rates than those from families in which the caregiver was employed. Specifically, the study found that children whose primary caregivers were unemployed had an odds ratio of 2.4 (95% CI: 2.22-2.56) for walking to school compared with children of working parents (Brophy et al., 2011). Based on the findings, this trend may be attributed to the increased availability of time for non-working parents to accompany their children on foot.

The next element discovered is the parents' or guardians' access to a driver's license. Studies indicate that parental access to a driving license significantly influences children's commuting behaviours, particularly their likelihood of walking to school. Table 4.2 shows that 89.75% of children have fathers with driving licenses, compared to 68% with mothers. Guardian only recorded 5%. On the other hand, car ownership had the highest percentage, at 90%, compared with other vehicle types (motorcycles, vans, and bicycles). Only 2.75% of children do not own a car at home. Many studies have consistently found that families with access to a vehicle, especially those with parents who hold a driver's license, are less likely to let their children walk to school. For instance, studies by Khalifa (2023) and Mehdizadeh et al. (2017) show that car ownership is a strong predictor of whether children are driven rather than allowed to walk, even when schools are close to home. This study also found that children living in households with a car are significantly more likely to be driven to school than those in households without a car. This phenomenon occurs because parents are concerned about safety and convenience when their children travel to school, often leading them to choose private vehicles over active modes of transport.

In conclusion, economic constraints can drive active travel behaviours among schoolchildren from less advantaged families. Therefore, addressing these barriers through community planning and safety measures could promote active transportation among children across various socioeconomic backgrounds.

4.2.3 Distribution of Respondents' Travel to School

This section analyses data on the distribution of respondents' travel to school among walking school children. The analysis is structured around several key variables identified in the survey: the frequency of parental exercise per week, mode of transport to school, distance from home to school, walking duration, the frequency of student walking per week, and companionship during walks.

Table 4.3
The Details of Walking to School

		Frequency	Percentage
Frequency of Parental Exercise	Not Exercise	113	28.2
	Less than 1 hour	136	34.0
	1 to 2 hours	102	25.5
	2 to 3 hours	19	4.8
	More than 3 hours	30	7.5
Mode of Transport to school	On Foot	378	-
	Bicycle	43	-
	Private Vehicle	121	-
	Public Transport	20	-
Distance from Home to school	Less than 1km	295	73.8
	2 to 3km	76	19.0
	More than 3km	29	7.2
Walking Time	Less than 5 minutes	173	43.3
	6 to 10 minutes	155	38.8
	11 to 15 minutes	42	10.5
	More than 15 minutes	30	7.5
Frequency of Student Walks in a Week	1 to 2 times	73	18.3
	3 to 4 times	36	9.0
	5 (everyday)	291	72.8
Companionship during Walks	Friend	155	38.8
	Siblings	94	23.5

Parents	68	17.0
Alone	110	27.5
Others	6	1.5

Table 4.3 shows the frequency of parental or guardian walking in a week. It shows that most parents exercise less than 1 hour a week, with 34% (136) of them, followed by those who do not exercise at 28.2% (113). Parents who exercise 1 to 2 hours per week reported the third-highest percentage at 25.5% (102). Parents who actively walk 2 to 3 hours or more per week recorded rates of 4.8% (19) and 7.5% (30), respectively. Overall, parents or guardians who exercised recorded a higher percentage (71.8%) than those who did not exercise (28.2%).

The survey results indicated a significant correlation between the frequency of parental or guardian exercise and the likelihood that children walk to school. Children with parents engaged in regular physical activity were more likely to walk to school. This finding supports existing literature that emphasises the role of parental behaviour in shaping children's physical activity levels (Duncan et al., 2007). The data suggest that active parents may model healthy behaviours, encouraging their children to adopt similar habits.

The next question asked about the mode of transport to school, allowing all 400 respondents to select multiple options. Table 4.3 below summarises the results, revealing that students use a variety of modes of transport other than walking to commute to school. While most reported walking, others still opted for private vehicles or public transportation as alternatives to commuting to school. Notably, students living far from their school were more likely to walk. This statement aligns with much previous research indicating that proximity to school significantly influences children's commuting choices (Zhu et al., 2014).

The distance from home to school was a crucial influence on children's walking behaviour. Based on the results, children residing closer to school were more likely to walk. 73.8% (295) of students reside within 1km of the school, whereas 19% reside 2-3km from the school. The remaining students' distance from home to school was shorter, with a lower percentage, 7.2% (29). This analysis highlighted that as distance increased, the likelihood of walking decreased significantly, which corroborates findings from other studies that emphasise the impact of distance to school on active commuting (Hatamzadeh, 2020; Mehdizadeh et al., 2017; J. Y. T. Wang et al., 2023).

Based on Table 4.3 The survey results showed that most students reported walking to school more than 3 times per week, and 72.8% (291) of them walked daily during school sessions. Many previous studies have noted that this phenomenon occurs when influenced by parents' walking habits and the presence of friends or siblings. This finding is supported by the survey data on companionship during walks.

This question allows respondents to select more than one answer for companionship during the walk. The result clearly shows that most students walk with their friends (38.8%, 155), followed by alone (27.5%, 110). Students walking with siblings and parents recorded 23.5% (94) and 17.0% (68), respectively. To conclude, the percentage of students walking to or from school with a companion was higher than that of those walking alone. This finding is supported by other studies suggesting a social component to children's commuting patterns: children are more likely to walk when they can do so with family members or peers (Zuo et al., 2021).

4.3 The Relationship Between the Distribution of Respondents' Travel Patterns to School According to Demographic Background

Understanding the relationship between respondents' travel patterns to school and their demographic backgrounds is essential for identifying the factors influencing children's commuting behaviours. All the factors tested can significantly affect how children travel to school, as they often shape access to resources, perceptions of safety, and parental attitudes toward active commuting.

4.3.1 The Association of Walking Frequency to School Based on Students' Demographic Background

Table 4.4
The Relationship Between Age Group and Walking Frequency to School in a Week

Frequency of Student Walking in a Week	Age Group		
	7-8 years	9-10 years	11-12 years
1 to 2 times	3.5	2.5	12.25
3 to 4 times	0.25	2.25	6.5
5 (everyday)	4.5	20.75	47.5

*N = 400 p-value = 0.293

The research highlighted a concerning trend: many physical activities, including walking to school, decline with age (Murphy et al., 2024b). Therefore, Spearman's rank-order correlation was used to assess the relationship between age and the frequency of walking to school per week. The analysis revealed no significant correlation ($r_s(400) = 0.053$, $p > 0.05$), suggesting that age does not significantly influence how often students walk to school.

Table 4.5
The Relationship Between Gender and Walking Frequency to School in a Week

Frequency of Student Walking in a Week	Gender	
	Boy	Girl
1 to 2 times	11.75	6.5
3 to 4 times	5.25	3.75
5 (everyday)	35	37.75

*N = 400 p-value = 0.033

A Chi-Square test of independence was performed to assess the relationship between gender and walking frequency to school. The results indicated a significant association between gender and walking frequency, $\chi^2(2, N = 400) = 6.83$, $p < .05$. This suggests that girls were more likely than boys to walk to school frequently. This result is supported by Murphy et al. (2024b), which found that female pupils who participated in a walking intervention showed increased physical activity levels. This highlights the importance of gender-specific approaches to encourage walking among male students.

4.3.2 The Association of Walking Distance Based on Students' Demographic Background

Table 4.6
The Relationship Between Age Group and Walking Distance to School

Walking Distance	Age Group		
	7-8 years	9-10 years	11-12 years
Less than 1km	11	82	202
2 to 3km	14	16	46
More than 3km	8	4	17

*N = 400 p-value = 0.001

A Kruskal-Wallis H test was conducted to determine whether walking distance to school differed across age groups. The results indicated a statistically significant difference in walking distance between age groups, $H(2) = 32.771$, $N = 400$, $p < .05$, suggesting that at least one age group walks a different distance to school than the others. The trend in Table 4.6 shows that distance increases with age, consistent with the findings of previous longitudinal studies. Chillón et al. (2015) found that the threshold distance discriminating walkers from passive commuters was 1.4 km for 10-year-olds, 1.6 km for 11-year-olds, and 3 km for 14-year-olds. This study also suggests that as children age, they prefer longer walking distances to school, reflecting increased independence and mobility during adolescence.

Table 4.7
The Relationship Between Gender and Walking Distance to School

Walking Time	Gender	
	Boy	Girl
Less than 1km	145	150
2 to 3km	45	31
More than 3km	18	11

*N = 400 p-value = 0.054

A previous study analysing physical activity patterns in children discovered that boys engaged in more vigorous physical activities, including walking longer distances to school, than girls (Duncan et al., 2007). A Mann-Whitney U test was conducted to evaluate whether there is a difference in walking distance to school between boys and girls. The results indicated a significant difference between boys and girls ($U = 18256.50$, $N = 208$ for boys, $N = 192$ for girls, $p = .054$), with a small effect size ($r = 0.10$). This result suggests that boys walk longer distances to school than girls, supporting the earlier statement. This difference was attributed to various factors, including social norms and parental encouragement regarding physical activity (Duncan et al., 2007).

4.3.3 The Association of Mode of Transport to School Based on Students' Demographic Background

Table 4.8

The Relationship Between Age Group and Mode of Transport to School

Mode of Transport	Age Group			Chi-Square	p-value
	7-8 years	9-10 years	11-12 years		
On Foot	29	99	250	4.082	0.130
Bicycle	-	4	39	13.278	0.001
Private Vehicle	11	26	84	1.507	0.471
Public Transport	7	5	8	20.452	0.001

*N = 400

The above table shows the relationship between age group and mode of transportation. Looking into the trend, the number of students choosing a mode of transportation increases with age, except for public transportation. The result in Table 4.8 shows that only two modes of transport, bicycle and public transport, indicated a significant difference between age groups in their choice of mode for school travel.

There was a non-significant difference between age groups in the choice of walking mode to school. The Pearson chi-square value shows that students aged 11 and 12 years outperform students aged 7 and 8 years and 9 and 10 years non-significantly in the selection of walking mode to school with $\chi^2 = 4.082$, $df = 2$, $N = 400$, $p > .05$. These results proved that students aged 11 and 12 years may have the capability and potential inclination to walk to school more than younger students. This finding is attributed to various factors, including environmental conditions, parental influences, social norms, and habit formation, which lead to a non-significant difference in walking behaviours across age groups.

Bicycle mode showed a significant difference between age groups in cycling to school. The Pearson chi-square value shows that students aged 11 and 12 years outperform the other age range significantly in selecting cycling mode to school with $\chi^2 = 13.278$, $df = 2$, $N = 400$, $p < .05$. Studies done by Schönbach et al. (2020) stated that children aged 11 and 12 may have parents who are more comfortable allowing them to cycle independently compared to younger children. This decision is based on parental encouragement and the perceived safety of cycling routes, which significantly influence children's active commuting behaviours. On top of that, as children grow older, parents may feel more confident in their children's ability to handle traffic and navigate safely and independently.

Table 4.9
The Relationship Between Gender and Mode of Transport to School

Mode of Transport	Gender		Chi-Square	p-value
	Boy	Girl		
On Foot	195	183	0.469	0.493
Bicycle	34	9	14.144	0.001
Private Vehicle	55	66	2.978	0.084
Public Transport	7	13	2.438	0.118

*N = 400

Table 4.9 above shows the relationship between gender and mode of transport to school. The result indicates that only one mode of transport (bicycle) shows a significant difference between genders. There was an essential difference between the genders in how they cycled to school. The Pearson chi-square value shows that boys outperform girls in selecting cycling mode to school with $\chi^2 = 14.144$, $df = 1$, $N = 400$, $p < .05$. This finding is supported by a relevant study done by Duncan et al., (2007) stated that boys are often socialised to engage in more physically active behaviours, including cycling, while girls may face societal pressures that discourage them from cycling due to safety concerns or perceptions of cycling as a less acceptable activity for females.

For other modes of transport, such as walking, private vehicles, and public transport, there is no significant difference in mode choices between genders, which may be attributed to parental concerns. Parents often influence their children's travel mode based on perceived safety and convenience (Guliani et al., 2015). If parents encourage both boys and girls to use the same mode of transportation, such as walking or taking public transport, it could lead to similar patterns across genders. Thus, it can be concluded that parental support may mitigate potential gender differences in school commuting.

4.3.4 The Association of Companionship During Walk to School Based on Students' Demographic Background

Table 4.10

The Relationship Between Age Group and Companionship During Walk to School

Companionship During Walk	Age Group			Chi-Square	p-value
	7-8 years	9-10 years	11-12 years		
Friend	6	33	117	10.862	0.004
Siblings	4	30	60	4.468	0.107
Parents	19	25	24	54.433	0.001
Alone	4	24	83	6.612	0.037
Others	-	2	4	0.649	0.723

*N = 400

Table 4.10 presents the relationship between age and companionship during a walk to school using a Chi-Square Test of Independence. Previous studies have found that older students (ages 11 to 12) are more likely to walk with companions (friends or peers) than younger students (ages 7 to 10). Thus, the analysis revealed a significant association between age groups and companionship with friends, with parents, and with being alone. This result suggests that older students were more likely to walk with companions than younger students. This situation arose from loneliness and walking. A study by Mizuta, Uchida, and Sawa (2023) found that walking with a companion significantly reduces loneliness compared to walking alone or not walking at all. These findings suggest that social companionship during physical activities, such as walking to school, is crucial for mental well-being, particularly among older adults.

Also, the analysis revealed no significant association between age groups and companionship for siblings and other family members. The results of this test suggest that companionship during walks to school does not differ significantly across age groups. This result was supported by a previous study by Ghani, Rachele, Washington, and Turrell (2016), which found that although older individuals may walk less frequently, companionship, such as with siblings and peers, did not significantly vary across age groups, indicating consistent patterns in social walking.

Table 4.11

The Relationship Between Gender and Companionship During the Walk to School

Companionship During Walk	Gender		Chi-Square	p-value
	Boys	Girls		
Friend	90	66	3.320	0.068
Siblings	43	51	1.926	0.165
Parents	33	35	0.395	0.529
Alone	55	56	0.370	0.543
Others	3	3	0.010	0.921

*N = 400

There was no significant difference between genders in the choice of companions during walks to school. The Pearson chi-square value for all groups is more than 0.05, indicating non-significance. However, most boys (N=90) walk with their friends, whereas girls (N=66) are more comfortable walking with their siblings. A previous study found that although boys and girls vary in how they travel to school, the selection of companions during travel does not differ significantly by gender, indicating a shared social experience (McDonald, 2012b).

4.4 The Relationship Between the Distribution of Respondents' Travel Patterns to School According to Socio-economic Background

The following section will discuss the relationship between respondents' travel patterns to school and their socio-economic background. These two areas are critical parts of this study, which sheds light on how various factors may influence children's commuting behaviours. This section will explore findings on the distribution of travel patterns among children by socioeconomic status, highlighting key determinants of their likelihood of walking to school.

4.4.1 The Association of Frequency of Parental Exercise Based on Socioeconomic Background

Table 4.12

The Relationship Between Parental Education Level and Frequency of Parental Exercise

Frequency of Parental Exercise	Parental Education Level				
	No Formal Education	Primary School	Secondary School	Cert/ Dip/ Degree	Master/ PhD
Not Exercise	2	4	68	34	5
Less than 1 hour	2	1	65	61	7
1 to 2 hours	3	3	37	51	8
2 to 3 hours	1	3	5	9	1
More than 3 hours	0	0	6	20	4

*N = 400 Chi-square = 43.587 p-value = 0.001

The researcher used Spearman's rank-order correlation to examine the relationship between parental education level and exercise frequency. Based on the results, these two variables showed a strong, positive, statistically significant correlation ($r_s = .177$, $p = .001$).

A study on parental education and physical activity behaviour found that children of parents with higher levels of education tend to engage in more physical activity. On the contrary, the variance in physical exercise behaviour was more significant among children with less educated parents, indicating a substantial impact of parental education on exercise habits (Huppertz et al., 2017).

Table 4.13

The Relationship Between Parental Income and Frequency of Parental Exercise

Frequency of Parental Exercise	Parental Income Level			
	No Income	B40	M40	T20
Not Exercise	2	92	17	2
Less than 1 hour	2	119	11	4
1 to 2 hours	4	74	19	5
2 to 3 hours	1	15	1	2
More than 3 hours	1	17	9	3

*N = 400

A Kruskal-Wallis test was conducted to determine whether there were differences in the frequency of parental exercise across different household income levels. The results indicated a significant difference in exercise frequency among the income groups [$\chi^2(3, N = 400) = 9.914$, $p = 0.019$]. The considerable result suggests that parental income may influence how often parents exercise. Higher or lower income

levels could correlate with different exercise habits, possibly due to access to fitness facilities, time availability, or health-related resources. Table 4.13 shows that schoolchildren are predominantly in category B40, in which most parents exercise for less than 1 hour per week. In the other direction, only 17 students had parents who exercised for over 3 hours in this income category.

Table 4.14

The Relationship Between Parental Employment Status and Frequency of Parental Exercise

Frequency of Parental Exercise	Parental Employment Status				
	Employed	Not Employed	Housewife	Student	Retired
Not Exercise	109	0	1	1	2
Less than 1 hour	133	0	3	0	0
1 to 2 hours	97	1	2	0	2
2 to 3 hours	17	2	0	0	0
More than 3 hours	29	0	0	0	1

*N = 400 Chi-square = 34.309 p-value = 0.005

A Chi-Square test of independence was performed to assess the relationship between parental exercise frequency and parental employment status. The results indicated a significant association between these two variables, $\chi^2 = 34.309$, $df = 16$, $N = 400$, $p < .05$. The significance result suggests a statistically significant relationship between the two categorical variables. It can be assumed that the frequency of parental exercise is not independent of parental employment status; instead, employment status may influence how often parents exercise.

4.4.2 The Association of Mode of Transport to School Based on Socioeconomic Background

Table 4.15

The Relationship Between Parental Income and Mode of Transport to School

Mode of Transport	Parental Income				Chi-Square	p-value
	No Income	B40	M40	T20		
On Foot	10	301	55	12	12.847	0.005
Bicycle	1	35	7	-	2.1	0.552
Private Vehicle	2	92	17	10	8.616	0.035
Public Transport	-	16	3	1	0.589	0.899

*N = 400

Table 4.15 shows the association between parental income and mode of transport to school among primary school children. This test is conducted to determine whether there is a significant relationship between parental income and the mode of transport schoolchildren use when travelling to school.

Based on the results, only two modes of transport show a significant association between two variables: walking and private vehicles. The p-value for these two modes was less than 0.05, indicating that parental income does not influence the choice of transport mode for school commutes. The parental income data clearly show that the B40 categories recorded the highest number of schoolchildren across all modes of transport.

Table 4.16

The Relationship Between Parental Employment Status and Mode of Transport to School

Mode of Transport	Parental Employment Status					Chi-Square	p-value
	Employed	Not Employed	Housewife	Student	Retired		
On Foot	363	3	6	1	5	0.907	0.924
Bicycle	41	-	-	-	2	5.667	0.225
Private Vehicle	120	1	-	-	-	5.372	0.251
Public Transport	19	-	1	-	-	2.196	0.700

*N = 400

Table 4.16 indicates the relationship between parental employment status and mode of transport to school. Many studies suggest that there is no significant relationship between these two variables. In other words, parental employment status does not influence the mode of transport used for school commutes. This statement is proven by the result obtained based on the Chi-square test. All p-values were greater than 0.05, indicating a non-significant relationship.

4.4.3 Summary of Significant Findings on Demographic and Socio-economic Factors Influencing Schoolchildren's Walking to School

This study involved 400 respondents and utilised various statistical tests to assess these relationships. The analysis of demographic and socio-economic factors influencing children's walking to school reveals several critical insights derived from survey data. This analysis primarily focuses on several aspects, including students' demographic backgrounds, parents' socio-economic status, and schoolchildren's walking travel behaviours.

Table 4.17
The Significant Findings based on Demographic, Socio-economic Factors and Distribution of Respondents' Travel Patterns to School

Aspect	Variable	Significant Findings
Demographic Background of Respondents	Age Distribution	A significant majority (66.25%) of respondents are aged 11 to 12 years, aligning with developmental milestones during which children begin to exhibit independence in daily tasks.
	Gender	Boys (52%) are more likely to walk to school than girls (48%), a trend attributed to social norms and safety perceptions that shape active commuting behaviours.
	Race	The predominant demographic among respondents is Malay (96.25%), reflecting the composition of the local school population.
	Body Mass Index (BMI)	A concerning 61.75% of children are classified as underweight, suggesting a positive correlation between active commuting and healthier body weight outcomes.
Socioeconomic Background of Parents or Guardians	Education Levels	Most parents have secondary education (53.25%), and 59.5% possess lower educational qualifications. This correlates with children's commuting behaviours: lower parental education levels often lead to higher walking rates due to limited access to vehicles.
	Employment Status	A high percentage (89.25%) of parents are employed, which contrasts with findings suggesting that children from unemployed households are more likely to walk to school because they have more time for supervision.
	Driving License and Vehicle Ownership	High rates of driving license ownership (89.75% among fathers) and vehicle ownership (90% of families have cars) suggest that families with such resources tend to choose driving over walking, influenced by safety concerns.
Distribution of Respondents' Travel Patterns to School	Travel Mode	While 378 (94.5%) of 400 respondents walk to school, other modes such as bicycles and private vehicles are also used.
	Distance and Duration	Most (73.8%) live less than 1 km from school, with most walking durations under 10 minutes. This proximity significantly influences the likelihood of walking.
	Parental Influence	There is a strong correlation between the frequency of parental exercise and children's likelihood of walking to school, suggesting that active parents model healthy behaviours.

Table 4.18
The Significant Findings based on Travel Patterns to School and their Demographic Background

Aspect	Variable	Significant Findings
Walking Frequency	Age Group	The analysis indicated no significant correlation between age and walking frequency, suggesting that as children age, the frequency of walking does not significantly change ($r_s(400) = 0.053$, $p > 0.05$)
	Gender	A significant association was found between gender and walking frequency, with girls walking to school more frequently than boys ($\chi^2(2, N = 400) = 6.83$, $p < .05$)
Walking Distance	Age Group	There was a significant difference in walking distance across age groups ($\chi^2(2) = 32.771$, $p < .05$), indicating that older children walk farther to school.
	Gender	Boys were found to walk longer distances than girls, although this difference was marginally significant ($U = 18256.50$, $p = .054$)
Mode of Transport	Age Group	A significant difference in mode of transport was observed, particularly with cycling; older children (11-12 years) were more likely to cycle than younger ones ($\chi^2 = 13.278$, $p < .05$)
	Gender	Boys were significantly more likely to cycle than girls ($\chi^2 = 14.144$, $p < .05$), indicating gender-specific preferences in transport modes.
Companionship During Walks	Age Group	Older students were likelier to walk with friends than younger students ($\chi^2 = 10.862$, $p < .004$). Companionship with parents also showed a significant association ($p < .001$), whereas companionship with siblings did not differ across age groups.
	Gender	There were no significant differences in companionship choices based on gender; however, boys tended to walk with friends more than girls did

Table 4.19

The Significant Findings Based on The Distribution of Respondents' Travel Patterns to School and Their Socioeconomic Background

Aspect	Variable	Significant Findings
Parental Exercise	Parental Education	A strong positive correlation exists between parental education level and exercise frequency, indicating that children of more educated parents are likely to engage in more physical activity. The statistical significance of this correlation was confirmed with a Spearman's rank-order correlation ($r_s(400) = 0.177, p = 0.001$)
	Parental Income	A Kruskal-Wallis test indicated significant differences in exercise frequency among different income groups ($\chi^2(3, N = 400) = 9.914, p = 0.019$). Most children belonged to the B40 category, in which parents typically exercised for less than 1 hour per week.
Mode of Transport and Socioeconomic Factors	Parental Education	No significant relationship was found between parental education level and the mode of transport children use to school, suggesting that educational attainment does not influence transport choices.
	Parental Income	A significant association was identified between parental income and walking or driving to school ($p < 0.05$), with the B40 income group showing the highest prevalence of walking.
	Parental Employment Status	No significant relationship was observed between parental employment status and mode of transport, suggesting that employment status does not affect school transportation choices.
Walking Frequency to School	Parental Education	There was no significant difference in walking frequency based on parental education levels ($F(4,395) = 1.646, p = 0.162$)
	Parental Income	A significant difference in walking frequency was observed across income groups ($H(2) = 8.954, p < 0.05$), contradicting the existing literature, which typically associates higher income with greater opportunities for physical activity.
	Parental Employment Status	Chi-square tests revealed no significant association between parental employment status and children's walking frequency ($\chi^2 = 5.837, p > 0.05$), suggesting that employment status may not be a critical factor influencing walking habits.

4.5 Summary

This chapter focused on analysing the demographic and socio-economic characteristics that influence children's walking-to-school behaviour. The findings highlight that age, gender, income, and parental education are key determinants of walking frequency and mode choice. The next chapter will examine how attributes of the built environment interact with these social factors to influence children's walking decisions.

CHAPTER 5

ASSESSMENT OF PEDESTRIAN INFRASTRUCTURE AND FACILITIES IN SCHOOL ZONES

5.1 Introduction

Chapter 5 presents the findings primarily from a qualitative approach (field observation method) and is supported by a quantitative approach (questionnaire survey method) conducted in the study area, focusing on the pedestrian facilities and infrastructure at the six selected schools. This chapter complements Chapter 4 by examining built environment factors, particularly pedestrian infrastructure and facilities in school zones. The ultimate aim of this chapter is to assess the current provision and condition of pedestrian infrastructure and facilities across selected school areas.

In addressing this pertinent issue, this chapter has effectively achieved Research Objective One, to analyse the built environment factors that influence children's decision to walk to or from school, and Research Objective Two, which aims to evaluate the current provision and condition of pedestrian infrastructure and facilities in school zones. The insights gained through this assessment provide a critical foundation for understanding the impact of the built environment on children's walking behaviour. Thus, the findings will be further synthesised in the following chapters to facilitate the exploration of the remaining research objectives.

Field observations were conducted to capture real-world conditions and user behaviours, providing valuable insights into how the built environment facilitates and hinders pedestrian movement, particularly in school zones where safety is crucial. Focusing on the six schools in the survey, this chapter emphasises the unique challenges and opportunities across different study areas.

A detailed description of the observation methodology, including the assessment criteria and the data collection process, follows. The core findings are presented school-by-school, examining key pedestrian elements such as walkways, crosswalks, and intersections, as well as school zone infrastructure and ancillary facilities, along with observed pedestrian behaviours and environmental factors. Each school's assessment integrates data from both field observations and questionnaire surveys to identify

whether the built environment encourages or discourages children from walking to school.

5.2 Evaluation of Pedestrian Infrastructure in School Zones

A checklist was used to assess specific features, with photographic documentation providing visual evidence of the conditions and any identified issues. Table 5.1 indicates a comprehensive inventory and evaluation of pedestrian facilities observed during the site assessment. The review addresses several key components that are essential for pedestrian safety and accessibility:

Table 5.1
Assessment Criteria for Pedestrian Infrastructure Around Schools

Category	Variables / Indicators	Assessment Criteria	Source
Sidewalks and Walkways	Presence	Whether sidewalks exist along pedestrian routes near the school.	(Bivina G.R. et al., 2018; Mulyadi M. et al., 2022)
	Width	Adequacy of sidewalk width to accommodate pedestrian volume and accessibility needs. (minimum recommended width: 1.8m)	(Bivina G.R. et al., 2018; Mulyadi M. et al., 2022)
	Continuity	Presence of an uninterrupted sidewalk without gaps or obstacles.	(Bivina G.R. et al., 2018; Mulyadi M. et al., 2022)
	Surface Condition	The quality of pavement surface smoothness, maintenance, and absence of cracks or hazards.	(Bivina G.R. et al., 2018; Mulyadi M. et al., 2022)
	Accessibility	Availability of curb ramps, tactile paving and features for persons with disabilities	(Bivina G.R. et al., 2018; Mulyadi M. et al., 2022)
	Obstructions	Presence of street furniture, signage, vegetation or other obstacles blocking pedestrian flow	(Bivina G.R. et al., 2018; Mulyadi M. et al., 2022)
Crosswalks and Intersections	Location and Visibility	Placement of crosswalks relative to school entrances and pedestrian desire lines, as well as visibility for both drivers and pedestrians.	(González-Gómez & Castro, 2019)
	Markings	Clarity and maintenance of crosswalk paint or tactile indicators.	(Pinkerton et al., 2013)
	Pedestrian Signals	Presence and functionality of pedestrian crossing signals or push buttons.	(Arizona Department of Health Services, 2010)
	Traffic Calming Measures	Use of raised tables, speed bumps, curb extensions, or other devices to slow vehicle speeds near crossings	(Pinkerton et al., 2013)
	Safety	Observed safety features and risk factors such as sightlines, vehicle speeds, and conflict points	(Pinkerton et al., 2013)
School Zone Infrastructure	Signage	Presence, visibility, and condition of school zone signs and speed limit	(Zhao et al., 2016)

		indicators.	
	Speed Limits	Post speed limits in school zones and enforce measures.	(Zhao et al., 2016)
	Drop-off / Pick-up Areas	The design, location, and management of vehicle areas for student drop-off and pick-up, and their impact on pedestrian movement.	(SMR et al., 2020)
	Bus Stops	Location and safety of school bus stops relative to pedestrian paths.	(Shabadin et al., 2022)
Ancillary Facilities	Lighting	Adequacy of street lighting for pedestrian safety during low-light conditions.	(Bivina G.R. et al., 2018; Mulyadi M. et al., 2022)
	Seating and Rest Areas	Availability of benches or resting spots along pedestrian routes.	(Bivina G.R. et al., 2018; Mulyadi M. et al., 2022)
	Shade and Shelter	The presence of trees, awnings, or shelters that protect from the weather.	(Bivina G.R. et al., 2018; Mulyadi. et al., 2022)
	Bicycle Facilities	The availability and condition of bicycle racks or lanes support multimodal access.	(Bivina G.R. et al., 2018; Mulyadi M. et al., 2022)
Pedestrian Behaviour and Safety	Observed Crossing Behaviour	Patterns include jaywalking, designated crossings, group crossings, or risky behaviours.	(Meneses & Buluran, 2022; Qin et al., 2025; Saltarin-Molino et al., 2023)
	Conflicts with Vehicles	Instances of near-misses, pedestrian-vehicle conflicts, or unsafe interactions.	(Meneses & Buluran, 2022; Qin et al., 2025; Saltarin-Molino et al., 2023)
	Vulnerable User Considerations	Observations related to children, persons with disabilities, or elderly pedestrians.	(Meneses & Buluran, 2022; Qin et al., 2025; Saltarin-Molino et al., 2023)
Environmental and Contextual Factors	Land Use Context	Types of surrounding land use (residential, commercial, institutional) influencing pedestrian demand and safety.	(Bivina G.R. et al., 2018; Mulyadi M. et al., 2022; Qin et al., 2025)
	Traffic Volume and Speed	Volume and speed of vehicular traffic on adjacent roads affect pedestrian safety.	(Bivina G.R. et al., 2018; Qin et al., 2025; Saltarin-Molino et al., 2023)
	Weather and Lighting Conditions	Environmental factors during observations impact pedestrian comfort and visibility.	(Qin et al., 2025; Saltarin-Molino et al., 2023)

Each variable and indicator is analysed based on adequacy, maintenance status, and compliance with applicable standards or guidelines. At the end of this chapter, areas with well-functioning infrastructure and those needing improvement in pedestrian safety and convenience will be highlighted.

Concurrently, a questionnaire survey was distributed to students to gather perceptions of safety, accessibility, the condition of pedestrian facilities, and satisfaction with walking conditions while using the facilities. Field observation focused on the physical infrastructure and pedestrian behaviours, including crossing patterns, compliance with traffic controls, and interactions with vehicular traffic. This comprehensive approach enabled a detailed, nuanced understanding of the pedestrian environment in each school zone.

5.3 Findings by School

This section presents the assessment of pedestrian facilities and walking environments at six selected schools that participated in the survey. The analysis is organised school-by-school to provide a clear, contextual understanding of the infrastructure conditions and their influence on children's preference for walking to school. Each school's profile includes an evaluation of key elements, including walkway conditions, crosswalks, signage, ancillary facilities, and observed pedestrian behaviours. The findings are supported by questionnaire data that capture students' perspectives, offering a comprehensive view of how the built environment facilitates or hinders schoolchildren's active travel to school.

5.3.1 SK Seksyen 7

SK Seksyen 7 Shah Alam is situated in the fastest-developing area of Shah Alam, which accommodates 1,839 students (Jabatan Pendidikan Negeri Selangor, 2025). SK Seksyen 7 is located within a mixed-use urban neighbourhood in Shah Alam. The school is situated in a medium-density residential area, surrounded by commercial zones and a public recreational park, creating a moderately walkable environment.



Plate 5.1 Main Entrance of SK Seksyen 7

The road network comprises internal streets with moderate traffic flow, particularly during school peak hours. A nearby bus stop and internal circulation roads provide good accessibility for both pedestrians and vehicles. While the area benefits from natural surveillance due to its proximity to nearby housing and facilities, occasional congestion at drop-off and pick-up times presents a challenge to pedestrian movement and safety.

5.3.1.1 Pedestrian Walkways

The pedestrian walkways around SK Seksyen 7 are generally well-developed, with widths ranging from 2.5 to 3.3 meters, exceeding the minimum recommended width of 1.8 meters. The width of the walkways varies across different areas, depending on the available reserve space. The sidewalks provide a continuous connection from the school building to the bus stop and nearby residential areas, with no gaps or obstacles observed. The following maps accompany this assessment (see Plate 5.2). The walkways' surface condition is good, and the paths are largely uninterrupted.



Plate 5.2 Pedestrian Network: SK Seksyen 7



Plate 5.3 Well-Designed Pedestrian Walkway at SK Seksyen 7

This school reported having curb ramps that facilitate wheelchair access. However, preliminary observations suggest that these curb ramps do not fully comply with Malaysian regulations, including the Malaysian Standard MS 1184:2014 on Universal Design and Accessibility in the Built Environment. The following photos (see Plate 5.4) indicate the curb ramp installed at SK Seksyen 7.



Plate 5.4 Curb Ramp Enhancing Accessibility at SK Seksyen 7

However, some areas do have obstructions, such as street furniture, signage, and vegetation. Regarding Plate 5.5, substantial trees are strategically located in the centre of the pedestrian walkway. Fortunately, the walkway's ample width ensures that pedestrians can move freely and comfortably, minimising any potential obstructions and enhancing the overall walking experience. This design fosters a pleasant environment for all individuals who navigate the space.

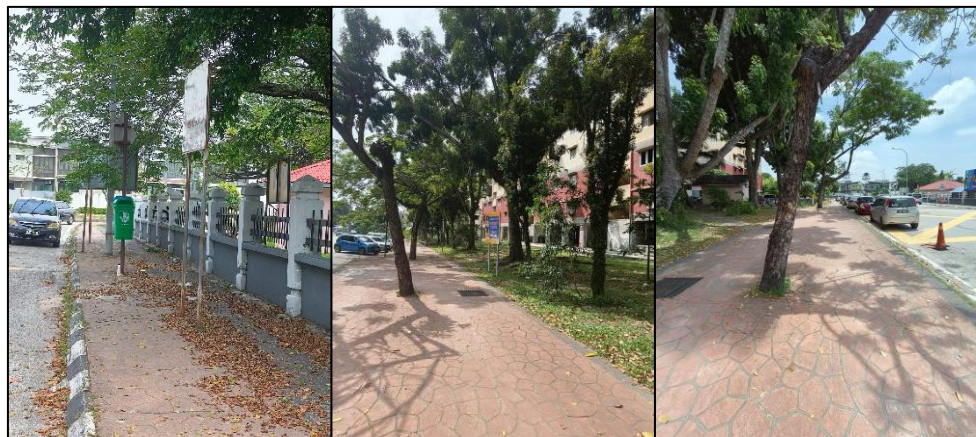


Plate 5.5 Obstructions from Trees and Street Furniture at SK Seksyen 7

According to the questionnaire, 77.78% of respondents in SK Seksyen 7 agreed or strongly agreed that the pedestrian walkways are safe and comfortable. This finding is consistent with on-site observations, indicating overall satisfaction. The high satisfaction level suggests that the pedestrian infrastructure around SK Seksyen 7 positively influences children's comfort and perceived safety, making it more conducive for walking to school.

5.3.1.2 Crosswalks and Intersections

The school has marked crosswalks conveniently situated near its entrances. The markings are easy to see, and speed humps are effectively utilised to slow down traffic. However, during observation, it was noted that the installed flashing light was not functioning. Despite this issue, 83.33% of students surveyed reported feeling safe when crossing the road near the school.



Plate 5.6 Marked Crosswalk Near School Entrance at SK Seksyen 7



Plate 5.7 Speed Hump for Vehicle Speed Reduction at SK Seksyen 7

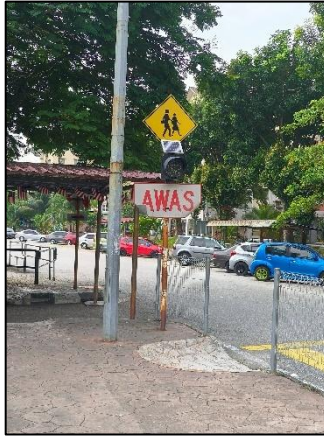


Plate 5.8 Flashing Light Installed (Non-functional) at SK Seksyen 7

5.3.1.3 School Zone Infrastructure

The area features school signage and a designated drop-off and pick-up zone adjacent to a bus stop. The bus stops are strategically placed in both directions in front of the school, facilitating convenient access for students. This arrangement ensures that all students can easily reach their transportation, enhancing their overall commuting experience.



Plate 5.9 Drop-off Zone Adjacent to Bus Stop at SK Seksyen 7



Plate 5.10 Bus Stops Positioned on Both Sides at SK Seksyen 7

However, there are no posted speed limit signs within the school zone. Despite the lack of these signs, traffic speeds appear moderate, likely due to traffic calming measures, such as speed humps, on the main road. Results from a questionnaire survey support this observation: 69.5% of respondents disagreed that drivers of motorised vehicles drive at maximum speed in school zones, while 30.5% agreed.



Plate 5.11 School Zone Signage Present at SK Seksyen 7

5.3.1.4 Ancillary Facilities

Observations show that there is dedicated pedestrian lighting, complemented by illumination from the main road. The combination of these two lighting types provides adequate visibility in the school zone, which is essential for safety during early-morning and late-evening hours.



Plate 5.12 Dedicated and Street Lighting at SK Seksyen 7

Additionally, there are well-utilised seating areas and shaded waiting spots, particularly during peak pick-up and drop-off times. Several seating areas are provided not only for student use but also for parents and guardians waiting for their children. These areas also offer protection from the sun and rain. Their strategic placement near the school entrance enhances usability and reflects good planning that supports pedestrian needs in the school environment.



Plate 5.13 Seating and Resting Spots at SK Seksyen 7

Observations suggest that pedestrian walkways at SK Seksyen 7, equipped with covered roofs, protect against the weather and improve lighting along the paths. This creates a more inviting and accessible environment for all users, especially schoolchildren. This statement is supported by student responses, which indicate that 77.78% disagreed with the idea that hot weather prevents students from walking to

school because of covered walkways, while only 22.22% agreed. This result proves that pedestrian shelters encourage more students to walk to school.



Plate 5.14 Covered Walkways at SK Seksyen 7

5.3.1.5 Pedestrian Behaviour and Safety

Children were generally observed using the designated pedestrian crossings around the school, showing an awareness of and adherence to safe crossing practices. However, some instances of jaywalking were observed near the drop-off and pick-up zones, likely due to vehicle congestion and the absence of physical barriers to guide pedestrian movement. Despite these issues, no direct conflicts between vehicles and pedestrians were observed during the site visit, indicating that the traffic-calming measures in place are effective.



Plate 5.15 Students Using Designated Walkways at SK Seksyen 7

5.3.1.6 Environmental and Contextual Factors

Additionally, traffic around the school is generally slow during regular hours; however, brief congestion occurs during peak drop-off and pick-up hours, which may pose a risk to pedestrians. Plate 5.16 indicated very slow traffic at the main entrance, where the pick-up and drop-off areas are located.



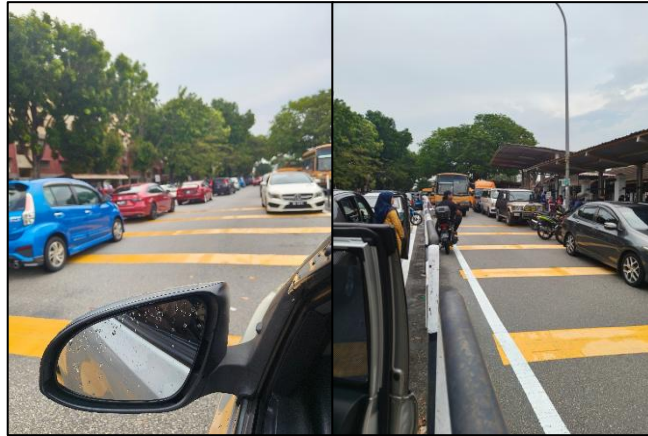


Plate 5.17 Slow Traffic Volume Observed During Peak Hours at SK Seksyen 7

The lighting conditions during the site visit were deemed sufficient for daytime safety; however, potential concerns remain for early-morning or evening commutes in poor weather or low-light conditions. Although lighting under covered walkways suggests good visibility, this infrastructure may not uniformly illuminate all walking paths. This is especially true at crossing points or in less-sheltered areas, which depend on road lighting serving vehicular traffic. These contextual features suggest that, while the area generally supports walkability, targeted enhancements to lighting coverage could improve safety and consistency across various conditions.

5.3.2 SK Seksyen 17

SK Seksyen 17 is located within a predominantly residential area of Shah Alam, characterised by medium-density housing and some institutional and commercial buildings. According to Jabatan Pendidikan Negeri Selangor (2025), the school has 1,396 enrolled students.

The school is situated near a collector road that experiences heavy traffic during peak hours, particularly during school drop-off and pick-up. The surrounding environment comprises residential areas and community facilities; however, the road design prioritises vehicles over pedestrians, with limited dedicated pedestrian infrastructure. Public transport is available in the vicinity, but its integration with pedestrian access is minimal. These factors collectively contribute to moderate walkability in the area, though traffic congestion, inadequate pedestrian facilities, and poor infrastructure maintenance compromise safety and comfort.



Plate 5.18 Main Entrance of SK Seksyen 17

5.3.2.1 *Pedestrian Walkways*

The pedestrian walkways around SK Seksyen 17 are narrow, with an average width of approximately 1.6 meters, which is below the recommended minimum of 1.8 meters. There is also a lack of continuity in the pedestrian walkways connecting to the surrounding areas. Schools attract many students who walk daily, not only from the bus stop to the school building but also from nearby residential neighbourhoods. To ensure safe and convenient movement, pedestrian paths within the school should connect

directly to those outside the gate, making it easier for students to access the school using the school van or other forms of transport. Moreover, footpaths should be established between schools and nearby residential areas to promote safe walking to school. Continuous pedestrian walkways will provide secure and convenient access for pedestrians. The accompanying map (see Plate 5.19) clearly illustrates the pedestrian network at SK Seksyen 17.



Plate 5.19 Pedestrian Network and Surrounding Land Use: SK Seksyen 17



Plate 5.20 Narrow Pedestrian Pathway at SK Seksyen 17

Besides, the surface condition is poor, with visible cracks and uneven pavement that may pose tripping hazards. Additionally, specific segments of the walkway lack continuity and are obstructed by overgrown vegetation, improperly placed signage, street furniture, and pedestrian signal lights. These findings underscore the urgent need for schools and responsible authorities to regularly inspect pedestrian walkways, remove or reposition obstructions, and implement routine maintenance to ensure safe, accessible pathways for all users. As pedestrians spend most of their travel time in the walking zone (often located on both sides of a road or street), this zone should be free of obstacles, protruding objects, and vertical obstructions that pose hazards to pedestrians, particularly to individuals with vision impairments. Additionally, accessibility features such as curb ramps are absent.

Questionnaire responses contrast with this observation; only 22.22% of respondents disagreed that the pedestrian paths are safe and comfortable. A significant number (77.78%) agreed, highlighting their satisfaction with the current condition of pedestrian facilities in their school zone.



Plate 5.21 Poor Surface Condition of School Walkway at SK Seksyen 17



Plate 5.22 Obstructions Blocking Pedestrian Flow at SK Seksyen 17

5.3.2.2 *Crosswalks and Intersections*

Crosswalks near the school are clearly marked and positioned close to the entrances. The school features a pedestrian signal with a push-button system that operates effectively, significantly enhancing the safety of students and other pedestrians in the vicinity. However, there is no signage to notify road users of the traffic signal's presence. Speed humps have been installed to help control vehicle speeds, which enhances pedestrian safety. Despite these safety measures, 80.56% of respondents in Seksyen 17 expressed concerns about intersection safety, particularly during peak hours, when traffic volumes are high. The following photos show the existing condition of each feature.



Plate 5.23 Marked Crosswalk Near School Entrance at SK Seksyen 17



Plate 5.24 Pedestrian Signal with Push Button at SK Seksyen 17



Plate 5.25 Speed Hump for Traffic Calming at SK Seksyen 17

5.3.2.3 School Zone Infrastructure

The school has signage, but it is unclear, which may have confused. Additionally, the sign had been peeled, further obscuring the intended information. This combination of factors likely contributed to the difficulty in understanding or following the signage. Besides, there is no posted speed limit display in the school zone. There is also a designated drop-off and pick-up area at the bus stop. This lay-by area helps reduce congestion and minimises conflicts between vehicles and pedestrians, particularly during peak hours. Additionally, bus stops are located in both directions.



Plate 5.26 Unclear Signage at SK Seksyen 17



Plate 5.27 Two-Way Bus Stops at SK Seksyen 17

5.3.2.4 Ancillary Facilities

The site observation revealed a notable absence of dedicated street lighting for pedestrian facilities. Street lighting is available but has a limited range, as it is primarily intended for use on vehicular roads. This condition has raised concerns about safety and visibility among individuals using the pathways, especially in the early morning and late evening, when the likelihood of schoolchildren using the pedestrian facilities is high.



Plate 5.28 Street Lighting at SK Seksyen 17

There is no designated pedestrian seating area near the school; however, a bus stop is located in front of the building, with a limited number of seats intended mainly for bus passengers. The pedestrian walkway lacks weather protection, as there are no covered walkways. The small covered area at the bus stop cannot accommodate many students at once. Additionally, there is no shade or shelter along the pedestrian pathways, leaving students exposed to the elements.

After reviewing the survey responses, it was found that the majority of SK Seksyen 17 respondents (69.44%) agreed that hot weather does not deter them from walking to school. This indicates that the absence of covered walkways does not significantly impact children's willingness to engage in AST.



Plate 5.29 Limited Seating and Shelter at SK Seksyen 17

5.3.2.5 Pedestrian Behaviour and Safety

Based on observations during peak hours, many students cross roads at non-designated points due to the absence of fencing, inadequate designated crossings, and insufficient signage. The lack of pedestrian barriers or fencing allows students to cross the road at various locations, especially near drop-off and pick-up points. Children walking without adult supervision are especially vulnerable in these conditions, as they are more likely to take risks or misjudge gaps in traffic. Jaywalking is common and beyond the pedestrian guide's control.



Plate 5.30 Lack of Fencing at SK Seksyen 17

During arrival and dismissal periods, high vehicle volumes combined with unregulated pedestrian movement lead to frequent conflicts among road users. Vehicle-pedestrian interactions were observed to be moderately risky, especially during dismissal hours. Fortunately, motorised vehicle users comply with the speed limit imposed in school zones, reducing the risk for vulnerable road users. Although vehicle-pedestrian interactions were observed to be moderately risky, the questionnaire survey indicated that the majority of respondents had never been nearly hit by a motorised vehicle passing through a school zone. A minority of them (11.11%) had experienced being practically hit.

5.3.2.6 Environmental and Contextual Factors

The school is situated near a residential area and commercial lots, but it is adjacent to a busy collector road, which increases traffic during school hours. The intensity of these activities, especially during peak hours, intensifies the demand for well-planned, safe pedestrian routes. Plate 5.31 shows traffic flow: slow traffic at 7 am during peak hours, when children and parents commute to school and work simultaneously, and fast traffic at 1 pm.

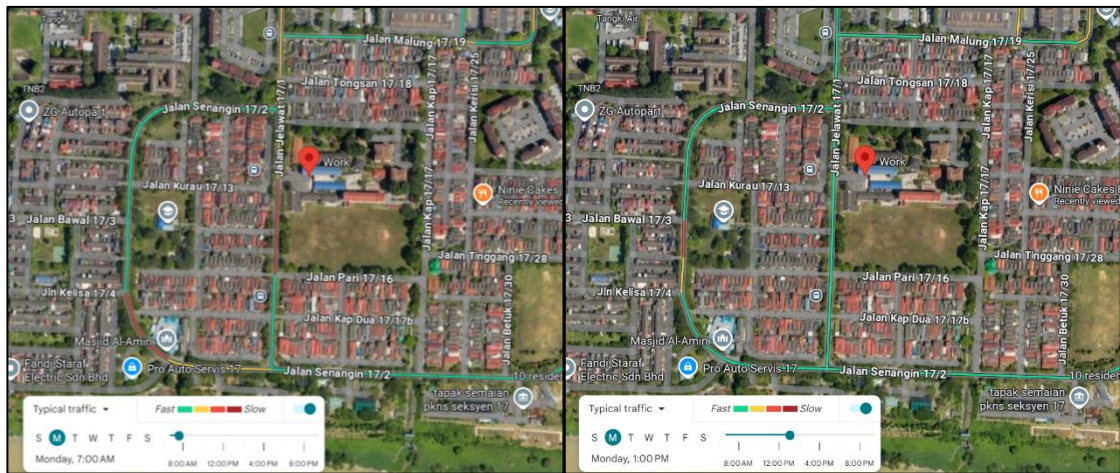


Plate 5.31 Traffic Flow Observed During Morning (7:00 am) and Afternoon (1 pm) Peak Hours Near SK Seksyen 17

While the built-up environment provides natural surveillance and promotes walkability, lighting conditions were observed to be inadequate, particularly during early morning hours. Lighting conditions during observation were moderate; however, the lack of pedestrian-specific lighting affected visibility. The available street lighting does not fully illuminate all pedestrian pathways, especially in areas not directly adjacent to the installation site.

5.3.3 SK Seksyen 19

SK Seksyen 19 has an enrollment of 1,483 students and is situated in a high-density residential neighbourhood in Shah Alam (Jabatan Pendidikan Negeri Selangor, 2025). The school is surrounded by densely populated housing, commercial units, and small community facilities, contributing to a busy environment, especially during peak hours. It is situated next to a secondary road that connects to major arterial routes, resulting in heavy traffic during these times.

The land use pattern around the school provides reasonable proximity between homes and the school. However, the walking environment is hindered by inconsistent infrastructure, informal parking, and inadequate enforcement of traffic rules. Despite the area's walkability, there is a significant lack of pedestrian safety measures, which creates potentially hazardous routes for children walking to school.



Plate 5.32 Main Entrance of SK Seksyen 19

5.3.3.1 Pedestrian Walkways

At SK Seksyen 19, the pedestrian walkways are among the narrowest, measuring 1.4 to 1.5 meters wide. These measurements fall below the recommended standard, posing a challenge during peak times, such as the start and end of school hours.



Plate 5.33 Narrow Walkways at SK Seksyen 19

The surface condition is poor, with major visible cracks, uneven paving, and occasional debris, posing hazards to walking schoolchildren. This deterioration increases the risk of danger on the way to school and indicates a lack of regular maintenance and timely repairs by the responsible authorities. Immediate attention and remedial action are necessary to restore the walkway to a safe and accessible condition, ensuring the well-being of all students who use this path daily.



Plate 5.34 Damaged and Poorly Maintained Pedestrian Surface at SK Seksyen 19

In terms of accessibility, there are no features for persons with disabilities, such as curb ramps, implemented within the school zones. The walkways are discontinuous in some areas and often obstructed by overgrown vegetation and ground digging (see Plate 5.36).



Plate 5.35 Pedestrian Network and Surrounding Land Use: SK Seksyen 19



Plate 5.36 Obstructions at SK Seksyen 19

Survey responses from SK Seksyen 19 reveal the following issue: only 34.4% of students believed the pedestrian facilities provided were safe. In comparison, 65.6% disagreed or strongly disagreed, indicating significant dissatisfaction with the pedestrian infrastructure in the school zone.

5.3.3.2 Crosswalks and Intersections

The visibility of crosswalks is generally good, especially in locations near school entrances. However, the crosswalk lines have faded significantly and no longer retain their former brightness. This deterioration compromises safety and underscores a lack of regular maintenance on the crosswalk paint, creating a less secure environment for students and pedestrians crossing the road.



Plate 5.37 Faded Crosswalk Markings at SK Seksyen 19

Currently, there are no pedestrian signals in place. In areas without traffic lights, pedestrians must cross the roads without any automated assistance. This can create hazardous situations, as drivers may not expect pedestrians to cross without traffic signals. Schoolchildren, in particular, may feel uncertain about when to cross, leading to hesitation or risky behaviour. Although speed humps are installed, they may not adequately compensate for the absence of signalised control.



Plate 5.38 Speed Hump for Traffic Calming at SK Seksyen 19

According to the questionnaire, 53.19% of respondents expressed concerns about the clarity and safety of the crosswalks, particularly during periods of heavy traffic. In contrast, 46.81% of respondents felt safe regarding the current conditions in the school zone.

5.3.3.3 School Zone Infrastructure

Upon thorough observation, it has been noted that the school has implemented signage; however, there are notable deficiencies in its installation. Currently, the signage is limited to basic speed hump warnings and child crossing indicators. In school zones, where the safety of children is a top priority, a more comprehensive set of signs is necessary. This should include visible speed-limit indicators, prominent child-crossing signs, and other relevant warnings to alert drivers to increased activity and potential hazards in these areas.



Plate 5.39 Basic School Zone Signage at SK Seksyen 19

A designated drop-off and pick-up area is located next to a bus stop, though congestion there is frequent. The location and safety of school bus stops are essential considerations. The observed bus stops are strategically placed to minimise the need for students to cross busy streets. It was noted that the bus stops provide safe waiting areas that are separated from traffic. The design of the bus stop area also accommodates students with disabilities and considers clear sightlines for both pedestrians and drivers.



Plate 5.40 Shared Drop-off and Bus Stop Area at SK Seksyen 19

During the observation, it was noted that the bus stop facilities consisted of only one-way stops, located on the school side of the road. The lack of structured traffic flow and enforcement contributes to safety concerns during peak times. In a survey, 59.57% of respondents reported the drop-off zone was chaotic, attributing this to the one-way bus stop, where vehicles often park alongside the pathway, blocking visibility for pedestrians.



Plate 5.41 One-Way Bus Stop at SK Seksyen 19

5.3.3.4 Ancillary Facilities

The current street lighting is inadequate for pedestrian use, as the existing lamps are primarily positioned to serve vehicular traffic along the road shoulder. This arrangement fails to adequately illuminate the walkways, increasing the risk to pedestrians who may be less visible to drivers. From personal experience, walking in the area at night, it is evident that the dimly lit pedestrian spaces create navigation challenges.

Although seating and rest areas are available, their limited number, combined with the lack of shade or shelter along the pedestrian walkways, exposes individuals to adverse weather conditions, including rain, sun, and wind. This lack of protection can make the walking experience uncomfortable and may deter schoolchildren from using the pathways in inclement weather.



Plate 5.42 Limited Seating with No Shade at SK Seksyen 19

Additionally, the lack of covered walkways exacerbates the poor lighting. Without an overhead structure to reflect and distribute light, areas with sparse street lamps remain dimly lit, creating an unwelcoming environment for pedestrians. This combination of open-air exposure and inadequate lighting undermines the sense of safety and security, particularly at night or in low-light conditions.

While 61.70% of respondents expressed satisfaction with the existing lighting in the school zone, 14.89% were dissatisfied and called for the installation of a dedicated lighting system along the pedestrian walkway. This feedback highlights the need for improvements to enhance pedestrian safety and comfort.

5.3.3.5 Pedestrian Behaviour and Safety

The condition and layout of the surrounding infrastructure significantly impact pedestrian behaviour around SK Seksyen 19. Due to narrow, poorly maintained walkways, children are often observed walking in single file or stepping into the road, especially during peak school hours. The lack of designated pedestrian crossings with traffic signals further increases the risks, as students must navigate traffic without any guidance or protection. This situation forces many to rely on their judgment when crossing roads, which can lead to hesitation or unsafe decisions, especially in areas with limited driver visibility.

Observations of pedestrian patterns reveal that students and accompanying adults tend to avoid damaged or obstructed walkways, instead opting for shorter routes that may expose them to vehicular traffic.

Survey findings support these behavioural tendencies: only 10.64% of respondents felt that pedestrian facilities were safe, and over half (63.83%) expressed concern about unclear and deteriorated crosswalks. These findings highlight a significant discrepancy between infrastructure design and pedestrian behaviour, underscoring the urgent need for improved safety measures, such as more precise markings, better lighting, and designated pedestrian zones, to promote safer walking practices.

5.3.3.6 Environmental and Contextual Factors

The environment surrounding SK Seksyen 19 is shaped by its location in a high-density residential area, complemented by commercial activity and a network of secondary roads connecting to major arterial routes. This creates a consistently high level of pedestrian and vehicular interaction, particularly during morning arrival and afternoon dismissal periods. These peak hours result in significant congestion, particularly around the drop-off and pick-up zones, where limited traffic flow design and informal parking further complicate movement. Plate 5.43 shows the existing traffic conditions between two peak hours on the main road adjacent to the school's main entrance, with similar fast-moving traffic flow at both times.

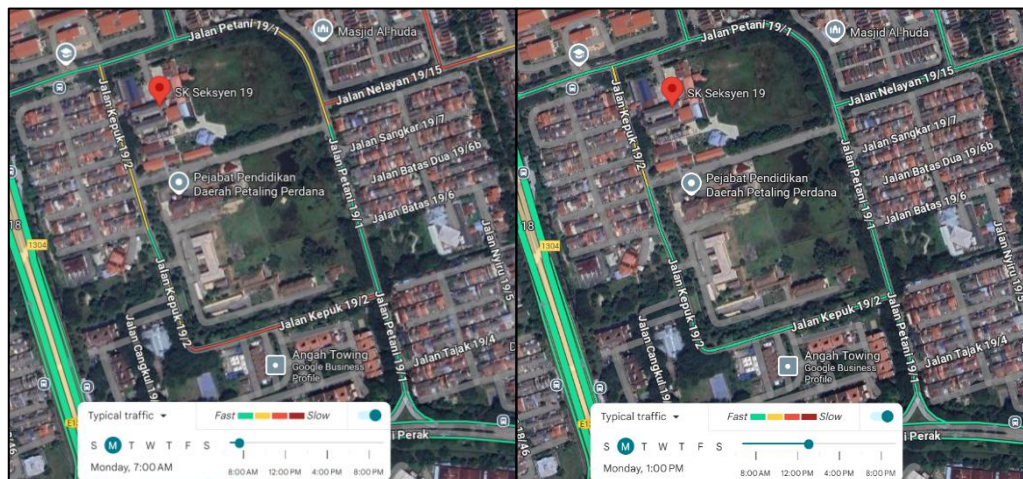


Plate 5.43 Traffic Flow Observed During Morning (7:00 am) and Afternoon (1 pm) Peak Hours Near SK Seksyen 19

Environmental factors, such as inadequate lighting, a lack of shaded walkways, and limited seating, compromise walking comfort and safety, particularly in inclement weather or during early morning or evening hours. The positioning of street lighting primarily benefits vehicular lanes, leaving pedestrian paths dim and unsafe, particularly in sections obstructed by overgrown vegetation or ongoing utility works. Moreover, the absence of facilities for students with disabilities, such as ramps or tactile paving, reflects a lack of inclusive infrastructure design.

5.3.4 SK Seksyen 24

SK Seksyen 24 has an enrollment of 1,972 students and is situated in a well-established mixed-use neighbourhood in Shah Alam (Jabatan Pendidikan Negeri Selangor, 2025). The surrounding area comprises medium- to high-density residential zones, interspersed with commercial areas and public amenities. The school is accessible via a network of internal roads that experience moderate to high traffic volumes during school hours, particularly during peak drop-off and pick-up times.

Despite the lively surroundings, the pedestrian infrastructure is relatively well developed, with wider walkways, seating areas, and shelters. The neighbourhood's overall layout has strong potential for walkability, supported by natural surveillance and proximity to the school. However, there is still a need for safety enhancements, particularly in traffic control and pedestrian priority measures.



Plate 5.44 Main Entrance of SK Seksyen 24

5.3.4.1 Pedestrian Walkways

The pedestrian walkways at SK Seksyen 24 are relatively broad, measuring between 2.2 and 3.0 meters. The surface condition is rated as good, and the walkway is almost continuous. While some accessibility features are in place, there are limitations; curb ramps are available, but they do not fully comply with universal design standards. The curb ramp is too narrow to accommodate a wheelchair (refer to Plate 5.47[b]). It has been designed to allow motorcycles or bicycles to pass through, which is inappropriate for ethical use.

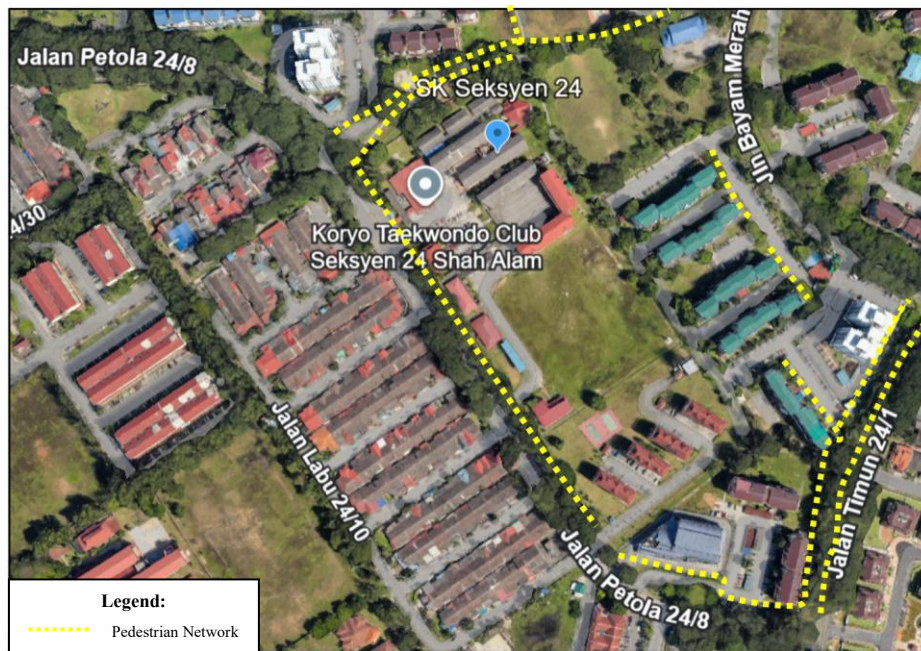


Plate 5.45 Pedestrian Network and Surrounding Land Use: SK Seksyen 24



Plate 5.46 Wide and Continuous Pedestrian Walkway at SK Seksyen 24



Plate 5.47 Non-Compliant Curb Ramp at SK Seksyen 24

Additionally, several obstructions, such as improperly placed signage and large trees, have been noted along the pedestrian path, hindering movement and creating hazards. Parked cars adjacent to the walkway also obstruct pedestrians' visibility.



Plate 5.48 Visual Obstructions at SK Seksyen 24

In a survey, 70% of respondents expressed satisfaction with the walkway's condition. However, a significant portion (30%) raised concerns about obstructions that affected their movement.

5.3.4.2 Crosswalks and Intersections

Crosswalks are appropriately positioned, but their markings have faded over time, reducing visibility. Challenges such as unclear crosswalk markings and somewhat disorganised traffic flow persist. Observations from the accompanying images (see Plate 5.49) indicate that the responsible authorities have not adequately maintained the existing facilities, leading to unclear road markings. This lack of clarity can confuse both pedestrians and drivers, potentially leading to road accidents. This issue is particularly problematic for individuals who are visually or mobility-impaired, as they may not have the necessary cues to navigate safely.



Plate 5.49 Faded Crosswalk Markings at SK Seksyen 24

To enhance pedestrian safety, it is crucial to improve crosswalk visibility so that motorists can see pedestrians. This could be achieved through the use of warning signs and traffic calming measures. Additionally, the absence of pedestrian signals may further compromise crossing safety, so speed humps have been installed to reduce vehicle speeds near schools. However, the signage for the speed humps is unclear and needs to be replaced.



Plate 5.50 Speed Hump for Traffic Calming at SK Seksyen 24

According to a questionnaire, 53.33% of respondents expressed uncertainty or concern regarding the condition of the crosswalks, specifically citing unclear markings as a significant issue. This finding suggests the need for immediate attention to crosswalk maintenance and improvements in visibility. Enhancing the clarity of crosswalks through regular repainting and supplementary signage could improve pedestrian safety and reinforce walking as a safe, viable mode of transport for schoolchildren.

5.3.4.3 School Zone Infrastructure

The school zone has signage, but it lacks sufficient reinforcement from speed-limit indicators. Some signs are broken and need to be replaced. There is a designated drop-off and pick-up area near a bus stop, frequently used by private vehicles. However, the traffic flow in this area appears to be moderately disorganised.



Plate 5.51 Damaged and Inadequate School Signage at SK Seksyen 24



Plate 5.52 Drop-off Zone Adjacent to Bus Stop at SK Seksyen 24

At SK Seksyen 24, the assessment of bus stop facilities revealed that the school has two bus stops: one on the school side of the road and the other on the opposite side. This dual arrangement is designed to facilitate the efficient boarding and alighting of students using school vans or private vehicles.



Plate 5.53 Dual Bus Stops at SK Seksyen 24

Survey results indicated that while 51.67% of respondents believe the infrastructure is functional, 13.33% pointed out that the absence of posted speed limits and supervision could create unsafe conditions. Additionally, 35% of respondents were uncertain about the provided infrastructure.

5.3.4.4 Ancillary Facilities

During observation, it was noted that there is no dedicated lighting for the pedestrian walkway; however, street lighting is available and provides reasonable illumination of the pedestrian areas. There is only dedicated lighting in the bus stop area. Seating and rest area with shelter are present and were observed to be in regular use. However, certain portions of the walkway remain exposed to the elements. Survey findings showed that 61% of respondents were satisfied with the lighting and shelter provisions, although 18% still recommended improvements, particularly to better protect students from rain.



Plate 5.54 General Street Lighting at SK Seksyen 24



Plate 5.55 Seating and Resting Spot at SK Seksyen 24



Plate 5.56 Sheltered Walkway at SK Seksyen 24

Furthermore, the distance between the road lights and the pedestrian facilities further exacerbates the issue, creating areas of shadow that could deter usage and compromise safety. The absence of dedicated street lighting poses several risks to pedestrians, including increased accident risk, reduced visibility, heightened fear of crime, and difficulty navigating the area safely, particularly for children and individuals with mobility issues. Additionally, this can discourage people from walking in the vicinity, making the area feel less inviting. Therefore, to enhance pedestrian safety and encourage greater use of these facilities, it is imperative to consider installing dedicated lighting solutions that prioritise pedestrian needs, ensuring well-lit pathways and promoting a secure, inviting environment for all users.

5.3.4.5 Pedestrian Behaviour and Safety

The pedestrian behaviour observed around SK Seksyen 24 reflects a generally positive interaction with the built environment, particularly due to the relatively wide, continuous walkways that support safer, more comfortable movement. Many students were seen walking in groups or with guardians, using designated walkways and drop-off areas. However, several behavioural risks were also noted, especially near obstructed or faded crosswalks, where pedestrians had to navigate cautiously due to reduced visibility and the absence of pedestrian signals.

The improper placement of signage and physical obstructions, such as trees and parked vehicles, adjacent to walkways often led pedestrians to veer toward the vehicular lanes, increasing the risk of conflict with traffic. The absence of clear pedestrian cues, such as visible crosswalk markings and signalised intersections, may further compel children and accompanying adults to make uncertain or unsafe crossing decisions.

Survey responses reflect this cautious approach, where 57.44% of participants expressed concern about crosswalk visibility and crossing safety. Although the walkways themselves received a relatively high satisfaction rating (63.83%), the combination of behavioural adaptation to obstructions and uncertainty about crossing safety highlights a clear need for infrastructural enhancements and stronger pedestrian prioritisation to foster safer, more predictable walking behaviour.

5.3.4.6 Environmental and Contextual Factors

The surrounding environment of SK Seksyen 24 benefits from a well-established, mixed-use neighbourhood with a moderate level of walkability. The layout of residential units, commercial premises, and public amenities near the school fosters natural surveillance and short walking distances, which are key contributors to a walkable and child-friendly environment. Ancillary facilities, including rest areas, shelters, and curb ramps, complement these positive contextual elements. However, several of these features require refinement to meet safety and accessibility standards.

In terms of traffic flow, the school is situated along internal roads that experience moderate to high vehicular activity during school peak hours. Plate 5.57 indicated that the traffic flow at 7 am was reported as fast-moving, whereas at 1 pm, it became moderate. While the general road design supports access, traffic becomes disorganised near the drop-off and pick-up areas, with frequent congestion caused by private vehicles stopping at bus stops and a lack of enforcement mechanisms. This situation creates conflict zones between cars and pedestrians, especially when crosswalks are poorly marked or obstructed.

Despite these strengths, several environmental limitations were observed that diminish the safety and usability of the pedestrian network. Key issues include the absence of dedicated pedestrian lighting, faded crosswalk markings, and a lack of posted speed limit signs in school zones. Although general street lighting is available, it is not positioned to adequately illuminate pedestrian routes, resulting in dark patches that reduce visibility and discourage walking, particularly during early morning and late evening hours. Moreover, improper parking and obstructions along walkways further eliminate the sense of safety and hinder mobility, especially for younger children or those with disabilities.

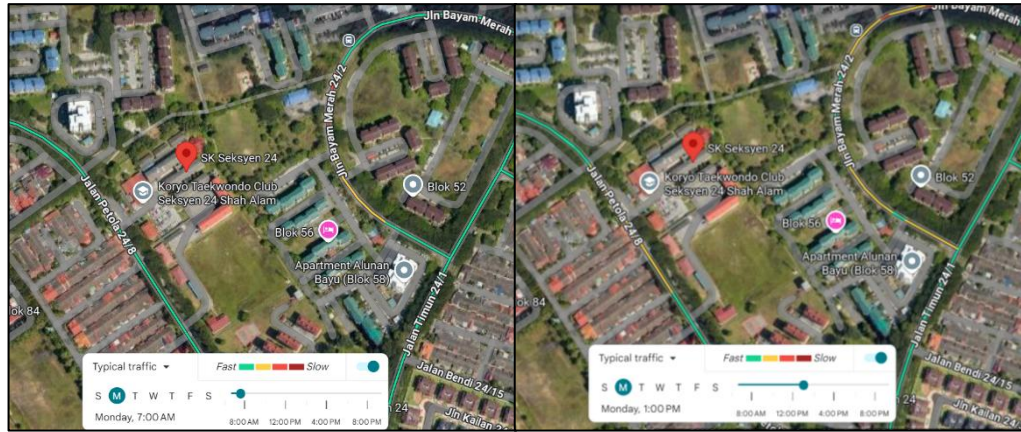


Plate 5.57 Traffic Flow Observed During Morning (7:00 am) and Afternoon (1 pm) Peak Hours Near SK Seksyen 24

5.3.5 SK Padang Jawa

SK Padang Jawa has a student enrollment of 1,356 (Jabatan Pendidikan Negeri Selangor, 2025) and is located in a suburban residential area on the outskirts of Shah Alam. The school is situated near a main road that serves both residents and through traffic, leading to a moderately high volume of vehicles during peak school hours. The surrounding environment primarily consists of landed residential properties, along with a few small shops and informal vendors operating near the school gates.

While the area benefits from accessible road connections and a nearby transit corridor (KTM Komuter), the pedestrian infrastructure is limited by narrow walkways, physical obstructions, and informal roadside activity. These conditions can compromise pedestrian safety and comfort. Nevertheless, the presence of shade, seating, and sheltered areas around the school offers some support for pedestrians, making SK Padang Jawa moderately walkable, but it still requires strategic improvements.



Plate 5.58 Main Entrance of SK Padang Jawa

5.3.5.1 Pedestrian Walkways

The pedestrian walkways at SK Padang Jawa have an average width of 1.5 meters, which is slightly narrower than the recommended standard of 1.8 meters. This results in congestion and discomfort, especially during peak times. While the surface condition of the walkways is generally good, with only a few defects, their narrow width contributes to crowding during busy periods.



Plate 5.59 Narrow Walkways at SK Padang Jawa

In terms of continuity, the pedestrian walkways are partially connected but inconsistent, particularly near the bus stop and vendor areas. Refer to Plate 5.60, which shows that the pedestrian walkway is only present in front of the school area and is not comprehensively connected to all the nearby areas.

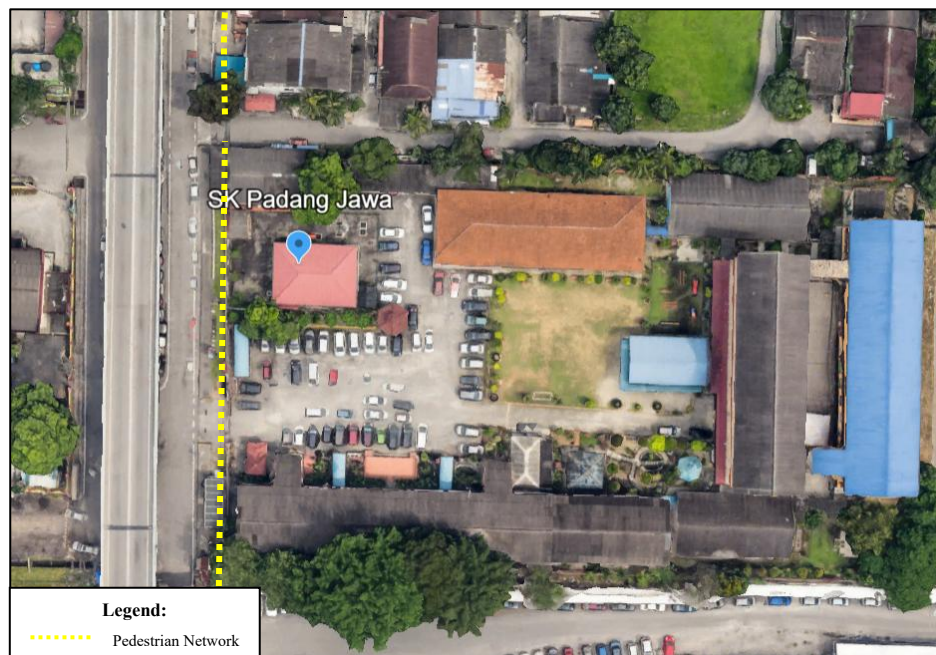


Plate 5.60 Pedestrian Network and Surrounding Land Use: SK Padang Jawa

Additionally, curb ramps, tactile paving, and other accessibility features for individuals with disabilities are noticeably absent in the school zone. Obstructions, such as vendors, were also observed along the walkways. The presence of activities such as hawker stalls and bus stops significantly increases pedestrian traffic, underscoring the urgent need for wider walkways in these areas.

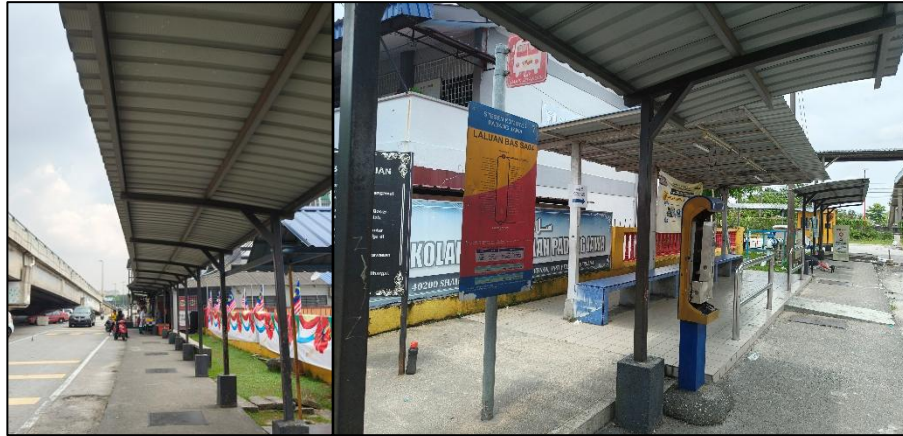


Plate 5.61 Informal Vendors and Bus Stops at SK Padang Jawa

However, observations suggest that there are no plans to widen the pedestrian areas in the future due to limited available space. The area is already compact due to current development, and no reserve area is available. Survey results, unlike the observation results, show that the majority of respondents (41.35%) were satisfied with the condition of the walkways. In comparison, 21.15% expressed dissatisfaction, citing narrow widths and obstructions as their main concerns. A high percentage of respondents were unaware of their satisfaction with the current condition of pedestrian facilities at SK Padang Jawa.

5.3.5.2 Crosswalks and Intersections

The visibility and location of crosswalks are good, and speed humps are installed to slow down traffic. However, there are no pedestrian signals or flashing lights present. This lack of electronic crossing aids may pose a challenge, especially for schoolchildren. Without traffic lights, both pedestrians and drivers need to exercise extra caution and vigilance, especially during peak hours. Schoolchildren should carefully observe traffic patterns and make eye contact with drivers before crossing the street. Meanwhile, drivers should be prepared to yield to pedestrians and maintain a slower speed in the area.



Plate 5.62 Marked Crosswalk at SK Padang Jawa



Plate 5.63 Speed Hump at SK Padang Jawa

5.3.5.3 School Zone Infrastructure

The school zone has signage, but there are no posted speed limits. Additionally, the signage appears to be broken, creating an unclear message. There is no designated drop-off and pick-up zone because limited space prevents its establishment, leading to disorganisation during peak hours. Bus stops are available and are also used as informal drop-off points for private vehicles. The bus stop area is very narrow, with no lay-by available, which contributes to heavy congestion during peak hours.



Plate 5.64 Damaged Signage at SK Padang Jawa



Plate 5.65 Narrow Bus Stop Lacking Lay-by Area at SK Padang Jawa

5.3.5.4 Ancillary Facilities

Street lighting is present and functions adequately. The seating area is limited, situated only at the bus stop, and is inadequate to accommodate the number of people. The shelter is also available at all walkways and strategically placed, offering comfort and shade to waiting students and guardians. Although the seating area is minimal, 72% of respondents expressed satisfaction with shaded areas and resting spots, with many highlighting them as crucial during hot weather.

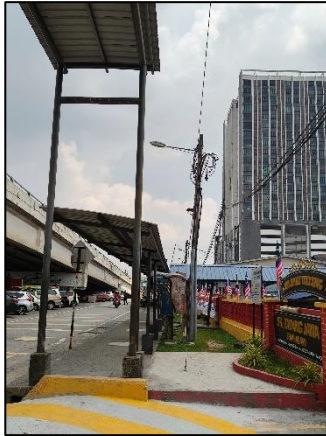


Plate 5.66 Street Lighting at SK Padang Jawa



Plate 5.67 Seating Area at SK Padang Jawa



Plate 5.68 Shaded Walkway at SK Padang Jawa

5.3.5.5 Pedestrian Behaviour and Safety

Pedestrian behaviour around SK Padang Jawa is influenced by both the physical constraints of the infrastructure and the dynamic roadside environment. Despite the generally good surface condition of the walkways, their narrow width, averaging 1.5 meters, forces pedestrians, including schoolchildren and parents, to walk in single file or spill onto the roadside during peak hours. This behaviour increases the risk of pedestrian-vehicle conflict, particularly near the school entrance, where informal vendors and the proximity of a bus stop intensify congestion.

The lack of accessibility features, such as curb ramps or tactile paving, limits mobility for individuals with disabilities and may contribute to erratic pedestrian movement as they seek alternative, informal routes to navigate the area. Moreover, the absence of pedestrian signals or flashing beacons at crosswalks requires pedestrians to rely on their judgment when crossing, which can be especially hazardous for children with limited traffic awareness.

Despite these shortcomings, survey responses indicate a relatively high satisfaction rate (60.58%) regarding walkway conditions. This suggests that users may have adapted their behaviour to the existing environment, possibly due to the presence of shade and limited seating facilities. Nonetheless, the 9.62% who expressed dissatisfaction, primarily due to obstructions and insufficient width, highlight a need to reassess how the built environment supports safe and predictable pedestrian behaviour in a high-traffic school zone. The remaining 29.8% had no idea of the walkway conditions.

5.3.5.6 Environmental and Contextual Factors

The environmental and contextual characteristics of SK Padang Jawa are defined by its location within a suburban residential setting adjacent to a major roadway. While this offers good vehicle access and connectivity, it also introduces challenges, including high traffic volumes and spatial constraints. Referring to **Error! Reference source not found.**, the traffic flow at 7 am is still under control, with traffic moving quickly. In contrast, traffic at 1 pm slows due to the morning session dismissal and the evening session arrival at school. Besides, informal commercial activities, such as hawker stalls near the school entrance, and the narrow design of bus stop areas without

lay-by areas contribute to a crowded and often chaotic pedestrian environment, particularly during school arrival and dismissal times.

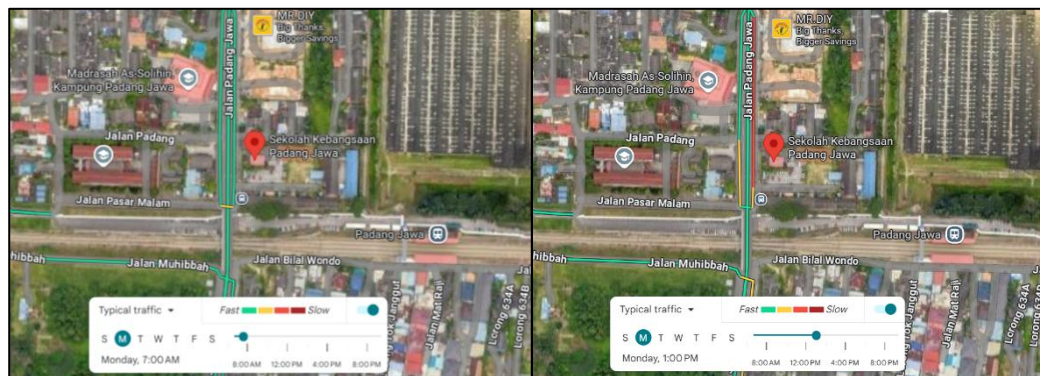


Plate 5.69 Traffic Flow Observed During Morning (7:00 am) and Afternoon (1 pm) Peak Hours Near SK Padang Jawa

Although dedicated drop-off and pick-up zones are limited in space, street lighting, shaded waiting areas, and rest facilities enhance the pedestrian experience. These ancillary amenities are valued by the community, with 50% of survey respondents expressing satisfaction, especially concerning weather protection and comfort. However, broken signage and the lack of posted speed limits reduce the effectiveness of the school zone infrastructure, diminishing the overall safety message to drivers.

The absence of plans to widen pedestrian paths further compounds the issue, as physical improvements are constrained by available land. Nonetheless, low-cost interventions such as replacing proper signage, clarifying pedestrian zones, and regulating vendors could significantly enhance environmental quality. The current context presents moderate walkability, but targeted improvements are essential to ensure the environment meets the safety needs of children in a suburban school setting.

5.3.6 SK Jalan U3

SK Jalan U3 has an enrollment of 1,759 students (Jabatan Pendidikan Negeri Selangor, 2025) and is located in a well-planned residential area of Shah Alam. The school is situated in a relatively low-congestion zone, benefiting from a structured road design and clearly defined zoning. It is primarily surrounded by residential housing and has minimal commercial development, which contributes to a calmer traffic environment.

Access to the school is via internal neighbourhood roads, which experience moderate traffic during peak hours. While the area lacks abundant commercial activity, its planned layout enhances safety and predictability for students commuting to and from school. Overall, the setting provides a conducive environment for walking, supported by good infrastructure.



Plate 5.70 Main Entrance of SK Jalan U3

5.3.6.1 Pedestrian Walkways

SK Jalan U3 features pedestrian walkways that are in good condition and relatively wide. The observed walkway widths range from 1.8 to 2.6 meters, meeting the recommended minimum of 1.8 meters. These paths are continuous and well-maintained, providing a comfortable walking experience (see Plate 5.72).



Plate 5.71 Pedestrian Walkway at SK Jalan U3



Plate 5.72 Pedestrian Network and Surrounding Land Use: SK Jalan U3

However, several obstructions were noted during the site visit. One segment had a hole covered with some wood, which blocks parts of the pedestrian walkways. These obstructions disrupt pedestrian flow, decrease the usability of the walkways, and pose safety risks, especially for vulnerable users such as schoolchildren, older adults, and individuals with disabilities. Furthermore, accessibility for people with disabilities remains an issue due to the absence of curb ramps and tactile paving. Survey data backs up these observations, with 65.66% of students expressing satisfaction with the condition and accessibility of the pedestrian walkways.



Plate 5.73 Hazardous Obstruction at SK Jalan U3

5.3.6.2 Crosswalks and Intersections

The crosswalks are strategically positioned to catch the eye of both drivers and pedestrians. The markings are bright and well-maintained, creating a clear path for students to traverse safely. To further enhance safety, speed humps have been installed near the school entrance, effectively curbing vehicle speeds and contributing to a calmer environment.



Plate 5.74 Clear Crosswalk Near Entrance at SK Jalan U3



Plate 5.75 Speed Hump Reducing Vehicle Speed at SK Jalan U3

However, a notable absence of pedestrian signals limits assistance for those crossing the street. Despite this lack of signalised support, the observation period revealed a commendable record with no significant safety incidents. In a recent survey, an impressive 65.66% of respondents expressed confidence in the safety of these crosswalks, believing they provided a secure route to school.

5.3.6.3 School Zone Infrastructure

The school stands out for its clear signage and posted speed limits, making it unique among the schools in this study. Well-maintained signs alert motorists to the school's presence and emphasise the need for increased caution, while speed limits effectively reduce vehicle speeds in these high-risk areas. A designated drop-off and pick-up area at the bus stop operates efficiently, minimising disruptions to pedestrian movement.



Plate 5.76 Properly Posted Speed Limit at SK Jalan U3

Initially designed for buses, the bus stop area has adapted to serve as drop-off and pick-up zones for private vehicles, reflecting the growing reliance on personal transportation for school commutes (refer to Plate 5.77). While this transformation enhances convenience for parents and guardians, it has also introduced challenges related to traffic congestion and pedestrian safety during peak hours. The increased number of vehicles necessitates careful management and design to ensure that pedestrian movement remains safe and unobstructed.

This situation highlights the need to reevaluate school zone infrastructure to accommodate current travel behaviours and enhance overall student safety. Additionally, survey responses indicate high satisfaction: 73.74% of respondents enjoyed the well-maintained pedestrian facilities in the school zone.



Plate 5.77 Bus Stop Cum Drop-off Area at SK Jalan U3

5.3.6.4 Ancillary Facilities

Street lighting is sufficient and extends across both vehicular and pedestrian paths. However, the school lacks seating and rest areas within the pedestrian route. There is also minimal shade or weather protection, which is installed only on the side of the school area walkway. This existing condition may deter walking during poor weather. According to this condition, only 37% of parents expressed satisfaction with ancillary facilities, with most noting the absence of resting spots and shelter as a drawback.



Plate 5.78 Street Lighting at SK Jalan U3



Plate 5.79 Shade and Shelter at SK Jalan U3

Based on on-site observation, it was noted that only one school (SK Jalan U3) lacked a seating area along the pedestrian walkway, including the bus stop area, which generally provides seating. The lack of seating areas may pose a significant concern for the overall accessibility and comfort of the school environment. A designated seating area provides a brief rest stop for schoolchildren on walks and promotes community interaction and engagement among students and parents.

Compared to other schools that have implemented seating areas, this school may miss opportunities to foster social connections and create a welcoming atmosphere. Moreover, the absence of such facilities can cause discomfort for visitors, especially during peak hours when foot traffic is highest.

5.3.6.5 Pedestrian Behaviour and Safety

The pedestrian behaviour observed around SK Jalan U3 reflects a generally positive walking environment supported by good infrastructure. The relatively broad, well-maintained walkways promote orderly, safe pedestrian movement, and students appear to utilise the designated paths effectively. The clear visibility of crosswalks and the presence of speed humps contribute to a calm traffic environment, allowing children to cross with greater confidence.

However, certain risks persist due to infrastructure gaps. For example, the presence of physical hazards, such as holes covered with wooden planks, may cause pedestrians to detour or walk unsafely around the obstruction. Additionally, the absence of curb ramps and tactile paving poses accessibility issues for users with mobility impairments. These factors could discourage safe pedestrian behaviour, especially for vulnerable users.

Despite these limitations, survey data indicated that 65.66% of students were satisfied with the pedestrian walkways, perceiving them as safe and accessible. This suggests that while users appreciate the general quality of infrastructure, their behaviour and safety could be further enhanced through minor interventions that address maintenance issues and improve inclusivity. It is essential to remove obstructions, implement universal design features, and establish a proactive maintenance routine to support consistent, safe pedestrian behaviour.

5.3.6.6 Environmental and Contextual Factors

SK Jalan U3 benefits from a well-organised, low-congestion residential environment that enhances walkability and pedestrian safety. The planned layout, limited commercial activity, and clear zoning result in fewer traffic conflicts and a more predictable environment for school travel. Internal roads feeding into the school experience only moderate traffic volumes during peak hours, further reducing risk exposure. Based on Figure 5.12, the traffic at 7 am is clearly shown to be moderately fast-moving during both peak hours.

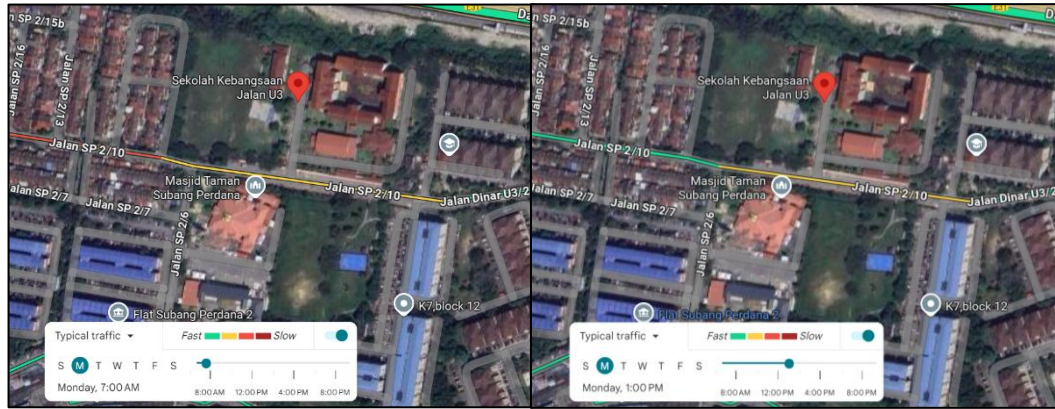


Plate 5.80 Traffic Flow Observed During Morning (7:00 am) and Afternoon (1 pm) Peak Hours Near SK Jalan U3

The school zone infrastructure stands out compared with other study areas. It features clear speed limit signage and well-positioned warning signs that enhance driver awareness and contribute to a safer school environment. Additionally, the designated bus stop area serves as both a drop-off and pick-up point. However, the growing use of private vehicles has introduced new challenges related to traffic flow and congestion. This reflects evolving transportation patterns and suggests the need for reconfigured layouts to accommodate changing demands while preserving pedestrian priority.

However, the absence of ancillary facilities such as a seating area limits user comfort, particularly for children and guardians waiting during peak periods. Only 37% of parents expressed satisfaction with these provisions, highlighting the importance of supporting not just safety, but also comfort and usability in school environments. Compared with other schools in the study, SK Jalan U3 is the only one without a designated seating area, which may affect both the functionality and the social quality of the space.

Overall, while SK Jalan U3 demonstrates a strong foundational environment for walking, there are contextual opportunities to enhance resting facilities (seating areas) and inclusive design features to elevate the walking experience for all users.

5.4 Discussion

The comprehensive site observations and questionnaire survey data across six selected primary schools in Shah Alam provide critical insight into how the built environment influences children's ability and willingness to walk to school. The discussion below synthesises the main findings across several key components of pedestrian infrastructure, highlighting common trends, location-specific issues, and potential areas for improvement.

5.4.1 Walkway Width and Surface Quality

The width and condition of pedestrian walkways are critical factors influencing walkability and comfort. Schools like SK Seksyen 7, SK Seksyen 24, and SK Jalan U3 reported higher satisfaction levels due to their wider walkways (ranging from 2.5 to 3.3 meters), which exceed the minimum recommended width of 1.8 meters under JKR standards. These walkways also featured smoother surfaces and fewer obstacles, ensuring safer passage for children.

On the other hand, SK Seksyen 17 and SK Seksyen 19, which have walkway widths as narrow as 1.4 meters and receive insufficient maintenance, received the lowest satisfaction ratings from students. Issues such as cracks, uneven surfaces, and restricted widths complicate movement, especially during busy school hours, raising the risk of pedestrian-vehicle collisions and endangering unaccompanied children.

Observations conducted at six selected schools in the area indicate that all provide pedestrian walkways, fostering a safe environment for students commuting to and from school. Schools with more expansive and well-maintained walkways, such as SK Seksyen 7, SK Seksyen 24, and SK Jalan U3, had higher student satisfaction rates. These schools conform to or exceed the 1.8-meter minimum standard, thereby enhancing the comfort and safety of the walking experience. In contrast, SK Seksyen 17 and SK Seksyen 19, with their narrower, poorly maintained walkways, received the lowest ratings. Such narrow paths not only impede movement but also heighten the risk of accidents, particularly during crowded times.

5.4.2 Crosswalks, Visibility and Safety

Crosswalks are essential for providing safe access to schools, but only SK Seksyen 17 had a working pedestrian push-button signal. The other schools were missing signalised crossings, which students frequently identified as a safety issue in the survey. The safety of SK Seksyen 19 and SK Seksyen 24 was further undermined by faded road markings, even though speed humps were present. The absence of a pedestrian signal necessitated another initiative to ensure safety, including the provision of a pedestrian guide during arrival and dismissal times.

Without electronic crossing aids, children had to rely on drivers' behaviour, creating particular risks for younger students. This disconnect between pedestrian needs and existing infrastructure highlights a significant gap in the prioritisation of safety across various school zones.

5.4.3 School Zone Infrastructure and Traffic Control

The effectiveness of traffic management in school zones greatly influences the safety and experience of pedestrians. Among the schools, SK Jalan U3 stood out for having designated speed limits and adequate signage, which promoted driver compliance and enhanced safety awareness. In contrast, other schools, such as SK Padang Jawa, lacked adequate signage, while schools like SK Seksyen 24 had damaged signs, which diminished the effectiveness of school zone alerts.

In schools without designated drop-off and pick-up zones or with poorly managed traffic, such as SK Padang Jawa and SK Seksyen 19, congestion and safety hazards significantly increased. The absence of proper parking enforcement and reliance on informal parking further contributed to the disorder, creating unsafe conditions during busy times.

5.4.4 Ancillary Facilities: Lighting, Seating and Shelter

Enhanced pedestrian comfort is influenced by factors such as lighting, seating, and shading, especially during inclement weather or while waiting. SK Padang Jawa was notable for its ample shaded spaces and seating options, resulting in over 70% of students expressing satisfaction. In contrast, SK Seksyen 17 and SK Jalan U3 fell short

in providing adequate seating and weather protection. Although these shortcomings may seem minor, they have a significant impact on children's experiences and their willingness to walk. A key observation is that even schools with strong infrastructure, such as SK Jalan U3, lack essential supportive features that contribute to a holistic walking experience.

5.4.5 Accessibility and Inclusivity

The absence of curb ramps and tactile paving was a common issue in nearly all schools. MS 1184:2014 mandates that ramps have a 1:12 slope and include tactile surfaces for the visually impaired. However, none of the schools adhered fully to these requirements. For instance, the curb ramp at SK Seksyen 24 was even repurposed for motorcycle and bicycle use due to its narrow width, highlighting deficiencies in planning and enforcement. The lack of universal design elements compromises safe access for students with disabilities, breaching the inclusive design principles outlined in the Persons with Disabilities Act 2008.

5.4.6 Pedestrian Behaviour and Risk

In areas with insufficient or poorly maintained infrastructure, unsafe behaviours such as jaywalking, walking on the road, or using areas not designated for crossing were observed, particularly around SK Seksyen 17 and SK Seksyen 19. Students adapted by avoiding broken walkways or travelling in groups, which enhanced safety by increasing visibility among peers.

Although most students used safe paths when available, disorderly conditions in school zones and a lack of physical barriers (such as fences) frequently left children vulnerable to traffic hazards.

5.4.7 Environmental and Land Use Context

The land-use context affected walkability. Schools located in mixed-use neighbourhoods, such as SK Seksyen 24 and SK Seksyen 7, benefit from natural surveillance and proximity to a range of amenities. In contrast, SK Padang Jawa, despite

being in a suburban area, faced challenges due to informal roadside activities (such as hawker stalls) and insufficient enforcement, which hindered pedestrian movement.

These observations underscore the importance of integrating urban design and land use with pedestrian planning to mitigate risks and encourage active travel to schools.

Table 5.2 outlines the assessment criteria employed to evaluate pedestrian infrastructure and facilities within school zones. The criteria are organised into key components: walkway conditions, crossing facilities, school zone infrastructure, and supporting amenities. Each component is evaluated according to its availability, condition, and functionality in facilitating safe and accessible pedestrian movement for schoolchildren. Also, user feedback and survey results supported each finding.

Table 5.2

Assessment Criteria for Pedestrian Infrastructure Around Schools

School	Walkway	Crosswalks and Intersections	School Zone Infrastructure	Ancillary Facilities	User Feedback / Survey Results	Key Issues Identified
Seksyen 7	Wide (2.5–3.3 m), continuous, good surface	Marked crosswalks, speed humps, flashing light (not working)	School signage present, no posted speed limits, organised drop-off/pick-up and bus stop areas	Lighting, seating, shade, and covered walkways	77.78% felt walkways safe; 83.33% felt safe at crossings	Flashing light malfunction, minor obstructions (trees, furniture)
Seksyen 17	Narrow (~1.6 m), poor surface, obstructions, discontinuity	Clear markings, only school with pedestrian signal and push-button, speed hump	Basic signage without speed limits; drop-off zone provided; 2-way bus stop	Limited lighting; no shelter or seating except at the bus stop	80.56% had safety concerns at intersections; 69.44% not deterred by hot weather	Poor surface, no accessibility features, random pedestrian movement due to lack of fencing
Seksyen 19	Very narrow (1.4–1.5 m), poor surface, obstructed	Faded markings, no pedestrian signal, speed humps present	Signage present but minimal; chaotic drop-off at 1-way bus stop	Limited seating, poor lighting, and no shelters	Only 34.4% felt walkways were safe; 59.57% reported drop-off zone chaos	Inadequate crossing support, poor surface, major obstructions, and safety risks
Seksyen 24	Wide (2.2–3.0 m), generally good surface, minor obstructions	Crosswalk markings faded, no signalised crossings, speed humps present	Signage present but incomplete; 2-way bus stop; moderate drop-off congestion	Lighting and rest areas are available; shelters are present, but coverage is inconsistent	70% satisfied with walkway; 53.33% expressed concern about unclear crosswalks	Faded crosswalks, no posted speed limits, visibility issues during poor weather
Padang Jawa	Narrow (~1.5 m), good surface, discontinuous	Clear markings, no pedestrian signals, speed humps present	No designated drop-off area; 1-way narrow bus stop; broken signage	Good lighting, seating, and shaded areas	60.58% satisfied; 39.42% cited concerns with width and obstructions	Informal vendors obstruct paths; no plans for future upgrades, and disorganised traffic circulation
Jalan U3	Wide (1.8–2.6 m), good surface, continuous	Bright crosswalk markings, speed humps, No pedestrian signal	Signage and posted speed limits present; efficient drop-off at the bus stop	Good lighting, but lacks seating and shelter	65.66% satisfied with walkway and crossing safety; only 37% satisfied with ancillary facilities	Obstruction from uncovered hole; no seating/rest area; accessibility features lacking

5.4.8 Best Practice Schools in Pedestrian Planning and Infrastructure

The comparative study of the six chosen schools highlighted that SK Seksyen and SK Jalan U3 exemplify effective practices in planning pedestrian infrastructure, each representing a holistic approach. These institutions showcase how careful design, adequate maintenance, and transparent management strategies play a crucial role in fostering a safer, more convenient, and walkable environment for students.

5.4.8.1 SK Seksyen 7: A Holistic Approach to Walkability

SK Seksyen 7 exemplifies best practices in pedestrian infrastructure through several key features. The area boasts wide, continuous walkways measuring 2.5 to 3.3 meters, which exceed minimum standards and facilitate free-flowing pedestrian movement. A well-designed pedestrian network links the school entrance directly to nearby residential areas and a bus stop, promoting accessibility. The inclusion of dedicated lighting and shaded rest areas enhances comfort and usability, especially during adverse weather conditions. Additionally, drop-off and pick-up zones are strategically located adjacent to bus stops to minimise traffic conflicts and improve overall traffic flow. Traffic calming measures, such as speed humps and carefully placed crosswalks, further enhance safety. This thoughtful design has yielded high user satisfaction, with 77.78% of students reporting that the pedestrian walkways are both safe and comfortable. Despite a minor issue with a non-functional flashing light, the overall planning, maintenance, and usage of space at SK Seksyen 7 promote a child-friendly environment that encourages walking.

5.4.8.2 SK Jalan U3: Planned Residential Design for Safety

SK Jalan U3 is a model school that exemplifies best practices, primarily due to its strategic location in a planned, low-congestion residential zone. It stands out in several areas, including clearly defined school zone infrastructure, which features visible signage and posted speed limits, a standard met by only one school in the study. The school also boasts well-maintained pedestrian paths 1.8 to 2.6 meters wide, with clear crosswalk markings and traffic-calming features such as speed humps. Additionally, organised drop-off and pick-up areas facilitate efficient circulation,

minimising the risk of vehicle-pedestrian interactions. Effective land-use planning further enhances its profile by limiting commercial activity and maintaining consistent traffic patterns. High student confidence in pedestrian safety is evident, with 65.66% of respondents expressing satisfaction with walkway and crossing conditions. While the school lacks ancillary facilities such as seating and shading, its overall infrastructure prioritises safety and supports predictable pedestrian behaviour.

The two case studies offer valuable insights into pedestrian safety and infrastructure. Walkway width, continuity, and surface condition are foundational to creating safe walking routes. Additionally, visible and enforced traffic control infrastructure, such as speed limits, signage, and crosswalks, significantly improves safety in school zones. Comfort features, such as lighting, seating, and shelters, further enhance the user experience and increase the likelihood of walking. Moreover, integrating land use with proper zoning supports the development of consistent, low-conflict pedestrian routes. Finally, user satisfaction data aligns with observed best practices, validating the effectiveness of investing in infrastructure improvements.

Therefore, future planning for school zones should draw on the strategies used at SK Seksyen 7 and SK Jalan U3. Schools that are not performing well should focus on enhancing key aspects, such as walkway design, traffic calming features, signage, and user-tailored amenities, to create a safer and more welcoming walking environment for children.

5.5 Summary

This chapter presents a detailed assessment of pedestrian infrastructure and amenities in the school zones of six selected primary schools in Shah Alam. By utilising site observations and data from a questionnaire survey, the chapter evaluated the condition of walkways, crosswalk safety, infrastructure within school zones, additional facilities, pedestrian behaviour, and surrounding environmental factors.

In conclusion, the detailed evaluation presented in Chapter 5 shows that aspects of the built environment significantly affect schoolchildren's readiness to walk to school. Primary schools like SK Seksyen 7 and SK Jalan U3, which feature well-maintained, spacious, and uninterrupted walkways, clear crosswalks, practical measures to calm traffic, and supportive facilities, have seen higher levels of student satisfaction and confidence in walking to school. Conversely, schools such as SK Seksyen 19 and SK Seksyen 17, which have narrow, obstructed, or poorly connected pathways, insufficient signage, and a lack of accessibility features, showed more safety concerns and discomfort among students, discouraging them from walking.

In summary, this chapter highlights the crucial importance of effectively designed, inclusive, and well-maintained pedestrian infrastructure in promoting safe and active travel to school. The comparative analysis highlights both exemplary practices and critical areas requiring urgent attention, informing the recommendations in the last chapter.

CHAPTER 6

SAFETY FACTORS AFFECTING CHILDREN WALKING TO SCHOOL: A MULTI-DIMENSIONAL ANALYSIS

6.1 Introduction

Walking to school is common for many children worldwide, offering numerous health and environmental benefits. However, this activity poses significant safety risks, particularly in areas with high traffic volumes or inadequate infrastructure. Understanding the safety factors associated with walking to school is essential to developing effective strategies to mitigate these risks and ensure a safe, healthy commute for schoolchildren.

In line with Research Objective 3, this chapter examines how infrastructure, environmental conditions, and pedestrian behaviour influence the safety of primary school children walking in Shah Alam. The chapter assesses the safety of walking schoolchildren in the study area. It utilises a comprehensive approach that combines observational evidence, survey responses, interviews, and literature. Safety is evaluated in three dimensions: infrastructural, behavioural, and environmental. This chapter is the final stage of the analysis phase, focusing on safety factors affecting schoolchildren's walking behaviour.

Combining these data collection methods allowed for a holistic analysis of safety factors, including environmental conditions, infrastructure quality, and behavioural practices. By integrating these perspectives, this chapter aims to provide a detailed understanding of the safety challenges faced by walking schoolchildren in the study area and to identify potential areas for improvement. Hence, the findings presented in this chapter will contribute to the broader discussion on enhancing safety for schoolchildren walking to school. They will inform policymakers, educators, and community stakeholders on strategies to create safer pedestrian facilities and more supportive environments for this vulnerable group.

This chapter presents the findings on the safety of walking schoolchildren in the study area. Building on the previous analysis of influencing factors (Chapter 4) and the assessment of pedestrian facilities and infrastructure (Chapter 5), this section focuses explicitly on safety conditions that affect children's walking experiences. The

evaluation encompasses both physical infrastructure and perceived safety dimensions, aiming to identify critical safety concerns and priority areas for intervention. The following indicators were adapted from previous pedestrian safety audits and school travel behaviour studies (McMillan, 2007).

Table 6.1
Safety Assessment Indicator for Walking Schoolchildren

Safety Assessment Indicator for Walking Schoolchildren			
Aspect	Indicator	Observation Criteria	
Infrastructural Safety Factors	Availability and Continuity	Presence and connectivity of sidewalks along school routes	
	Pedestrian Infrastructure	Width and Condition	Minimum width for safe walking; even surface, free from potholes
		Obstructions	The presence of vendors, parked vehicles, and debris blocking walkways
	Crossing Facilities	Zebra Crossings	Marked pedestrian crossings near schools or intersections
		Signalised Crossings	The presence of pedestrian traffic signals or school crossing guards
	Traffic Conditions	Traffic Volume and Speed	Vehicle density during peak school hours, observed speed levels
		Traffic Calming Measures	Speed bumps, rumble strips, and signage to slow traffic near schools
	Environmental and Social Safety	Street Lighting	Presence and adequacy of lighting on walking routes
Visibility and Surveillance		Open views, passive surveillance from nearby homes or shops	
Perceived Crime / Security Threats		Reported fear of harassment, crime, or stray animals	
Behavioural Aspects	Child / Parent Perception of Safety	Survey-based indicators of how safe routes are perceived	
	Walking Supervision and Group Walking	Whether children walk alone, with peers, or are accompanied	

Source: *Safe Routes to School National Partnership (2016)*

6.2 Infrastructural Safety Factors

This section presents the key infrastructural factors affecting children's safety while walking to school, based on field observations in the study area and responses from students, parents, and stakeholders (collected through questionnaires and interviews). The analysis focuses on four main aspects: sidewalk availability, crosswalks and traffic control, and lighting and visibility. This element was briefly introduced in Chapter 5 and is further detailed in this chapter, particularly regarding safety. These factors directly affect children's exposure to risk and their ability to navigate the walking environment safely. The following paragraph provides a comprehensive overview of the key components across all aspects and emphasises their importance in promoting children's safety when walking to school.

6.2.1 Pedestrian Infrastructure

Sidewalks are essential pedestrian facilities that provide dedicated space for walking and separate pedestrians from vehicular traffic. The evaluation of sidewalks should consider several crucial things, including their presence, width, and condition. According to JKR guidelines, the minimum pedestrian walkway width is 1.25 meters, while 2.0 meters is considered desirable, especially in school zones (Jabatan Kerja Raya Malaysia, 1986). A 1.5-meter-wide sidewalk is generally regarded as adequate to allow two pedestrians to walk side by side. Furthermore, sidewalks must be well-maintained and free of cracks, debris, and other obstructions that could pose a hazard to pedestrians. The absence of sidewalks or poorly maintained pathways can force children to walk on roadways, significantly increasing their risk of being involved in accidents.

Field observations revealed that the sidewalks in the six schools that participated in the survey are inconsistent in width and often absent along major school routes. However, all six schools reported widths greater than the minimum of 1.25m. Photos showing the sidewalk width at six schools are presented in Section 5.3.1 (page 139). Continuous sidewalks were observed only at SK Seksyen 7 and SK Jalan U3. In contrast, the remaining four schools experienced frequent interruptions to pedestrian routes due to obstructions such as temporary stalls, vegetation, signage, and street furniture.

The findings from field observation are supported by a questionnaire survey, in which the majority of respondents expressed a clear preference for using these walkways rather than walking on the grass verge or road surface. Referring to Table 6.2, students disagreed and strongly disagreed, with a median response of 2 (Disagree), to the statement suggesting a preference for walking on the grass or the road (Question 33). This finding indicates that students perceive the designated pedestrian paths as safer, more legitimate, or more comfortable than alternative walking surfaces.

Table 6.2

Preference to Walk on the Grass and Road rather than the Sidewalk

		Very Disagree	Disagree	Not Sure	Agree	Very Agree	Total	Median
Prefer to walk on the grass rather than using the sidewalks	Frequency (n)	50	187	98	46	19	400	22
	Percentage (%)	12.5	46.8	24.5	11.5	4.8	100	
Prefer to walk on the road rather than using the sidewalks	Frequency (n)	56	180	77	54	33	400	22
	Percentage (%)	14.0	45.0	19.3	13.5	8.3	100	

This behaviour aligns with evidence from stated-preference research, which confirms that wider sidewalks and lateral buffers significantly influence pedestrian attractiveness and comfort (Kasraian et al., 2021). Although grass surfaces may appear more comfortable in theory, in practice, they are often unpleasant and impractical, especially during adverse weather conditions. Research has consistently shown that pedestrians tend to choose formal pedestrian infrastructure over informal routes, such as grass or roads. For example, a study of route-choice behaviour in China found that features such as sidewalks, on-street parking, garbage bins, and street lighting significantly influenced pedestrians' use of designated pedestrian spaces rather than alternative walking surfaces (Jin et al., 2022). Assessments of pedestrian environments indicate that low levels of objective infrastructure quality, such as narrow sidewalks and fewer buffers, may not deter people as much as the lack of a designated route. People still prefer officially recognised walkways.

Approximately 60.8% of respondents agreed or strongly agreed that the presence of dirty or damaged pedestrian facilities discourages their use. This indicates that the physical condition and maintenance of pedestrian infrastructure are significant determinants of user comfort and perceived safety, particularly for schoolchildren and their parents.

Table 6.3

Respondents' Views on the Ease of Walking to School without Facing Obstacles

Response Category	Frequency (n)	Percentage (%)
Very Disagree	17	4.25
Disagree	60	15.00
Not Sure	75	18.75
Agree	187	46.75
Very Agree	61	15.25
Total	400	100.00
Median	4.0 (Agree)	

Table 6.3 indicates that respondents generally view the walking environment positively, as unobstructed and convenient, with a median response of 4.0 (Agree) (Question 29). This result suggests that most respondents encountered minimal physical or environmental barriers along their walking routes to school, given that their paths were relatively safe and accessible. However, direct observational data presented different findings. Observations revealed multiple physical and environmental obstacles along school routes, including signage, street furniture, and vegetation that blocks pathways, as well as uneven sidewalks. Supporting the findings obtained from the observational method, parents echoed these concerns. One parent from SK Padang Jawa shared:

“Although there are footpaths, they are too narrow or broken, and large trees are blocking the path. It is not safe for small children, especially when it rains” (refer to Plate 6.1).

(Parent, SK Padang Jawa)

These conditions force children to walk on the roadside, increasing their vulnerability to traffic accidents and exposure to unsafe conditions. Overall, SK Jalan U3 had better infrastructure, with wider sidewalks and designated pedestrian lanes free of obstructions.



Plate 6.1 Narrow Sidewalk at SK Padang Jawa



Plate 6.2 Street Furniture that Blocks the Pathway

The subjective nature of perception-based responses may explain this discrepancy. Students may normalise or underreport barriers due to familiarity with their routes or a lack of awareness of what constitutes an “obstacle.” Additionally, younger respondents may lack the critical lens to evaluate safety hazards objectively. Social desirability bias may also influence responses, particularly when students perceive that agreeing with positive statements is the expected or favourable choice.

In contrast, observational data offer an objective and standardised account of the walking environment. It identifies hazards that students might not recognise as problematic, even though they represent genuine safety concerns from an urban planning perspective.

These findings underscore the importance of employing both subjective (survey-based) and objective (observational) methods to gain a comprehensive understanding of walkability and safety. While perceptions are valuable for measuring satisfaction and comfort, they should be considered alongside observational data to inform planning and interventions effectively.

6.2.2 Crossing Facilities

Crosswalks are essential for facilitating safe crossings at intersections and mid-block locations. Crosswalks are also important in school zones, where schoolchildren continue to use them. The evaluation of crosswalks in the study area focuses on their visibility, design, and accessibility. Marked crosswalks using high-visibility paint can significantly enhance visibility and alert drivers to the presence of pedestrians. In contrast, the inclusion of pedestrian crossing signals provides clear guidance on safe crossing times, thereby improving safety for schoolchildren walking. Additionally, placing these crosswalks in high-pedestrian-traffic areas is essential to encourage their use and ensure adequate accessibility.

Crossing the road safely remains a significant challenge in many parts of the study area. Based on field observations in the study area, pedestrian crossings were generally located within 25 meters of the main school gate, consistent with the practices recommended by Jabatan Kerja Raya (1986). Field observations at both SK Seksyen 19 and SK Seksyen 24 highlighted a significant safety issue: faded or poorly visible pedestrian crossing markings directly in front of the school gates. These worn-out markings fail to adequately alert drivers, especially during early morning and rainy conditions, thereby increasing the risk of vehicle-pedestrian conflicts. Additionally, this compromises safety by reducing driver compliance and raising uncertainty among young pedestrians, thereby violating national school-zone safety standards.

Pedestrian signals were found to be nonfunctional and absent at several observed intersections. According to Jabatan Kerja Raya Malaysia (1986), a complete signalised pedestrian crossing (with a traffic light) should be considered when the road carries more than 500 vehicles per hour and more than 100 schoolchildren cross per hour during peak times. If these conditions do not justify a signalised crossing, an unsignalised pedestrian crossing (also known as a zebra crossing) must still be provided. To evaluate the two warrant conditions for providing signalised pedestrian crossings at school zones, responsible authorities must conduct the School Zone Traffic Volume Survey and the Schoolchildren Pedestrian Crossing Survey. The absence of pedestrian signals or crossing guards further increases the danger, especially for younger children, who may lack the judgment to cross the road safely.

Based on the questionnaire results, further support is provided for the findings from field observations. A significant number of respondents expressed concerns about

the dangers on roads near school zones, noting that crossing the street was among the most stressful parts of walking to school. Referring to Question 47, more than half of the respondents (60.1%) agreed that vehicle speed near school gates was excessive and that drivers often failed to slow down at pedestrian crossings. This situation led the parents to feel a strong need for improved safety and to advocate for tighter traffic control measures, such as functioning pedestrian signals, crossing guards, and more visible road signs. Based on an informal interview conducted with walking schoolchildren, one student said:

“I wait a long time for the cars to stop, but they do not. Sometimes I run across my friends.”

(Respondent, SK Seksyen 24)

On the other hand, random interviews with students and parents revealed a strong relationship between well-marked, signalised crossings and perceived safety. Respondents who reported the presence of well-marked, signalised crossings tended to express greater confidence in allowing their children to use active transport to school. In contrast, those who encountered faded markings, obstructed views, and unsignalized intersections associated these with higher safety risks. Hence, this suggests that the visibility and clarity of crossing design directly influence user confidence and compliance among both pedestrians and drivers.

In general, objective observations and subjective perceptions both underscore that the safety of school crossings depends not only on their physical presence but also on design quality, visibility, and ongoing maintenance. Properly maintained crossings, clearly indicated with sufficient signage and traffic control, can significantly enhance safety and encourage active transport as a practical option for getting to school. Visibility at critical points, such as crosswalks and intersections, was carefully examined. It was observed that sightlines were clear and unobstructed, providing drivers and pedestrians adequate time and distance to detect each other. This visibility is crucial in preventing accidents and ensuring safe crossing for walking schoolchildren.

No conflicts or near-miss incidents between pedestrians and vehicles were observed during the assessment period. The combination of clear sightlines and controlled vehicle speeds contributed to a safe environment with minimal risk of accidents.

Based on the site observations, the school zones for all six schools participating in the survey demonstrate strong adherence to safety principles. The absence of risk factors related to sightlines, vehicle speeds, and pedestrian-vehicle conflicts indicates that the current safety measures are effective. The implementation of speed humps plays a significant role in maintaining low vehicle speeds, thereby reducing potential hazards and promoting a safer environment for schoolchildren walking to school and other pedestrians.

6.2.3 Traffic Conditions

Another safety-related aspect is traffic conditions, which play a crucial role in ensuring the safety and efficiency of road networks. This analysis focuses on two key aspects: traffic volume and speed, and traffic calming measures. Understanding these factors is essential for identifying potential safety risks and optimising traffic flow. High traffic volumes and fast-moving vehicles are common near some schools, often driven by a few individuals, especially during peak hours. The lack of speed-control measures, such as speed bumps, warning signs, or reduced-speed zones near schools, makes walking more dangerous, especially for children. Children are often seen waiting for long periods to cross the road safely. The following paragraphs will analyse the existing traffic conditions in the study area.

6.2.3.1 Traffic Volume and Speed

Traffic volume may refer to the number of vehicles passing a point on a road over a specified period. This aspect is essential for assessing road capacity and identifying potential bottlenecks.

Field observations and manual traffic counts were conducted at selected school sites during peak hours, specifically from 7:00 a.m. to 8:00 a.m. (arrival time) and 12:30 p.m. to 1:30 p.m. (dismissal time). At SK Seksyen 24, the volume exceeded 500 vehicles per hour, while at SK Seksyen 7, it averaged 600-700 vehicles per hour. This high concentration of traffic is primarily due to private vehicles dropping off children, school vans, and through traffic using the same road during peak hours. Referring to the criteria outlined in Arahan Teknik (Jalan) 8/86, released by Jabatan Kerja Raya Malaysia (1986), the data meet the requirements, which recommend that pedestrian

crossing facilities be considered if pedestrian volume exceeds 50 people per hour and vehicle volume exceeds 300 vehicles per hour. This data also meets the criteria for providing a complete signalised pedestrian crossing (with a traffic light), which should be considered when the road carries more than 500 vehicles per hour and more than 100 schoolchildren cross per hour during peak times. These thresholds were significantly exceeded at both schools observed.

Additionally, traffic congestion near the school gates creates chaotic conditions, which worsen on rainy days. Double parking, stopping in unauthorised areas, the absence of a crossing guard, and inadequate enforcement were commonly observed, further compromising pedestrian visibility and the safety of schoolchildren crossing. Heavy traffic during peak school hours significantly increases pedestrian volumes, resulting in longer wait times for children attempting to cross the street safely. This congestion can also contribute to unsafe crossing behaviours, as children may resort to jaywalking or crossing between parked vehicles to navigate the busy streets. According to Safe Kids Worldwide (2016), higher traffic volumes are associated with a greater risk of pedestrian injuries in school zones, particularly in areas lacking adequate traffic management infrastructure. During a formal interview conducted with parents, a parent said:

"The road is too busy, especially at 1 o'clock. The cars do not stop even when children are waiting to cross."

(Parent, SK Seksyen 24)

On the other hand, speed limits in school zones are a critical component to ensure the safety of schoolchildren commuting to and from school. The speed limits are influenced by road design, traffic volume, and environmental conditions. For example, lower speed limits are imposed in school zones or areas with high pedestrian activity.

There are several important reasons for reducing speed limits in school zones. First, it may significantly enhance safety by decreasing the risk and potential severity. Malaysia has committed to reducing road traffic speeds in school zones from 50 km/h to 30 km/h, as announced by Deputy Prime Minister Datuk Seri Ahmad Zahid Hamidi, in collaboration with the World Health Organisation (WHO) and other stakeholders.

The statistics from the police indicated that there were 322 cases of road accidents at school zones nationwide in 2024, where the victims were either injured or

killed, contributing to the decision to reduce the speed limit. Overall, fatalities involving pedestrians showed a decrease from 511 deaths in 2016 to 394 in 2019. The recorded data also showed that 27% of crashes occurred in school zones. In his speech, Datuk Seri Ahmad Zahid Hamidi also mentioned that international research has shown that every one kilometre of speed reduction can lower the fatality rate by four or five per cent. He also added that a 5% reduction in speed can reduce fatal accidents by 30% (The Star, 2024). A 30 km/h speed limit is often recommended for school zones to minimise the impact of accidents, as this speed is considered safer for pedestrians in the event of a collision. The World Health Organisation (2013) also recommends that speeds near schools and pedestrian areas should not exceed 30 km/h, as this speed significantly reduces the risk of fatality in the event of a collision.

School zones are sections of roadways that front schools or are adjacent to school boundaries. That is the place where schoolchildren's movements are regular. School zones may extend between 200 and 500 meters, depending on the number of vehicles parked along the roadside, waiting to pick up schoolchildren at the end of the school day. Walking activity among schoolchildren is the primary basis for implementing the reduced school zone speed limits. It may also include irregular traffic and other pedestrian movements resulting from children being dropped off and picked up from schools.

The issues mentioned earlier significantly compromise the safety of schoolchildren. Hence, the School Zone speed limits are set to a recommended speed of 30 km/h, and based on the research on the tolerance of the human body to absorb crash energy indicated that the impact speeds between vehicles and unprotected road users such as pedestrians, cyclists and motorcyclists should not exceed 30 km/h regardless of geometric layout if pedestrian and cyclist risk of death are to remain below the nominated level of 10% (Jabatan Kerja Raya Malaysia, 2016).

Based on field observations at two selected schools, the designated speed limit in front of both SK Seksyen 7 and SK Seksyen 24 was 30 km/h, as recommended by JKR and the Ministry of Education for school zones. However, it was observed that a substantial number of vehicles exceeded the speed limit, particularly after clearing the congested zone near the school gates, posing a risk to late-arriving children and those crossing to nearby residential areas.

“Some cars drive very fast in school zones, especially after peak hours. Occasionally, students still arrive late to school, which makes us worry for their safety when crossing the road.”

(Teacher, SK Seksyen 19)

6.2.3.2 Traffic Calming Measures

Exceeding the posted speed limit near schools poses significant safety risks. It reduces the driver’s reaction time, which is crucial for responding to sudden environmental changes, such as the presence of pedestrians. Additionally, higher speeds are associated with increased risk of both the frequency and severity of pedestrian injuries in the event of a collision. This situation is particularly perilous in areas where pedestrian crossing points are unmarked or uncontrolled, further heightening the risk to vulnerable road users, including children.

Vehicle speeds within the school zone were assessed to evaluate compliance with safety standards. Speed humps were installed along the approach roads to most schools, serving as effective traffic-calming measures that naturally encouraged drivers to slow down. However, at SK Seksyen 24, the speed humps were worn, faded, and ineffective at slowing vehicles. Moreover, the school zone signage at this location was damaged and placed too far from the school entrance, reducing its visibility to drivers approaching the school.

Among the six schools that participated in the field observation, only SK Jalan U3 displayed a speed limit sign within its school zone. In contrast, the remaining schools relied solely on warning signs indicating that schoolchildren were crossing the street. The uneven implementation and maintenance of these safety measures suggest a need for improved enforcement and regular upkeep to ensure effective speed management near all schools.

In addition, field observations revealed inconsistencies in signage and overall traffic management across the study area. Although warning signs were present at all six schools, many were obscured by trees, street furniture, or temporary stalls, further limiting visibility and reducing their effectiveness at alerting drivers to walking schoolchildren. In some cases, the signs were placed too close to the school gates, leaving drivers insufficient time to slow down. Several signs were also found damaged, faded, or poorly maintained, highlighting a lack of regular upkeep by the responsible

authorities. Moreover, the absence of posted speed limit signs in several locations represents a critical gap that must be addressed to ensure vehicle users are aware of the appropriate speed restrictions within school zones.

It can be concluded that clear, well-maintained speed limit signage is vital for reminding drivers to control their speed, especially in areas with high pedestrian activity, such as school zones. Implementing traffic calming measures, such as chicanes, road narrowing, or traffic circles, where appropriate, can further reduce vehicle speeds and improve pedestrian safety, including walking schoolchildren.

The following paragraph presents the findings from the questionnaire survey concerning responses to the speed limit enforced in school zones. Figure 6.1 illustrates respondents' feedback on the survey questions. The first question asked whether drivers in school zones tend to exceed the posted speed limit.

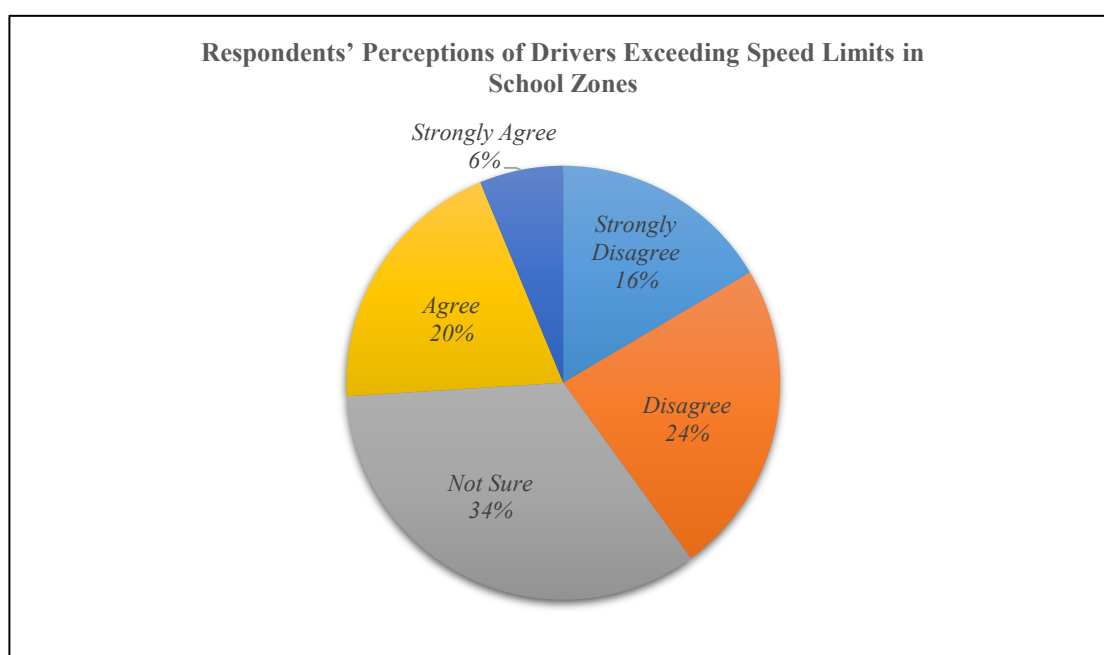


Figure 6.1 Perception of Drivers Exceeding Speed Limits in School Zones

Based on Figure 6.1, 26% of respondents (6% Strongly Agree and 20% Agree) believe that drivers in school zones tend to drive at maximum speed. This result indicates that a small proportion of students perceive speeding as a concern in their school areas, raising safety issues for walking schoolchildren. Upon examining the disagreement results, approximately 40% (24% Disagree and 16% Strongly Disagree) of respondents did not believe drivers exceeded the speed limit within school zones.

This result suggests that a substantial number of respondents perceive traffic speeds in their school zones to be generally under control or within acceptable limits.

Notably, about 34% of respondents select ‘Not Sure’, reflecting uncertainty or limited awareness about actual driving behaviour near schools. These high proportion responses may indicate that many students and parents are either unfamiliar with speed limits in school zones or have limited exposure to speeding incidents. This result also suggests difficulty, especially among younger respondents (primary schoolchildren), in accurately judging vehicle speeds.

Variation in these findings highlights differing traffic conditions among the six participating schools. While field observations identified worn-out speed humps, faded signage, and the absence of posted speed limit signs in several school zones, many respondents still perceived their school zones as relatively safe. This suggests a possible perception gap between the actual and perceived levels of safety.

Therefore, these findings emphasise the need to improve visibility and maintenance of traffic calming measures. For instance, clear speed limit signage, consistent enforcement, and repainting of road markings are necessary to ensure both actual and perceived safety within school zones. Enhancing these elements may help foster safer walking environments and build greater confidence among parents and schoolchildren to engage in active travel to school.

6.2.4 Summary of Infrastructural Safety Findings

The above findings demonstrate that the physical condition, design quality, and maintenance of pedestrian and traffic facilities strongly influence children’s safety and willingness to participate in active travel to school. A synthesis of field observations and questionnaire responses reveals several consistent patterns, with most respondents agreeing that their walking environment is safe and adequately equipped with pedestrian facilities. However, observational evidence identified significant shortcomings in infrastructure quality and management.

Regarding key infrastructure gaps, several issues were identified, including discontinuous or obstructed sidewalks, faded or damaged crosswalk markings, insufficient pedestrian lighting, and inadequate maintenance of signage and traffic calming devices. Also, the absence of properly placed speed limit signs further reduces driver awareness in school zones. These deficiencies have contributed to increased

exposure of children to vehicular risks, particularly at crossing points and along high-traffic access routes.

In summary, while student and parent perceptions suggest moderate satisfaction with existing facilities, objective assessments indicate that infrastructure conditions remain below recommended safety standards. Therefore, addressing maintenance, visibility, and continuity challenges across pedestrian networks is necessary to improve actual and perceived safety, thereby supporting the objective of encouraging safe and sustainable active travel to school.

6.3 Environmental and Social Safety Factors

This section examines the environmental and neighbourhood conditions that influence the safety and comfort of walking children to school. Beyond physical infrastructure, street lighting, visibility, surveillance, and perceived crime or security threats, other aspects play a critical role in shaping children's perceptions of safety and parents' willingness to allow independent walking. Thus, the analysis in this section integrates findings from field observations and questionnaire surveys to evaluate how these external environmental conditions contribute to or hinder safe walking practices among walking schoolchildren in general.

6.3.1 Street Lighting and Visibility

Street lighting is essential in ensuring the safety of walking schoolchildren, particularly during early morning and late evening hours or in areas with limited natural light. Well-lit pedestrian routes not only enhance a driver's ability to see pedestrians but also help children and parents identify potential obstacles, hazards, or approaching vehicles. Inadequate lighting can reduce visibility, increase the risk of accidents, and may discourage children from walking to school due to perceived danger. Therefore, this subsection will assess lighting and visibility along school routes, as understanding how the built environment supports or hinders safe walking is crucial, particularly for schoolchildren who walk to school.

Field observation surveys were conducted at selected primary schools in the study area. The findings revealed that several pedestrian walkways lacked sufficient street lighting, particularly along access roads leading to school entrances. No dedicated

lighting infrastructure is provided exclusively for pedestrian walkways in the study area. Instead, pedestrian visibility relies solely on street lamps along main roads, which are often spaced far apart and primarily oriented toward vehicle traffic. As a result, this arrangement contributes to dim, uneven lighting along pedestrian paths, especially in areas set back from the main road, near school gates, and within residential access lanes.

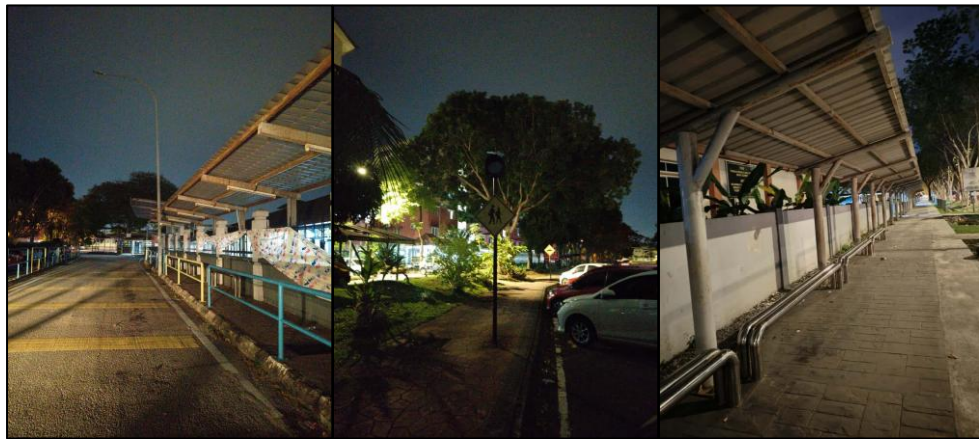


Plate 6.3 Inexistence of Dedicated Lighting for the Pedestrian Walkway at SK Seksyen 7 and SK Seksyen 17

For example, at SK Seksyen 24, the walkway connecting the school gate to nearby residential areas passes through a lane without dedicated pedestrian lighting. Additionally, shadows from trees and fences further reduce visibility in that area. Similar conditions were recorded at most of the remaining schools, where pedestrian routes around the back and side entrances had limited coverage from nearby streetlights. This finding is supported by the respondents' feedback based on the interview.

"The area in front of the school is too dark in the mornings, and cars drive fast, ignoring the walking schoolchildren who are passing through the same area."

(Respondent, SK Seksyen 19)

This situation raises safety concerns, particularly during the early morning hours when children walk to school in low-light conditions. Insufficient lighting makes it difficult for pedestrians to see potential hazards on the path and for drivers to detect schoolchildren, especially near unsignalised crossings or at points where children emerge from residential streets. Besides, the lack of dedicated pedestrian lighting indicates a gap in infrastructure planning, where the needs of pedestrians were not

prioritised during the development of school access routes. This contributes to a lower sense of safety among children and parents, potentially discouraging walking to school.

Previous studies show that improved pedestrian lighting significantly reduces crash risks in school zones. Rahman et al. (2020) in their research suggest that visibility enhancements, such as adequate lighting, contrasting pavement colours, and reflective signage, can reduce pedestrian-vehicle collisions by up to 30% in urban school areas. It was supported by the Road Safety Audit Guidelines for Malaysia (Jabatan Kerja Raya, 2011), which recommends adequate lighting at all pedestrian crossing points, particularly near schools and public transit stops.

Inadequate street lighting was reported not only in school zones but also in some residential areas adjacent to schools, particularly those further from the main roads. This existing condition posed risks to schoolchildren who walk to school early in the morning or late in the afternoon, especially on overcast or rainy days. This is worsened by the faded condition of pedestrian signs and unclear school zone warnings, which reduce drivers' awareness of walking schoolchildren. Additionally, overhanging trees and poor maintenance of existing fixtures further reduced visibility along these paths. Following JKR's Nota Teknik (Jalan) 18/97 – Basic Guidelines on Pedestrian Facilities, the provision of pedestrian walkways must maintain a minimum vertical clearance of 2 metres along their entire length (Jabatan Kerja Raya Malaysia, 1997). This requirement is designed to protect the safety of pedestrians, including children, adults, and individuals using assistive mobility devices, from overhead obstructions such as tree branches and signage.

During the questionnaire survey, respondents were asked to share their perceptions regarding the adequacy of lighting and visibility along pedestrian walkways used by schoolchildren. Figure 6.2 indicates that 60% (n = 240) of respondents rated the lighting and visibility along pedestrian walkways as adequate or very adequate. This result suggests that, from the users' perspective, illumination levels in most schools are generally satisfactory and support safe walking conditions.

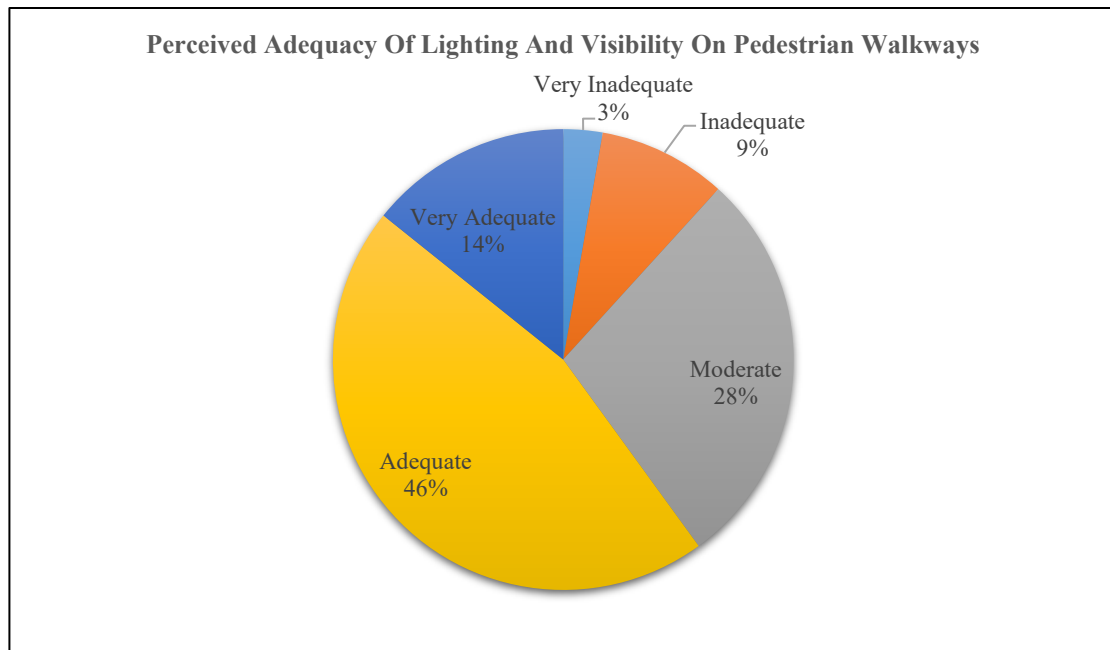


Figure 6.2 Perceptions of the Adequacy of Lighting and Visibility on Pedestrian Walkways

However, 28% ($n = 113$) of respondents rated the lighting as moderate, suggesting inconsistent illumination quality or limited coverage across different walking routes. Additionally, a smaller proportion, 12% ($n = 47$), perceived the lighting as inadequate or very inadequate, suggesting that certain areas may still experience poor visibility, particularly during early morning or late evening hours.

Therefore, these findings highlight that while lighting is generally perceived as sufficient by respondents in many locations, targeted improvements may still be necessary in specific routes and residential areas where poor visibility has been reported. Inadequate illumination not only compromises the visibility and safety of walking schoolchildren but also discourages active transportation among them due to parental safety concerns. Moreover, this situation reflects a shortfall in meeting the recommended planning standards for pedestrian lighting infrastructure in school zones.

6.3.2 Perceived Crime and Security Threats

In addition to the above factors, perceptions of crime and personal security significantly influence both parents' and children's willingness to engage in active travel to school. Despite adequate walking routes being in place, potential threats such as crime, harassment, or the presence of strangers may discourage walking and increase dependence on motorised vehicles. Hence, this subsection discusses the respondents' perceptions of crime and safety threats within the study area, based on field observations and questionnaire findings.

Figure 6.2 illustrates the frequency of harassment or disturbance by strangers as reported by walking schoolchildren in the study area. It was noted that 70% of respondents reported never experiencing any form of harassment while travelling to or from school. This finding clearly suggests that, overall, the walking environment around most schools is perceived as relatively safe from stranger-related threats, allowing children to walk independently without exposure to such threats.

A smaller proportion of respondents (11%) reported being rarely disturbed, while 7% experienced such incidents sometimes. Additionally, 11% of respondents reported being often harassed by strangers, while only 1% stated that occurrences were very frequent. The above higher-frequency responses represent a minority, but they must still be considered, as they indicate that some children are occasionally exposed to potential security risks during their school trips.

Table 6.4 highlights the importance of maintaining a visible security presence to enhance lighting and surveillance in less-trafficked areas. Also, this finding encourages community awareness to strengthen the sense of children's safety. Strengthening school-community cooperation and routine patrols could encourage more children to walk to school independently and confidently while reducing the likelihood of such encounters.

Table 6.4
 Respondents' Exposure to Personal Security Threats while Walking to or from School

	Harassment or Disturbance by Strangers	Exposure to Wild Animal Attacks	Knowledge of Snatch Theft Cases around Schools
Never	70%	71%	49%
Rarely	11%	12%	15%
Sometimes	7%	5%	15%
Often	11%	11%	17%
Very Often	1%	1%	4%

Table 6.4 presents the frequency of harassment or disturbance by strangers reported by schoolchildren walking to school across the six schools. The pie chart shows that a substantial majority of respondents (70%) reported never experiencing any form of harassment while travelling to school, suggesting that the walking environment around most schools is perceived as relatively safe from stranger-related threats. In contrast, a smaller proportion of respondents (11%) reported being rarely disturbed, followed by 7% who reported experiencing such incidents sometimes. 11% of respondents notably stated that strangers often harassed them, and only 1% reported very frequent occurrences. Although these higher-frequency responses are a minority, this issue is severe, indicating that some children are occasionally exposed to potential risks on their way to or from school. A visible security presence, improved lighting and surveillance in less-trafficked areas, and community awareness promotion need to be implemented to address the severe findings highlighted.

In addition, Table 6.4 presents the frequency of exposure to wild-animal attacks reported by schoolchildren. The majority of respondents (71%) reported never having encountered any wild animal attacks, suggesting that such incidents are relatively rare in the study area. However, 12% rarely, 5% sometimes, and 11% often reported being exposed to wild animals such as stray dogs or monkeys during their school trips, indicating a slight but notable proportion of respondents. Only 1% of respondents reported experiencing such incidents very often, posing safety concerns, especially for younger schoolchildren who walk alone. Thus, these findings highlight the need to properly maintain pedestrian routes and control stray and wild animals near school zones to create a safe and convenient walking environment.

Additionally, Table 6.4 presents the level of awareness among schoolchildren regarding snatch theft incidents occurring near their schools. Almost half of the respondents (49%) reported never having heard of any snatch theft cases, suggesting that such incidents are either uncommon or have not occurred in the community. Nonetheless, 15% rarely, 15% sometimes, and 17% often represent a considerable proportion of schoolchildren who expressed some awareness of these crime cases. Additionally, only 4% of respondents reported being very frequently aware of such cases, proving the persistence of safety concerns among some students. Therefore, these findings highlight the importance of maintaining security surveillance and community awareness around school zones to prevent crime and enhance the safety of schoolchildren walking to school.

6.3.3 Summary of Environmental Safety Findings

In summary, the findings clearly indicate that environmental factors such as lighting, visibility, and the presence of security personnel play a critical role in shaping children's perceptions of safety when travelling to school. Based on the responses of walking schoolchildren, the lighting along most routes adjacent to the school was perceived as adequate. However, this contradicts field observations, which revealed dim or uneven illumination in certain areas near school gates and residential lanes. On the other hand, serious safety incidents were uncommon. Some respondents reported occasional harassment by strangers, encounters with stray animals, and awareness of snatch thefts near schools. Therefore, these crucial findings highlight that, although the walking environment is generally safe, localised risks still exist. As mentioned previously, safety measures such as strengthening street lighting, maintaining pedestrian routes, increasing visible security patrols, and promoting community vigilance are highly recommended to reduce the risk and enhance both perceived and actual safety among walking schoolchildren.

6.4 Behavioural Safety Factors

Behavioural and perceived aspects are another aspect that significantly influences whether parents allow their children to walk to school and whether children themselves feel comfortable doing so (walking to school). This section presents the analysis of questionnaire data and field observations on how children and their parents perceive safety while walking to school, as well as how walking patterns, such as supervision and group travel, influence their comfort levels.

6.4.1 Children's or Parents' Perception of Safety

The surrounding environmental and social conditions strongly shape both parental perceptions and children's walking behaviour. Parents who perceive their neighbourhood as unsafe due to poor lighting, heavy traffic, or the presence of strangers are less likely to allow their children to participate in active travel. Similarly, children who have personally experienced or witnessed unsafe events such as bear-miss incidents or harassment will be reluctant to walk to school. This situation demonstrates that both objective safety conditions and subjective perceptions of risk influence decision-making, especially regarding school travel.

In the questionnaire survey, respondents were asked to indicate their perception of safety when commuting to and from school by active means of transportation. This includes their level of concern about traffic danger, strangers, stray animals, and other environmental threats that may influence walking behaviour. This section explores the children's perceptions of safety, particularly regarding parental encouragement and the influence of perceived risks on their willingness to walk to school.

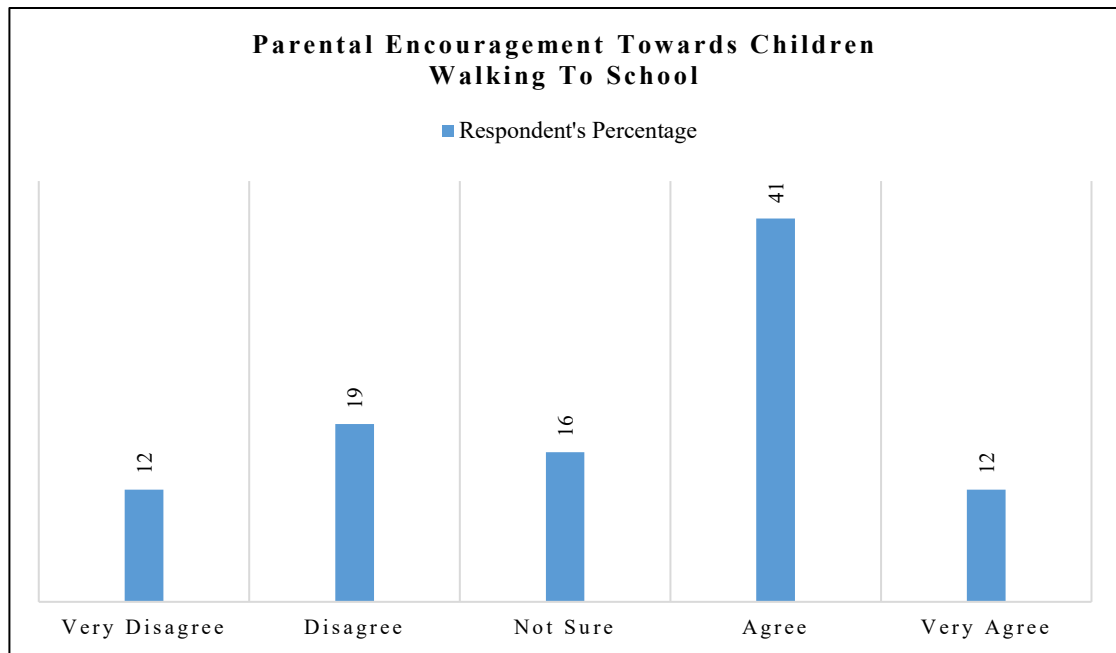


Figure 6.3 Respondents' Agreement Levels on Parental Support for Walking to School

Figure 6.3 illustrates respondents' perceptions of how supportive their parents are of active travelling to school. The findings show that slightly more than half of the respondents (53%) perceived their parents as encouraging them to use active transport (walking), proving a generally positive attitude towards active commuting. The median response was 4 (Agree), indicating that parental support for walking is relatively common among families in the study area. Nevertheless, nearly one-third of respondents (31%) reported that their parents were not supportive, either disagreeing or strongly disagreeing with the idea of actively travelling to school. Meanwhile, 16% of respondents remained uncertain, indicating that some children receive mixed messages or have limited discussions with their parents about permission to walk to school.

This distribution explains that while parental encouragement is prevalent, a significant portion of parents still hesitate to allow their children to walk independently due to safety-related concerns, including traffic exposure, fear of crime, or insufficient pedestrian infrastructure (Mitra, 2013; J. R. Panter et al., 2010). The results also imply that children's own experiences, such as witnessing unsafe conditions, may reinforce parental caution and reduce their confidence while walking. This proves that parental attitudes reflect a complex balance between environmental realities and perceived risks in the school zone.

This result suggests the need for safety improvements, such as improved street lighting, clearly marked pedestrian crossings, and active community surveillance, to strengthen parents' sense of security. Also, awareness programs and safety education initiatives can be implemented with the participation of both parents and students, encouraging more supportive attitudes toward walking and promoting safer, more sustainable school travel practices.

6.4.2 Walking Supervision and Group Walking

The way children travel to school also plays a critical role in their perceived safety. To understand the social context of schoolchildren's journey, respondents were asked with whom they usually walk. Given that children may walk with different companions throughout the week, this question allowed for multiple responses. The five options provided were Friends, Siblings, Parents or Guardians, Alone and Others. A total of 400 respondents completed this question, and the frequency of each response is presented in Figure 6.4.

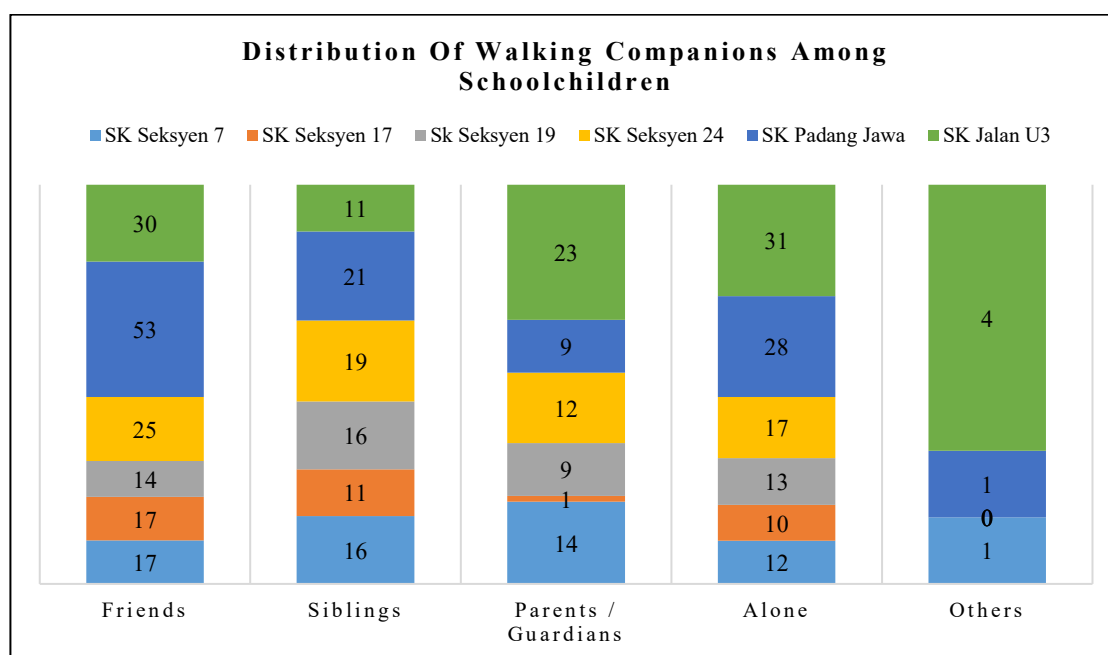


Figure 6.4 Distribution of Walking Companions among Respondents (N=400)

Figure 6.4 presents the distribution of walking companions reported by schoolchildren, indicating that most respondents (156) walk with friends, followed by those who walk with siblings (94) and those who walk alone (111). A smaller number of students (68) walk with parents or guardians, while very few (6) reported walking with others, such as neighbours or caregivers. These findings indicate that peer companionship is the most common walking arrangement, reflecting children's social preference and growing independence as they commute to school. Walking with friends and siblings was considerably more common than walking alone. This aligns with the existing literature suggesting that children prefer walking in peer or sibling groups as they grow older, due to a greater sense of independence. These findings also imply that parents allow their children to walk without adult supervision, trusting their confidence in the surroundings and their ability to navigate the route. Qualitative comments from the interview indicated that:

"My child prefers not to walk alone, especially near the playground where dogs usually gather."

(Parent, SK Seksyen 24)

Despite this, a notable proportion of children reported walking alone (111 respondents). This number is substantial, especially given safety concerns for lone walkers, including exposure to traffic hazards, personal security issues, and reduced visibility. The fact that some children walk alone suggests that many parents and guardians trust their children to navigate the walking environment, or lack other practical options due to work and scheduling constraints. However, this underscores the importance of ensuring that the built environment around schools is designed to support safe, independent walking, including pedestrian crossings, traffic-calming measures, and well-maintained sidewalks.

Those who walk with Parents or Guardians (68 respondents) may be younger children or come from families that are more protective of their school journeys for safety reasons. The relatively lower number for this category suggests that parental accompaniment decreases as children grow older and gain autonomy. Finally, the "Other" (6 respondents) category indicates that very few children travel in other, less common ways, such as with other relatives, neighbours, or caregivers.

Overall, these findings indicate that group walking with a companion, particularly with friends or siblings, is a protective factor for children's AST. This reinforces the value of Walk-to-School programs or Walking Buses, initiatives in which a group of children walks together under light supervision, reducing parental anxiety. Improving perceptions of safety and actual safety tend to promote active commuting to school.

6.4.3 Summary of Behavioural Safety Findings

In summary, the findings from this section imply that parental attitudes, children's experiences, and walking companionship significantly influence both perceived and actual safety. According to the questionnaire results, most parents encourage their children to walk, but some remain hesitant due to safety concerns. It is undeniable that walking with friends or siblings enhances confidence and reduces risk, whereas walking alone exposes one to vulnerability. Overall, strengthening parental trust, promoting group walking, and improving pedestrian infrastructure are essential to fostering safer, more confident walking behaviour among schoolchildren.

6.5 Comparative Safety Assessment among Schools

The following section presents a comparative assessment of the relative safety performance of six schools participating in the field observations and survey: SK Seksyen 7, SK Seksyen 17, SK Seksyen 19, SK Seksyen 24, SK Padang Jawa, and SK Jalan U3. The comparison integrates data and findings from the significant safety dimensions discussed in the previous sections, based on evidence obtained from field observations, questionnaire surveys, and interviews.

Overall, based on the analysis and findings in Chapter 5, SK Jalan U3 and SK Seksyen 7 demonstrated the highest safety levels, primarily due to continuous sidewalks, visible pedestrian crossings, and effective traffic calming measures within their school zones. Also, both schools exhibited well-maintained infrastructure and effective traffic management at school gates, contributing to smoother pedestrian flow and reduced exposure to vehicular risks.

In contrast, schools with moderate safety conditions are evident at SK Padang Jawa and SK Seksyen 24. Despite having fundamental pedestrian facilities, issues such as narrow or obstructed sidewalks, faded crosswalk markings, and poor lighting near pedestrian routes have reduced the comfort and visibility for walking schoolchildren. The situation is worsened by inconsistent signage placement and weak enforcement of speed limits, resulting in safety gaps in these school zones.

Meanwhile, SK Seksyen 17 and SK Seksyen 19 exhibited the lowest comparative safety ratings. This result is primarily due to heavy traffic congestion during peak hours, limited pedestrian crossings, and the absence of precise speed control mechanisms. Additionally, poor lighting, unclear signage, and minimal enforcement around school gates were identified as contributing factors to perceived risks, especially among parents and students.

From a behavioural perspective, walking in groups is more common among schoolchildren across six schools, reflecting stronger social and environmental support for safe walking. Referring to Figure 6.4, schools with inadequate pedestrian infrastructure, namely SK Padang Jawa, had higher proportions of students accompanied by parents or siblings, indicating lower perceived safety.

In summary, this comparative assessment highlights significant variation in safety levels across schools in the study area. It was noted that the differences are primarily attributed to variations in infrastructure quality, environmental conditions, and traffic management. Therefore, targeted interventions tailored to each school's safety deficiencies are essential in achieving a more consistent and reasonable standard of pedestrian safety across Shah Alam's school zones.

6.6 Summary

In summary, this chapter examined the safety level of walking schoolchildren in the study area, emphasising three critical dimensions: infrastructural, environmental and behavioural safety. The findings revealed that although most respondents perceive their walking environment as generally safe, observational evidence identified several persistent challenges that contradict this perception and compromise actual safety conditions.

Infrastructural issues such as discontinuous sidewalks, faded crosswalks, insufficient lighting, and inconsistent signage remain critical barriers to safe walking among schoolchildren. Meanwhile, environmental conditions, inadequate illumination and limited surveillance in certain areas further reduce perceived and actual safety. Also, behavioural findings indicate that while many children walk with peers or siblings, parental concerns about traffic and security continue to hinder independent walking.

Although the findings indicate that none of the six case study schools faces serious safety issues, many Malaysian parents still perceive walking to school as unsafe. The social stigma surrounding road traffic conditions, crime, and overall environmental safety is associated with urban areas in Malaysia. However, research indicates that these concerns may be overstated in well-planned neighbourhoods like Shah Alam City, where most schools have adequate pedestrian facilities, visible crossings, and effective environmental safety measures.

In conclusion, the findings indicate that safe school travel requires not only improvements to physical infrastructure but also behavioural and environmental interventions. While this study primarily identifies the influencing factors affecting children's walking to school, these findings also provide critical insights for urban planners and local authorities. Understanding these factors enables more informed decision-making in school siting, infrastructure provision, and policy formulation. Specifically, factors such as distance, perceived safety, and infrastructure quality can serve as key planning indicators for designing walkable school environments and guiding future school development. These insights form the basis for the child-sensitive planning guidelines proposed in Chapter 7.

CHAPTER 7

CHILD-SENSITIVE PLANNING AND DESIGN GUIDELINES FOR WALKABLE SCHOOL ZONES

7.1 Introduction

Chapter 7 presents comprehensive guidelines for enhancing the provision of pedestrian facilities within primary school zones, specifically contextualised for the urban environment of Shah Alam City, Malaysia. This framework is designed to address the multidimensional factors identified in the study that influence children's walking behaviour. This chapter presents a structured approach to planning, designing, implementing, and maintaining pedestrian infrastructure that promotes safety, accessibility, and walkability for schoolchildren. This chapter also aims to translate empirical findings into actionable, contextually grounded, scalable, and policy-relevant strategies. It serves as a strategic guide for urban planners, local authorities, educational institutions, and other stakeholders in creating child-friendly, safe, and accessible school travel environments.

The framework has been systematically developed through an integrative approach that combines theoretical insights, empirical research, stakeholder perspectives, and international best practices. The methodological foundation was based on identifying key influencing factors derived from both qualitative and quantitative findings. Data collected through questionnaire surveys, site observations, and interviews were triangulated to identify key deficiencies and opportunities in the existing condition of pedestrian infrastructure in Shah Alam. Drawing upon relevant theoretical underpinnings such as the Safe Routes to School (SRTS) model, these factors were translated into practical design guidelines, planning strategies, and policy measures aligned with local governance and urban development goals.

The framework directly reflects the core findings of this research, highlighting the significance of demographic and socioeconomic background, pedestrian infrastructure quality, overall safety, parental perceptions, environmental design, and institutional coordination in shaping children's school travel behaviour. Specifically, the study identified critical impediments, including inadequate sidewalk continuity, insufficient signage, and insufficient enforcement in school zones. These findings

underscore the need for a holistic intervention that improves physical infrastructure and addresses perceptual, behavioural, and policy-related dimensions of walkability. The framework thus represents a synthesis of research evidence and applied urban practice, bridging the gap between knowledge generation and policy implementation. Accordingly, the framework serves as a practical tool for urban planners and decision-makers, representing a scholarly contribution toward advancing sustainable and inclusive mobility for children in Malaysian cities.

7.2 Objectives of the Framework and Guidelines

The development of the framework and guidelines is grounded in a clear set of objectives to address the challenges and opportunities identified earlier in this study. The primary goal is to create a safer, more inclusive, and supportive walking environment for children when travelling to and from school. The objectives are elaborated as follows:

7.2.1 Improve Walkability and Safety for Schoolchildren

This framework and guideline were prepared to enhance the walkability of school environments, with a strong emphasis on pedestrian safety. Walkability refers to the extent to which the built environment supports and encourages walking by providing safe, connected, comfortable, and accessible pathways. Considering the context of school-going children, walkability must go beyond basic functionality, prioritising child-specific needs and acknowledging children as the most vulnerable road users.

This framework addresses key safety concerns raised by parents, school authorities, and local stakeholders. By proposing targeted design interventions, aiming to reduce traffic-related risks as well as to create an environment that actively protects and prioritises the safety of children as pedestrians. Additionally, improved walkability fosters independence, supports social interaction among peers, and strengthens the connection within the community. By making walking a safe and viable option, this framework also encourages families to shift away from reliance on motorised vehicles toward active modes, thereby reducing congestion around school zones.

7.2.2 Promote Active Transport

The next objective is to promote active transportation, particularly walking, as a sustainable and health-enhancing mode of commuting for schoolchildren. As discussed in the literature review section, active transport makes a significant contribution to children's physical, mental, and emotional well-being. Walking regularly to school has been associated with improved fitness, better concentration in class, increased social engagement, and the development of road safety and awareness and spatial cognition.

Currently, in many urban areas, including Shah Alam City, the reliance on private vehicles for short school commutes has led to rising traffic congestion, environmental pollution, and sedentary lifestyles among schoolchildren. Thus, by promoting walking through initiatives such as improving walking infrastructure, implementing safety measures, and adopting supportive policies, it may be possible to reverse the current trends and embed active transport into the culture of daily school travel.

This guideline also highlights community-based strategies, such as walking school buses, car-free school zones, and walk-to-school campaigns, and assesses their suitability for implementation in our country. This kind of initiative not only encourages children to walk but also fosters a sense of shared responsibility for the safety of child pedestrians.

7.2.3 Integrate Child-Friendly Urban Design Principles

Lastly, this framework was prepared to integrate child-friendly urban design principles into the planning, design and management of public spaces around schools. A child-friendly environment is known as safe, inclusive, accessible, engaging, and empowering for children of all backgrounds and abilities. It focused not only on efficiency and aesthetics but also on a deep understanding of how children experience and interact with their environment. Several key principles are emphasised in this guideline, including:

- Human-scale design that reflects children's height, pace, and perception;
- Visibility and transparency to improve safety and make it easier for adult supervision.
- Accessibility for all, including children with disabilities, as guided by Malaysian Standard MS 1184:2014 on Universal Design; and
- Interactive and engaging spaces include colourful wayfinding signs, playful elements along the walking route, and shaded rest areas.

By considering the above principles, the framework and guidelines developed ensure that walking routes are not only safe for young pedestrians but also enjoyable and empowering for children. This framework and guideline support the idea that cities and neighbourhoods must be designed to respect and consider children's rights to move safely and independently in their walking environment.

7.3 Implementation Framework and Proposed Guidelines for Safe School Zone Pedestrian Infrastructure and Facilities: From Planning to Maintenance

This section proposes a set of comprehensive, child-centric guidelines designed to enhance the safety, accessibility, and walkability of school routes for primary school children. These guidelines are based on the study's findings, which examined the relationship between built environment characteristics and children's safety concerns about their willingness to walk to school. This guideline was also prepared in alignment with relevant Malaysian standards, including MS 1184:2014 Universal Design and Accessibility, international best practices, the needs and desires of parents and school communities, and, most importantly, the specific physical, cognitive, and social characteristics of primary schoolchildren. To ensure that the proposed design interventions are actionable and sustainable, this section organises the guidelines into four implementation phases: Planning, Design, Monitoring, and Maintenance, with a focus on child-centric infrastructure in school zones. Thus, the components described in Section 7.3 demonstrate how design guidelines are translated into real-world implementation.

7.3.1 Legal Policy and Current Guidelines

These standard guidelines should be considered alongside relevant current policies and legislation to ensure that the objective of creating a child-friendly pedestrian environment is effectively implemented for the common good of schoolchildren and the community.

Table 7.1
Current Policies, Legislation and Guidelines to refer to

	Document / Reference	Issuing Authority / Year	Relevance
Policies	National Physical Plan 4 (NPP-4)	PLANMalaysia (2023)	Incorporates walkability, safe mobility, and sustainable urban design under the Liveable Malaysia agenda.
	National Urbanisation Policy 2 (NUP-2)	PLANMalaysia (2016)	Promotes pedestrian-friendly and inclusive city environments
	13th Malaysia Plan (13MP)	Economic Planning Unit (EPU), Prime Minister's Department (2026–2030)	Emphasises sustainable mobility, safe routes to school, and active transport.
	Malaysia Road Safety Plan 2022–2030	Ministry of Transport (MOT)	Targets reduction of pedestrian fatalities; includes measures for school zones.
	Malaysia Sustainable Development Goals (SDGs)	United Nations Malaysia / EPU	Goal 11: Sustainable Cities and Communities; promotes safe, accessible walking infrastructure.
	New Urban Agenda (NUA)	UN-Habitat / Malaysia commitment	Advocates for inclusive design and child-friendly public spaces.
	National Transport Policy (NTP) 2019–2030	Ministry of Transport (MOT)	Encourages non-motorised and active travel infrastructure, including pedestrian walkways.
	National Road Safety Council (MKJR) Framework	MOT / MIROS	Promotes road safety culture and child pedestrian protection initiatives.
	Green Neighbourhood Planning Policy	PLANMalaysia (2012, revised 2018)	Includes the provision of pedestrian paths and connectivity as green mobility indicators.
Legislation	Street, Drainage and Building Act 1974 (Act 133)	Federal Government of Malaysia	Empowers local authorities to ensure safe public walkways and building setbacks for pedestrians.
	Town and Country Planning Act 1976 (Act 172)	PLANMalaysia	Provides the legal basis for planning and controlling development, including pedestrian access.
	Road Transport Act 1987 (Act 333)	Ministry of Transport	Regulates school zones, speed limits, and pedestrian safety measures.
	Uniform Building By-Laws (UBBL) 1984	Ministry of Local Government Development	Specifies access and safety requirements for pedestrian and disabled users.
	Local Government Act 1976 (Act 171)	Ministry of Local Government Development	Governs the responsibilities of PBTs in providing and maintaining walkways and footpaths.

Guidelines	Garis Panduan Perancangan Laluan Pejalan Kaki (Pedestrian Pathway Planning Guidelines)	PLANMalaysia (2018)	Defines standards for width, gradient, surface, and connectivity of pedestrian paths.
	Garis Panduan Perancangan Kejiranan Hijau (Green Neighbourhood Planning Guidelines)	PLANMalaysia (2012)	Encourages walkable neighbourhoods with safe pedestrian routes.
	Garis Panduan Perancangan Kawasan Sekolah	PLANMalaysia (2020)	Provides planning standards for school sites, including access, safety, and pedestrian connectivity.
	Garis Panduan Bandar Selamat (Safe City Planning Guidelines)	PLANMalaysia (2012)	Promotes crime prevention through environmental design (CPTED) and safe pedestrian movement.
	Malaysian Standard MS 1184:2014 – Universal Design and Accessibility in the Built Environment	Department of Standards Malaysia	Core reference for inclusive walkway and crossing design.
	Malaysian Standard MS 1331:2003 – Road Marking for Pedestrian Crossings	Department of Standards Malaysia	Specifies the design and placement of pedestrian crossings.
	Malaysian Standard MS 2318:2019 – Urban Design and Public Spaces	Department of Standards Malaysia	Addresses pedestrian circulation and human-scale design.
	JKR Standard Specification for Road Works (Section 14: Pedestrian Facilities)	Public Works Department (JKR)	Sets technical standards for walkway construction and maintenance.
	Implementation Guide for the Green Neighbourhood Development Initiative – Provision of Pedestrian Paths	PLANMalaysia (2012)	Details the steps to create safe, continuous pedestrian links.
	Details the steps to create safe, continuous pedestrian links.	Manual on Traffic Control Devices (MTC I/II) JKR / MOT	Regulates signage, road markings, and traffic control in school zones.
	Road Technical Instructions (Arahan Teknik Jalan) – ATJ 8/86 & ATJ 26/97	JKR	Provide geometric and safety design guidance for pedestrian crossings and walkways.
	Safe Routes to School (SRTS) Concept / Pilot Guidelines	MIROS / MOT / MOE	Malaysia's adaptation of SRTS for school zone safety.

7.3.2 Guiding Principles

The proposed guidelines are grounded in the following principles:

- 1.** Child-Centred Design: Prioritising the safety, visibility, and comfort of children as vulnerable road users.
- 2.** Safe System Approach: Designing roads and pedestrian infrastructure that reduces risks.
- 3.** Universal Accessibility: Ensuring that the walking infrastructure is inclusive for children of all abilities.
- 4.** Environmental Sustainability: Promoting active transport (walking) as an eco-friendly alternative to private motorised transport.
- 5.** Community Engagement: Encouraging local stakeholders' involvement in maintaining and monitoring pedestrian infrastructure.

7.3.3 Proposed Guidelines

Table 7.2

Proposed Child-Centric Guidelines for the Planning, Design, Monitoring, and Maintenance of Pedestrian Infrastructure in Primary School Zones

PHASE 1: PLANNING					
No	Proposed Guideline			Cost Implications and Phasing Priorities	
1	Conduct walkability audits and safety risk assessments using reference to child-specific distance ranges. (300–400 meters for a 5–10-minute walk)			Low-Cost / Minimal Investment (Short-Term: 0-1 year)	
2	Identify high-risk school zones based on traffic speed, infrastructure gaps, and walking patterns.			Low to Medium-Cost (Short-Term: 0-2 years)	
3	Engage school authorities, parents, and local communities in participatory mapping and planning.			Low-Cost (Short to Medium-Term: 1-3 years)	
4	Embed school zone enhancements into Local Plans and Development Control guidelines.			Medium-Cost / Moderate Investments (Medium-Term: 3–5 years)	
PHASE 2: DESIGN					
No	Component	Finding	Issue	Proposed Guideline Guideline	Cost Implications and Phasing Priorities
1	Pedestrian Walkway Design	Lack of continuous pedestrian paths	Interrupted or unsafe walking routes	Provide continuous sidewalks (min. 1.5m, preferably 2.0m) in high-volume areas; ensure slip-resistant, obstruction-free surfaces; comply with MS 1184:2014.	Medium-Cost / Moderate Investments (Medium-Term: 3–5 years)
2	Accessibility	Inaccessible infrastructure for disabled or young children	Exclusion of vulnerable users	Install kerb ramps at crossings, intersections, and school entrances (gradient ≤ 1:12); provide handrails or tactile curbs along slopes; ensure tactile paving in accordance with MS 1184:2014.	Low-Cost / Quick Wins (Short-Term: 1–2 years)
3	Safe Road Crossings	Unsafe road crossings near school gates	Children face risks while crossing roads	Provide zebra crossings with reflective paint visible at child eye level; install raised crosswalks or speed tables near school gates; reduce crossing widths (<10m) and add refuge islands (if appropriate).	Low-Cost / Quick Wins (Short-Term: 1–2 years)
		High traffic volume and speed near schools create unsafe	Children face a high risk when crossing busy or fast-moving roads at ground	Provide universally accessible pedestrian bridges with ramps or lifts, safety features,	High-Cost / Long-Term Investments (5 years and

		conditions for children at road crossings.	level.	lighting, and child-friendly elements in high-risk school zones.	beyond)
4	Traffic Calming	High traffic speed around schools	Children are exposed to an unsafe traffic environment	Enforce a 30 km/h speed limit in school zones with child-height signage; install speed humps, rumble strips, or chicanes within 300m of school zones.	- Speed limit & signage: Low-Cost / Quick Wins (Short-Term: 1–2 years) - Physical traffic calming measures: Medium-Cost / Moderate Investments (Medium-Term: 3–5 years)
5	Intersection and Connectivity	Poor connectivity between residential areas and schools	Children forced to take longer, unsafe routes	Improve street connectivity; provide continuous pedestrian walkways linking schools, homes, and local amenities; minimise conflict points at intersections.	High-Cost / Long-Term Investments (5 years and beyond)
6	Wayfinding and Signage	Lack of child-friendly navigation cues	Children are confused or disengaged with routes.	Install child-friendly signage (height ~1.2m), themed road markers (cartoon footprints and trails), and integrate educational cues (e.g., paw prints = walking distance).	Low-Cost / Quick Wins (Short-Term: 1–2 years)
7	Resting Areas and Shades	Fatigue among younger children	Children are unable to complete long walks comfortably	Provide shaded resting or seating every 250–300m; include trees or covered walkways for comfort during hot or rainy weather.	Medium-Cost / Moderate Investments (Medium-Term: 3–5 years)
8	Lighting and Visibility	Poor lighting in school zones	Reduced safety in early morning/evening	Install adequate, dedicated lighting for the pedestrian walkway at a child-appropriate height; maintain clear sightlines by preventing vehicle parking and trimming vegetation near crossings.	Low-Cost / Quick Wins (Short-Term: 1–2 years)
		Children and vulnerable users struggle to be seen and heard at crossings, especially in busy traffic conditions.	Limited visibility and a lack of auditory or visual cues increase the risk of accidents when children cross roads.	Install audible pedestrian signals and flashing beacons at school crossings to improve visibility and safety.	Medium-Cost / Moderate Investments (Medium-Term: 3–5 years)
9	Safety Enforcement	Safety concerns during peak hours	High congestion and child exposure to	Encourage CCTV in high-risk areas; deploy	Medium-Cost / Moderate

		risks	RELA / staff/volunteers as patrollers during peak hours; coordinate traffic enforcement with police.	Investments (Medium-Term: 3–5 years)
		School zones experience high congestion during pick-up and drop-off times, with vehicles crowding near school gates.	Children are exposed to traffic hazards and reduced walkability because motor vehicles dominate during peak hours.	Implement school street schemes that restrict motor vehicle access during peak hours to prioritise children's safety (if appropriate).
				Low-Cost / Quick Wins (Short-Term: 1–2 years)

PHASE 3: MONITORING

Finding	Issue	Proposed Guideline	Cost Implications and Phasing Priorities
Inadequate monitoring of walking infrastructure	Deterioration of safety over time	Conduct biannual walkability audits with parents/students; track KPIs (walking rates, accident frequency); enable feedback reporting via schools/apps.	Low-Cost / Quick Wins (Short-Term: 1–2 years)

PHASE 4: MAINTENANCE

Finding	Issue	Proposed Guideline	Cost Implications and Phasing Priorities
Lack of ongoing maintenance	Rapid decline in infrastructure quality	Assign responsibility to councils/community teams; repair sidewalks, crossings, signage promptly; involve CSR programs in beautification/upgrades.	Low-Cost / Quick Wins (Short-Term: 1–2 years)

ADDITIONAL FINDINGS

No	Component	Finding	Issue	Proposed Guideline	Cost Implications and Phasing Priorities
1	Parental Perceptions and Social Norms	Parents and school communities consistently express concern about children's exposure to traffic hazards, unsafe crossings, and a lack of supervision in school zones.	Safety concerns discourage parents from allowing their children to walk to school, reducing independent mobility and walking rates.	Strengthen safety through supervised crossings (patrollers, volunteers), CCTV in high-risk areas, and traffic enforcement at peak hours.	- Patrollers, volunteers, and enforcement: Low-Cost / Short-Term (1–2 years) - CCTV installation and: Medium-Cost / Medium-Term (3–5 years)
				Introduce an insurance or protection scheme for walking schoolchildren to cover accidents or incidents during their journey, providing reassurance	Schoolchildren insurance scheme: Medium-Cost / Medium-Term (3–5 years)

					to parents and promoting safer, independent mobility.	
					Community and School Collaboration: - Neighbourhood volunteer teams shall be established to monitor and assist schoolchildren along designated walking routes. - Schools shall collaborate with nearby commercial premises and residences to designate watch points for community supervision. - Collaboration with the public health sector shall be strengthened to promote walking to school as part of a healthy lifestyle initiative.	
					Promote walking through awareness campaigns, walk-to-school days, and community initiatives like “walking school buses.” Embed road safety and active mobility education in school curricula to normalise walking as a healthy and safe practice.	Low-Cost / Quick Wins (Short-Term: 1–2 years)
2	Governance and Institutional Support	Different agencies (local councils, JKR, MOT, MOE, police, schools, and communities) work in silos with limited integration of responsibilities in school zone planning.	Lack of coordination leads to gaps in infrastructure provision, inconsistent enforcement, and weak policy implementation.		Establish a stakeholder coordination framework that clearly defines roles and responsibilities (planning, funding, enforcement, maintenance). Form inter-agency task forces or committees to streamline decision-making and ensure integrated child-friendly planning.	Low-Cost / Quick Wins (Short-Term: 1–2 years)

7.4 Stakeholder Roles and Responsibilities

The successful implementation of pedestrian facilities in primary school zones requires coordinated efforts among multiple stakeholders. Each party has complementary roles in ensuring the school environment is safe, accessible, and conducive to walking. These roles and responsibilities included policy development, planning and design, enforcement, community engagement, and maintenance.

In summary, local governments and city councils play a primary role in setting policies, allocating funding, and overseeing implementation at the municipal level. In contrast, urban planners and engineers are responsible for translating these policies into safe, functional infrastructure guidance grounded in technical and evidence-based standards. Meanwhile, parents and the community are responsible parties who advocate and act as regulators, helping to identify issues with pedestrian facilities and promoting safety initiatives. Additionally, law enforcement agencies provide essential support through traffic regulation, safety assurance, and educational outreach.

Therefore, a clear understanding of each stakeholder's responsibility may ensure more effective collaboration and accountability in creating safe, accessible, and conducive pedestrian facilities around school zones. The following Table 1.2 summarises in detail their respective roles:

Table 7.3
Roles and Responsibilities of Key Stakeholders in Providing Pedestrian Facilities and Enhancing Pedestrian Safety in Primary School Zones

Stakeholder	Roles and Responsibilities
Ministry of Education/ <i>Kementerian Pendidikan Malaysia</i> (KPM)	<ul style="list-style-type: none"> - Oversee school operations and safety-related upgrades within school grounds. - Support road safety education in school curricula. - Facilitate coordination between schools and other agencies. - Approve infrastructure improvement requests from schools.
Ministry of Transport (MOT)	<ul style="list-style-type: none"> - Formulates national policies and strategies to enhance pedestrian safety in school zones. - Integrates school zone pedestrian planning into broader transport development frameworks. - Develops design standards and technical guidelines for pedestrian infrastructure in school areas (e.g., crosswalks, sidewalks, overhead bridges). - Ensures infrastructure near schools complies with safety and accessibility standards. - Coordinates with local councils, state agencies, the Ministry of Education, and enforcement bodies to implement pedestrian improvements around schools. - Allocates federal funding for upgrading and maintaining pedestrian infrastructure in school zones. - Provides grants or financial assistance to local governments for school safety-related projects.

	<ul style="list-style-type: none"> - Implements awareness campaigns targeting school communities on pedestrian safety. - Supports initiatives to reduce school zone accidents (e.g., traffic calming, signage improvements). - Monitors school zone pedestrian facilities to ensure they meet established standards. - Evaluates the effectiveness of implemented safety measures and makes policy or design adjustments as needed.
Local Authorities/ <i>Pihak Berkuasa Tempatan</i> (PBT) Example: <i>Majlis Bandaraya Shah Alam</i> (MBSA)	<ul style="list-style-type: none"> - Develop and enforce local policies and guidelines for pedestrian safety in school zones. - Plan, construct, and maintain pedestrian walkways and crossings and school zone signs. - Ensure pedestrian-friendly elements are incorporated in development plans. - Approve and monitor local development plans. - Implement traffic calming measures in school zones. - Manage street furniture and control hawker encroachment. - Engage with residents and school communities on improvement priorities and local safety issues. - Allocate municipal budgets and secure funding (e.g., federal/state grants) for pedestrian infrastructure upgrades.
Public Works Department/ <i>Jabatan Kerja Raya</i> (JKR)	<ul style="list-style-type: none"> - Design and build pedestrian infrastructure on federal or state roads. - Maintain footpaths, crossings, and road safety facilities near schools. - Provide technical standards for road and pedestrian design. - Support infrastructure upgrades around schools.
PLANMalaysia (Town and Country Planning Department)	<ul style="list-style-type: none"> - Develop policies that incorporate walkability and child-friendly environments. - Issue planning guidelines for pedestrian paths and school zones. - Ensure pedestrian access is considered in development plans. - Plan and design safe, inclusive, and efficient pedestrian pathways around schools. - Oversee implementation of infrastructure such as sidewalks, kerb ramps, crossings, and traffic calming devices. - Ensure all facilities adhere to national standards (e.g., MS 1184:2014, <i>Garis Panduan Perancangan</i>). - Use data (e.g., from iRAP or accident reports) to prioritise high-risk school zones. - Incorporate child-friendly and universal design principles in streetscape planning.
Law Enforcement Agencies: Road Transport Department/ <i>Jabatan Pengangkutan Jalan</i> (JPJ) and Royal Malaysia Police/ <i>Polis Diraja Malaysia</i> (PDRM)	<ul style="list-style-type: none"> - Enforce school zone traffic laws (speed limits, signage compliance, pedestrian crossing rules, and traffic violations) and manage traffic around schools during peak times. - Conduct road safety education campaigns and demonstrations in schools. - Provide presence near school zones during peak hours to manage traffic and ensure order. - Provide support for school zone patrols and crossing guards. - Record traffic offences and accident data involving school zones for planning and monitoring.
Land Public Transport Agency/ <i>Agensi Pengangkutan Awam</i> <i>Darat</i> (APAD)	<ul style="list-style-type: none"> - Regulate school and public transport services. - Plan transit integration with safe pedestrian access. - Support last-mile connectivity to schools.
Malaysian Institute of Road Safety Research (MIROS)/ <i>Institut Penyelidikan</i> <i>Keselamatan Jalan Raya</i> <i>Malaysia</i>	<ul style="list-style-type: none"> - Research pedestrian safety and infrastructure. - Provide road safety recommendations and audit tools. - Support implementation of the International Road Assessment Programme (iRAP) and school zone assessments.
NGOs and Road Safety Advocates Example: Safe Kids Malaysia	<ul style="list-style-type: none"> - Run public awareness campaigns on child pedestrian safety. - Provide training, materials, and workshops for schools and parents. - Collaborate with stakeholders on pilot projects and advocacy.

School Authorities & Parent-Teacher Association (PTA)/ <i>Persatuan Ibu Bapa dan Guru</i> (PIBG)	<ul style="list-style-type: none"> - Identify and report school-related safety issues. - Organise initiatives such as walking buses or patrol volunteers. - Liaise with local authorities for improvements. - Educate students and parents on safe practices (Awareness programs and feedback mechanisms).
Resident and Community Associations	<ul style="list-style-type: none"> - Voice concerns regarding children's safety, hazardous pedestrian conditions and lobby for infrastructure improvements. - Participate in consultation on planning and upgrades. - Participate in school patrols, walking school buses, or community clean-up initiatives. - Organise or support local campaigns promoting safe walking and road safety education. - Serve as a bridge between schools, local authorities, and enforcement agencies.

7.5 Key Influencing Factors and Stakeholder Framework for Child-Friendly Walking Environments

The development of a safe and walkable pedestrian environment in a school zone is influenced by the integration of physical, social, and institutional factors. Thus, this section identifies the key issues observed in the local context, links them to specific components of the proposed framework, and assigns the corresponding stakeholders responsible for implementation. Table 7.4 below presents a structured overview.

Table 7.4
Key Influencing Factors, Identified Issues, Strategic Framework Components, and Relevant Stakeholders for Enhancing Schoolchildren's Walking Environment in Shah Alam

Key Influencing Factor	Identified Issues (Shah Alam Case Study)	Framework Component	Relevant Stakeholders
Pedestrian Infrastructure Quality	<ul style="list-style-type: none"> - Discontinuous sidewalks - Narrow walkways - Absence of curb ramps - Poor maintenance 	Design standard for sidewalks, crossings and kerb ramps	<ul style="list-style-type: none"> - Urban planners - Local Council
Traffic Safety Concerns	<ul style="list-style-type: none"> - Lack of speed calming - Unsafe crossings 	Implementation of traffic calming and crossing guards	<ul style="list-style-type: none"> - Traffic police - Transport Agencies
Environmental Comfort	<ul style="list-style-type: none"> - Absence of shading - Poor lighting 	<ul style="list-style-type: none"> - Shaded routes - Lighting guidelines 	<ul style="list-style-type: none"> - Local authorities - School management
Parental Perceptions and Social Norms	<ul style="list-style-type: none"> - Concerns about child safety - Social acceptance of walking 	<ul style="list-style-type: none"> - Community outreach - Walk-to-school programs - Awareness campaigns 	<ul style="list-style-type: none"> - Schools - Parent-Teacher Associations (PTAs)
Governance and Institutional Support	Limited coordination between stakeholders	Stakeholder framework with defined responsibilities	<ul style="list-style-type: none"> - MBSA - Ministry of Education - NGOs
Monitoring and Evaluation Gaps	Lack of post-implementation assessment mechanisms	Development of KPIs and feedback mechanisms	<ul style="list-style-type: none"> - Academic institutions - Municipal planners

7.6 Funding and Resource Allocation

The successful implementation of child-friendly pedestrian facilities depends not only on their design and the policies applied, but also on sufficient and sustainable funding. In this case, a multi-stakeholder financing approach is necessary to ensure that pedestrian improvements, including infrastructure provision, education and awareness programs, and community engagement initiatives, can be implemented and maintained over time. The following part elaborates on initiatives that can be considered for each stakeholder.

7.6.1 Funding Sources from the Public Sector

Local authorities, specifically municipal and state governments, play a crucial role in providing financial support for pedestrian infrastructure, particularly in school zones. The financial sources include funding allocations from municipal development budgets, road-safety funds, and school-zone improvement grants.

Additionally, federal programs organised by the Ministry of Transport, the Ministry of Local Government Development, or the Ministry of Education can be appointed to support large-scale projects, such as the redesign of roads around school zones, the construction of a pedestrian bridge, if appropriate, and the enhancement of traffic-calming infrastructure. Sustainable funding is crucial, as integrating child pedestrian safety into national planning frameworks and local transport plans requires a long-term budget commitment.

7.6.2 Private Sector and Corporate Social Responsibility (CSR) Contributions

Another funding source is the private sector and CSR contributions, which provide valuable complementary funding. Companies operating in or near school communities can contribute resources, whether in the form of financial or in-kind support. The involvement of companies requires supporting small-scale walking infrastructure, contributing to community awareness programs, or providing safety equipment specifically for walking schoolchildren.

Additionally, partnerships with businesses in sectors such as construction, banking, or telecommunications can help sponsor safe routes, fund school-based reward programs, or provide branded educational materials to encourage schoolchildren to practise active commuting. Additionally, as tokens, developers and private transport providers involved in delivering pedestrian facilities in that school zone may also be required to allocate a portion of project profits toward enhancing local mobility improvements as part of regulatory compliance or planning approvals. It was believed that involving various stakeholders with distinct initiatives could contribute to sustainable funding and ensure that pedestrian facilities are consistently maintained.

7.6.3 Community-Based Funding Initiatives

The initiative to engage the community in collecting funding sources not only supplements financial resources but also fosters a sense of ownership and stewardship among contributors. On the community side, residents, Parent-Teacher Associations (PTAs), and school boards can collaborate or run fundraising drives, organise awareness events, or apply for neighbourhood grants.

Small-scale initiatives, such as crowdfunding among parents and the community for shaded seating areas or mural painting along school routes, can enhance visibility and community pride while also engaging children in practising AST during their daily commute. Additionally, community engagement also increases the chances of long-term maintenance and monitoring of installed infrastructure.

In conclusion, a diversified funding strategy is crucial to ensure that child-friendly walking infrastructure can be implemented, maintained, and adapted over time. All stakeholders at every level, including policymakers, private partners, parents, and students, must contribute their resources and energy to build a walkable future for schoolchildren, thereby promoting an active, healthy lifestyle.

7.7 Policy Recommendations and Integration Strategies

A straightforward policy integration and strategic alignment with the current planning framework are crucial, ensuring the sustainability and scalability of child-friendly pedestrian environments. This section presents key recommendations to

enhance pedestrian safety and improve walkability for schoolchildren, and to incorporate them into local and national policy instruments.

First, this is achieved through integration into local development plans, which include provisions for safe pedestrian access to schools, as clearly outlined in regional planning documents such as the Local Plan, Structure Plan, and Special Area Plans. The recommendation may include zoning requirements to protect pedestrian walkways, prioritising walkway upgrades in school zones, and mentioning dedicated funding for child mobility projects. For the urban design guidelines adopted by local authorities, the document should include child-centric infrastructure standards, such as minimum sidewalk width, crossing designs, and visibility improvements, grounded in the principles outlined in this guideline.

Second, this idea can also be implemented through School Travel Plans (STPs). It is encouraged that each school develop a School Travel Plan (STP) in collaboration with local authorities, school administrators, and Parent-Teacher Associations (PTAs). The School Travel Plan must include identifying typical student travel patterns, assessing safety risks along school pedestrian routes, and proposing targeted measures such as supervised walking groups, redesigning pick-up/drop-off zones, and establishing preferred walking paths. This plan offers a structured, school-specific approach that can contribute to local planning and budgeting efforts. Support for implementing STP should be incorporated into district-level education policies and backed by training and resources from the local government.

Third, policy support at national and local levels is necessary to realise the idea. Relevant national ministries, including the Ministry of Transport, the Ministry of Education, and the Ministry of Local Government Development, should collaborate to issue cross-sectoral policies and guidelines that standardise and address the needs and characteristics of child pedestrians. This includes integrating pedestrian safety indicators into national performance frameworks, establishing school design standards, and making periodic safety assessments in school zones compulsory.

At the local level, the local authority should adopt regulations enforcing speed limits in school zones, mandate regular maintenance of walking facilities, and provide incentives to developers who contribute to walkability enhancements through planning approvals. By aligning enforcement, design, and funding, local governments can ensure that the safe walking journey to school remains consistently at the top of the priority list.

7.8 Conclusion

The production of these child-centric guidelines represents a significant step toward creating safer, more inclusive, and ultimately more engaging walking environments for primary schoolchildren. Based on extensive research, stakeholder input, and international best practices, this framework and guideline address the unique physical, cognitive, and behavioural needs of younger children, ensuring that this group is not treated as miniature adults, but as users with distinct requirements.

Suppose this framework and these guidelines are implemented holistically. In that case, the number of children walking to school is expected to increase, and they will commute safely and with greater confidence than in previous years. This idea will support the development of healthier lifestyles, reduce traffic congestion around schools, and contribute to environmental sustainability. Additionally, it encourages behavioural change, awareness, and stronger community bonds. Ultimately, it empowers children by providing a safer environment and enabling greater independence in their neighbourhoods.

Therefore, to realise the full impact of this guideline, a coordinated action is necessary. Stakeholders, including local authorities, urban planners, transport agencies, school administrators, and parents, must collaborate in prioritising the needs of young pedestrians in urban development. Adequate funding, political will and public awareness are necessary to ensure these recommendations can be realised. The school is a crucial medium for leading walking initiatives, supported by the community, and plays a key role in ensuring ongoing maintenance, safety monitoring, and a feedback mechanism.

Lastly, creating a safe, walkable, and child-friendly walking environment is not merely a transportation issue; rather, it is a social responsibility. In a nutshell, this framework invites all stakeholders mentioned to commit to a shared vision that encourages AST, while ensuring our children can walk to school safely and happily.

CHAPTER 8

CONCLUSION AND RECOMMENDATIONS

8.1 Introduction

This chapter presents the research context, beginning with a summary of the study, reflecting on each stage, and concluding with the findings derived from the research objectives and the overall contributions of the research. This chapter also suggests practical recommendations for future research. The goal is to highlight the importance of enhancing the walking environment for children, particularly for school travel in urban areas of Malaysia.

8.2 Research Summary

The research summary section provides a concise overview of the research process undertaken throughout the study, comprising four systematic stages. Each stage contributes to a comprehensive understanding of the factors influencing children's walking to school in Shah Alam City.

The stages consist of a preliminary study to establish the research foundation, followed by a mixed-methods approach to collect primary and secondary data. A thorough data analysis phase then uncovers key patterns and relationships among the variables. The final stage involves developing a child-centric walkability framework, accompanied by guidelines validated by experts and stakeholders. The following section provides a brief overview of each stage and its contribution to achieving the research objectives.

8.2.1 Stage 1: Preliminary Study

Stage 1 involved identifying the issues and problems and developing the study framework. At this stage, a critical review of the literature was conducted to understand international and local perspectives on AST, with a focus on walkability, pedestrian infrastructure provision, and safety concerns for children. The review identified research gaps, specifically the lack of child-specific pedestrian guidelines and the limited studies on walking behaviour among Malaysian schoolchildren.

The conceptual and methodological frameworks, grounded in the socio-ecological model and child-centric planning principles, were also developed during this stage. This step led to the formulation of research questions and objectives targeting several factors, including demographic and socio-economic characteristics, as well as built environment and safety aspects. The latter is the primary factor, with ancillary factors supporting it. This preliminary stage also involves assessing Shah Alam as the appropriate case study area, due to its diverse school zones and the planning initiatives under the Smart and Sustainable City initiative.

8.2.2 Stage 2: Mixed Method of Data Collection

The second stage employed a mixed-methods approach, gathering comprehensive data to answer the research questions. Both qualitative and quantitative data were used to triangulate the findings and enhance the reliability of the results. Four data collection methods were carried out.

First, a questionnaire survey was used, administered to 400 primary schoolchildren aged 7 to 12 from six schools across Shah Alam. All participants were those who walked to or from school at least twice a week. The survey gathered vital information on their travel modes, walking frequency, perceived safety, and the influence of the built environment.

Secondly, field observations were conducted in pedestrian environments around the six selected schools. The elements assessed during field observation include sidewalk conditions, crossing facilities, lighting, shades, obstructions and overall safety features.

Thirdly, semi-structured interviews were conducted with several stakeholders, including parents, school administrators, local authorities, and infrastructure providers. This study aims to understand the institutional roles in promoting AST, community perceptions, and the current challenges associated with this mode of travel.

Lastly, this study also uses secondary data, including current national and policy documents, design guidelines, and planning reports. This revision was conducted to assess the institutional and policy context of pedestrian planning in Malaysia and to contribute to the development of a child-centric framework and guidelines, building on existing applications.

8.2.3 Stage 3: Data Analysis and Research Findings

This study involved analysing the data collected, identifying critical factors, and automatically validating the research objectives specified earlier. Quantitative data from the questionnaire survey were analysed using both descriptive and inferential statistics to identify associations between walking behaviour and the primary factors. The findings revealed strong correlations between household income, gender, distance to school, and walking frequency. Boys, children from lower-income households, and those living closer to school were more likely to walk regularly.

Qualitative data from field observations and in-depth interviews were analysed thematically to identify recurring patterns and stakeholder concerns. These analyses highlighted safety as the predominant issue, followed by inadequate infrastructure maintenance, environmental conditions such as poor lighting and traffic exposure, and parental perceptions of danger. Observational evidence further confirmed physical deficiencies, including obstructed or discontinuous sidewalks and the lack of safe crossing points near school zones. The triangulated analysis provided complementary evidence that clarified both barriers and enabling factors for children walking to school, forming the empirical foundation for the following research stage.

8.2.4 Stage 4: Development of Framework, Guideline and Validation Process

Stage 4 is the final stage, focusing on synthesising the findings into practical, child-centric planning tools, as outlined in the guideline. At this stage, a framework was developed to guide stakeholders, comprising urban planners, local authorities, school administrators, and policymakers, in creating safe and walkable school environments.

This framework included child-centric design guidelines, such as appropriate sidewalk widths, traffic-calming elements, signage, accessibility features, and ancillary pedestrian elements. This framework also outlines a multi-level stakeholder engagement model based on the Quadruple Helix, comprising government, academia, industry, and community.

A guideline was drafted based on international best practices and existing local guidelines deemed suitable for the study, and adapted to the Malaysian context. It was prepared in accordance with actionable design criteria and implementation phases,

considering planning, design, monitoring, and maintenance, and is tailored explicitly for school zones.

The final procedure, a validation process, was undertaken to validate the relevance and feasibility of the proposed framework and guidelines. Four experts representing local government, academia, industry, and community participated in the validation process. Their input was used to refine the components and ensure alignment with existing regulatory frameworks and community needs.

8.3 Reflection of Objective Achievement

This section elaborates on the key conclusion drawn from the study, in line with its research objectives. The study examined multiple dimensions influencing children's decisions to walk to school, including demographic and socioeconomic background, built environmental factors, and safety conditions. It highlights the need for child-sensitive planning guidelines. Thus, the conclusions reflect the triangulated findings from several data collection methods, including a questionnaire survey, field observations, and in-depth interviews.

8.3.1 Research Objective 1: To analyse the demographic, socio-economic characteristics and built environment factors that influence children's decision to walk to or from school.

The achievement of Research Objective 1 was addressed through the analyses presented in Chapters 4 and 5, which explored the influence of demographic and socio-economic characteristics, as well as built environment factors, on children's decisions to walk to or from school. The findings revealed that demographic characteristics, such as age, gender, and socio-economic status, play a vital role in shaping children's travel behaviour. Boys were more likely than girls to walk to school, possibly due to parental safety concerns and cultural norms. Also, children from lower-income households were more likely to walk, likely because transportation options were limited.

Besides, parental modelling of physical activity and attitudes toward walking significantly influenced children's decision to walk to school. It was observed that children whose parents regularly engaged in physical activity, often walking to school themselves, were more physically active.

On the other hand, proximity to school, the presence and quality of sidewalks, the availability of pedestrian crossings, and the overall walkability of the neighbourhood were identified as key enablers of walking to school from a built environment perspective. Conversely, long distances, poor footpath connectivity, lack of shade, and traffic congestion during peak hours were deterrents. It can be concluded that both social and spatial factors are crucial and must be considered when promoting equitable and safe AST among primary school children.

8.3.2 Research Objective 2: To assess the current provision and condition of pedestrian infrastructure and facilities in school zones.

The achievement of Research Objective 2 was addressed comprehensively in Chapter 5, which provided a detailed assessment of the current provision and condition of pedestrian infrastructure and facilities across the selected school zones in Shah Alam. Based on field observations carried out at six schools, the findings revealed significant inconsistencies and inadequacies in the provision of pedestrian infrastructure. However, at some schools, particularly those located in well-planned residential areas, the walkways were relatively safe and accessible, creating a good walking environment. However, the remaining schools lacked basic pedestrian amenities. The issues that are commonly discovered deficiencies include:

- Narrow, discontinuous, and obstructed sidewalks
- Poorly maintained pavements and damaged surfaces
- Faded or missing crosswalk markings
- Lack of signage, seating area, and lighting
- Absence of designated drop-off zones

Additionally, in some areas, informal street vendors, bus stops, and parked vehicles obstructed visibility along pedestrian paths, forcing children to walk along the roadway. These conditions not only discourage schoolchildren from participating in AST but also expose them to physical risk. Findings from field observations confirmed that the existing infrastructure does not adequately support walkability in school zones. This highlights the urgent need for standard guidelines that address children's physical, perceptual, and developmental characteristics.

8.3.3 Research Objective 3: To examine how environmental conditions, pedestrian behaviour, and infrastructure influence the safety of primary school children walking in Shah Alam.

The achievement of Research Objective 3 was realised through the comprehensive safety analysis in Chapter 6, which examined how environmental conditions, pedestrian behaviour, and infrastructure collectively influence the safety of primary school children walking in Shah Alam. Based on the safety analysis, it was found that a combination of physical, behavioural, and perceived safety factors shapes children's walking experiences. The key issues identified include:

- Unsafe and inconsistent crossing facilities, including faded markings, missing zebra crossings, and inadequate traffic-calming devices near school gates.
- High traffic volume and speed during school peak hours increases exposure risk to children, especially near drop-off and pick-up zones.
- Poorly maintained and obstructed walkways, such as discontinuous sidewalks, uneven surfaces, and obstructions caused by vendors or parked vehicles.
- Inadequate lighting and weak visibility, particularly in residential lanes and around school entrances, create perceived and actual safety concerns.
- Unsupervised and risky pedestrian behaviour, including jaywalking and sudden road entry, is often influenced by peer imitation and a lack of adult supervision.
- Environmental and social safety concerns, including limited surveillance, stray animals, and occasional incidents of harassment or petty crime in school areas.

Responses from parents and students in a questionnaire survey conducted indicated a strong perception of danger, particularly among girls and younger children. Most parents cited crime, traffic accidents, and a lack of supervision as reasons for not allowing their children to walk or bike to school.

Based on the analysis conducted, this study concluded that a multi-dimensional strategy is required to address pedestrian safety, combining infrastructure upgrades, behavioural change campaigns, and more vigorous enforcement of traffic regulations near schools.

8.3.4 Research Objective 4: To propose child-sensitive guidelines for effective pedestrian infrastructure and facility planning in school zones.

Research Objective 4 was achieved in Chapter 7, where evidence-based and child-sensitive guidelines were proposed to support the development of adequate pedestrian infrastructure and facilities in school zones. This draft was prepared to enhance walkability and safety for schoolchildren, drawing on both empirical findings and benchmarking against international best practices. These are among the recommendations stated in the guideline:

- Minimum sidewalk width appropriate for children
- Dedicated, marked pedestrian crossings at all school access points
- Incorporation of traffic calming devices such as raised crossings, zebra lines, and warning signs
- Provision of ancillary facilities like shade, rest areas, lighting, and fencing to guide child movement
- Integration of accessibility features to accommodate all children, including those with mobility challenges

Additionally, the chapter summarises the roles and responsibilities of each stakeholder group, including local authorities, school administrators, parents, and community organisations. This guideline was also prepared in accordance with a phased implementation framework. Each element is mapped to its corresponding phase, covering planning, design, monitoring, and maintenance, to ensure practicality and sustainability.

Ultimately, this study concludes that developing design guidelines must be grounded in a child-centric, evidence-based approach to create safer and more inclusive school zones that support children's health, independence, and well-being.

8.4 Research Contributions

This section highlights a meaningful contribution to the body of knowledge on AST and child-friendly urban planning in Malaysia. The research contributions can be categorised into four key areas: theoretical, practical, methodological, and policy-level contributions.

8.4.1 Contributions to the Body of Knowledge

This research develops the existing literature on children's travel and walking behaviour by combining physical, behavioural, and perceptual dimensions into an integrated framework. This study applies a socio-ecological model to Malaysian urban school zones, offering a nuanced understanding of how demographic and socio-economic characteristics, built environment factors, and safety aspects collectively shape walking behaviour among schoolchildren. In addition, this study develops the framework and guidelines that pivot on child-centric urbanism, emphasising the unique mobility needs of children in transport planning.

8.4.2 Practical Contributions for Urban Planners and Local Authorities

This study also classifies critical design deficiencies in school zone infrastructure. Thus, preparing actionable design guidelines personalised to children's characteristics ensures their safety and mobility. Urban planners and local authorities responsible for pedestrian planning can use and adapt the child-sensitive planning framework developed in this study to evaluate, prioritise, and improve pedestrian infrastructure in primary school areas. These practical contributions may support the development of safer, more inclusive, and more walkable environments, thereby encouraging primary school children to practice active travel to school.

8.4.3 Contributions for School Administrators and Communities

Rather than focusing on theoretical and practical aspects, this research also highlights the roles of schools, parents, and communities in supporting and encouraging safe walking to school. By understanding the barriers and enablers of walking to school

among schoolchildren, school administrators can collaborate with local authorities to implement awareness campaigns. Programs such as walking school buses and participatory planning initiatives can be implemented to engage students in practising active commuting to school. This idea may automatically encourage greater community engagement in maintaining pedestrian safety near schools.

8.4.4 Contributions for Policy Makers and Government Agencies

At the policy level, this research provides evidence-based justification for incorporating child-focused criteria into urban mobility policies, school development guidelines, and transportation safety programs, as outlined in the findings presented. The proposed guidelines, which include stakeholder roles and responsibilities outlined in Chapter 8, may serve as a reference for integrating inter-agency collaboration, particularly among local authorities, transport agencies, and education ministries. Additionally, this study aimed to support the national agenda of sustainable and inclusive urban development by promoting active commuting to school at the primary school level.

8.4.5 Methodological Contributions

Lastly, the contribution of this research lies in its methodology, which demonstrates the value of a mixed-methods approach. It combines questionnaire surveys, field observations, safety audits, and stakeholder interviews to capture both quantitative and qualitative dimensions of the research problem. The adaptation of child-centric principles, demonstrated through a checklist and a stakeholder-informed validation process, enhances the reliability and real-world relevance of the proposed framework and guidelines.

8.5 Novelty of the Study

Beyond the previously outlined contributions, this study introduces several novel aspects to the field of AST, particularly in the Malaysian urban context, that differentiate it from prior research.

First, an integrated analytical framework is developed that combines demographic, socio-economic, built environment, and safety factors to explain schoolchildren's walking behaviour. This comprehensive approach facilitates a holistic understanding of the interrelated determinants influencing AST, particularly in the Malaysian urban environment.

Second, this study advances theoretical application by integrating the Socio-Ecological Model (SEM) with Children's Independent Mobility (CIM), thereby providing a multi-level perspective that encompasses both behavioural and environmental influences on children's mobility. This integration establishes a structured framework for analysing school travel behaviour within real-world urban contexts.

Third, this study employs a mixed-methods design that integrates quantitative survey analysis (questionnaire), qualitative (stakeholder interviews), and structured field observations. Incorporating direct on-site assessments of pedestrian infrastructure in school zones yields empirical insights into environmental conditions and enhances the validity of the findings obtained.

Fourth, the study integrates user-centred perspectives by documenting the experiences and perceptions of schoolchildren and their parents and by gathering input from relevant stakeholders. This methodology ensures that the analysis accurately represents real-world conditions by considering the views and user requirements, thereby supporting more inclusive and practical planning outcomes.

This study presents a set of context-specific, child-sensitive planning and design guidelines for pedestrian infrastructure, particularly in school zones. These guidelines, tailored to the Malaysian context, aim to assist urban planners, practitioners and policymakers in enhancing walkability and safety for schoolchildren.

Overall, the primary contribution of this study is its integrated framework, rigorous methodological approach, inclusion of user perspectives, and the formulation of actionable planning guidelines.

8.6 Implications for Planning and Policy

Aspects	Proposed Guidelines	Implications
School Location Planning	<ul style="list-style-type: none"> Conduct walkability audits and safety risk assessments using reference to child-specific distance ranges. 300-400 meters for a 5–10-minute walk 	The findings highlight that distance is a key determinant of walking behaviour. Therefore, planners should prioritise the development of schools in residential neighbourhoods, ensuring they are within a walkable radius. This supports neighbourhood-based school planning and reduces dependency on motorised transport.
School Zone Design	<ul style="list-style-type: none"> Provide continuous sidewalks Provide a zebra crossing Provide universally accessible pedestrian bridges Provide universally accessible pedestrian bridges Enforce a 30 km/h speed limit in school zones 	The study demonstrates that safety and infrastructure quality significantly influence walking decisions. Thus, school zones must be designed with integrated pedestrian infrastructure, including continuous sidewalks, safe crossings, and traffic calming measures.
Policy and Approval Process	<ul style="list-style-type: none"> Provide pedestrian facilities considering the characteristics of the children. 	Local authorities should incorporate child-sensitive pedestrian criteria into planning approval processes to ensure that new school developments meet minimum walkability and safety standards.
Retrofitting Existing Schools	<ul style="list-style-type: none"> Conduct biannual walkability audits with parents/students; track KPIs; enable feedback reporting via schools or apps. Assign responsibility to councils or community teams; repair sidewalks, crossings, and signage promptly; involve CSR programs in beautification or upgrades. 	Existing school environments should be audited and upgraded based on the identified influencing factors, particularly regarding safety and infrastructure deficiencies.

8.7 Recommendations for Future Research

While this study has achieved its goal of identifying the factors influencing children's decisions to walk to school and pedestrian safety in school zones, several areas remain unanswered and require further research. Thus, several recommendations are proposed and should be considered in future research.

Firstly, future research should consider the case study area, including rural, peri-urban, and high-density urban school zones. This recommendation aims to capture a broader range of demographic and socio-economic backgrounds, as well as built environmental conditions and safety aspects in that particular area. Currently, this study focuses solely on the urban area, specifically Shah Alam City, and overlooks the broader range of settlement typologies. This is important for a better understanding of how geographic context influences children's preferences for walking to school and their walking behaviour. Not only should we consider the different urbanisation contexts, but we should also conduct a comparative analysis across school types, including government, private, and religious schools. This could reveal new behavioural or infrastructural patterns, contributing to more comprehensive findings.

Secondly, future research is encouraged to conduct longitudinal studies on children's walking behaviour. This study employed a cross-sectional design, meaning data were collected at a single point in time rather than over an extended period. Unlike cross-sectional studies, a longitudinal research design examines how changes in infrastructure, school policies, or parental attitudes influence children's walking habits over time. Employing this approach may help assess the long-term impact of interventions or urban planning reforms.

Thirdly, it is recommended to incorporate participatory methods in research with children. The activities considered for this targeted group, such as drawing exercises, photo-voice, and mapping, aim to gain a deeper insight into children's perceptions, needs, and experiences regarding AST. The children's voices and preferences are crucial in creating a child-friendly walking environment and must be incorporated into planning processes, as this approach is genuinely responsive to their needs. As is usually the case nowadays, all the infrastructure used by children is designed according to adult preferences, without considering their unique characteristics, needs, and preferences, which affects their daily mobility to and from school.

Fourthly, future research should incorporate advanced analytical techniques to enhance the robustness of findings. For example, regression analysis can be used to examine relationships and predictive effects among variables influencing schoolchildren's walking behaviour. Also, correlation analysis can be used to examine the strength and direction of relationships among variables influencing children's walking behaviour. Additionally, Geographic Information System (GIS) analysis can be used to assess spatial patterns in school accessibility, the distribution of pedestrian infrastructure, and walkability. Integrating these analytical techniques would yield deeper insights into both behavioural and spatial dimensions of AST.

Lastly, future research should assess the effectiveness of existing policies and community-led programs aimed at enhancing pedestrian safety in school zones. This includes evaluating local pedestrian safety policies, traffic enforcement near schools, and walking-to-school campaigns. Assessing the implementation and outcomes of these initiatives can help refine existing policy frameworks and resource allocation strategies.

In summary, by building on the foundation of this study, future research can further strengthen the case, thereby ensuring a safe, walkable, and child-friendly school environment across Malaysia.

8.8 Final Concluding Remarks

This research examines the intricate web of factors influencing children's walking to school, focusing on their demographic and socioeconomic backgrounds, the pedestrian environment, and safety factors. By applying a mixed-methods approach during data collection, which included surveys, field observations, and stakeholder engagement through in-depth interviews, this research provided a detailed picture of the current challenges and opportunities of active school commuting among primary schoolchildren in urban Malaysia.

Based on the various analyses conducted, the findings revealed that children's decision to walk to or from school is shaped not only by physical infrastructure (e.g., sidewalks, crossings, and traffic controls) but also by behavioural patterns, parental perceptions, and demographic and socio-economic backgrounds. Despite various government efforts to promote walkability and child safety in school zones, there remains a lack of infrastructure and planning that are sensitive to enhancing safety and independent walking among schoolchildren.

In response to these issues, this study developed a child-sensitive planning framework and design guidelines to assist stakeholders in creating more inclusive pedestrian environments in school zones. This framework and set of guidelines were prepared based on the findings from the entire study. This draft was validated by four multi-level stakeholders, representing government, academia, industry, and community, based on the Quadruple Helix. The guideline was intended to support decision-makers at multiple levels throughout the pedestrian planning process, from policy to implementation.

Ultimately, this research confirms that creating walkable school zones requires not only design and infrastructure but also a multidisciplinary effort and collaboration among government, schools, and the community. By addressing the safety, accessibility, and inclusivity of the walking environment, we can cultivate healthier, more sustainable urban mobility habits for future generations.

REFERENCES

- Abdullah, Y. A., Jamaluddin, N. B., Yakob, H., Hassan, M. A., Nasrudin, N., Yusup, M., Ahmad Zaki, Z., & Zanudin, K. (2022). Urban Governance Approaches for Low-Carbon Cities. The Case of Shah Alam Local Government, Malaysia. *Journal of the Malaysian Institute of Planners*, 20, 311–330.
- Ahmed, S., Adnan, M., Janssens, D., & Wets, G. (2020). A Route to School Informational Intervention for Air Pollution Exposure Reduction. *Sustainable Cities and Society*, 53. <https://doi.org/10.1016/j.scs.2019.101965>
- AIP Foundation. (2025). *Safe School Zones Guide*.
- Arizona Department of Health Services. (2010). *Active School Neighbourhood Checklist (ASNC) Assessment Tool*.
- Bakhtiar, I. S., Mokhtar, S., & Hussein, M. Z. S. (2022). Pedestrian Infrastructure Quality of Service In Urban Neighbourhood: A Case Study in Wangsa Maju, Kuala Lumpur, Malaysia. *Civil and Sustainable Urban Engineering*, 2(1), 1–11. <https://doi.org/10.53623/csue.v2i1.57>
- Basu, N., Oviedo-Trespalacios, O., King, M., Kamruzzaman, M., & Haque, M. M. (2023). What do pedestrians consider when choosing a Route? The Role of Safety, Security, and Attractiveness Perceptions and the Built Environment during Day and Night Walking. *Cities*, 143. <https://doi.org/10.1016/j.cities.2023.104551>
- Bivina G.R., Purnima Parida, Mukti Advani, & Manoranjan Parida. (2018). Pedestrian Level of Service Model for Evaluating and Improving Sidewalks from Various Land Uses. *European Transport*, 2(67), 1–18.
- Brindley, C., Hamrik, Z., Kleszczewska, D., Dzielska, A., Mazur, J., Haug, E., Kopcakova, J., Marques, A., Altenburg, T., Demetriou, Y., & Bucksch, J. (2023). Gender-Specific Social and Environmental Correlates of Active Travel to School in Four European Countries: the HBSC Study. *Frontiers in Public Health*, 11, 1. <https://doi.org/10.3389/fpubh.2023.1190045>
- Brophy, S., Cooksey, R., Lyons, R. A., Thomas, N. E., Rodgers, S. E., & Gravenor, M. B. (2011). Parental factors associated with walking to school and participation in organised activities at age 5: Analysis of the Millennium Cohort Study. *BMC Public Health*, 11. <https://doi.org/10.1186/1471-2458-11-14>
- Carver, A., Panter, J. R., Jones, A. P., & van Sluijs, E. M. F. (2014). Independent Mobility on the Journey to School: A Joint Cross-sectional and Prospective

- Exploration of Social and Physical Environmental Influences. *Journal of Transport and Health*, 1(1), 25–32. <https://doi.org/10.1016/j.jth.2013.12.003>
- Castro-Lemus, N., Romero-Blanco, C., García-Coll, V., & Aznar, S. (2021). Gender-Differentiated Analysis of the Correlation between Active Commuting to School vs Active Commuting to Extracurricular Physical Activity Practice during Adolescence. *International Journal of Environmental Research and Public Health*, 18(11), 1–8. <https://doi.org/10.3390/ijerph18115520>
- Ceccato, V., & Loukaitou-Sideris, A. (2022). Fear of Sexual Harassment and Its Impact on Safety Perceptions in Transit Environments: A Global Perspective. *Violence Against Women*, 28(1), 26–48. <https://doi.org/10.1177/1077801221992874>
- Chillón, P., Panter, J., Corder, K., Jones, A. P., & Van Sluijs, E. M. F. (2015). A longitudinal study of the distance that young people walk to school. *Health and Place*, 31, 133–137. <https://doi.org/10.1016/j.healthplace.2014.10.013>
- Creswell, J. W., & David Creswell, J. (2018). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (Fifth Edition). SAGE Publications. Inc.
- Delice, Y., Özen, H., & Amirnazmiasfar, E. (2019). Analysing Modal Shift Based on Critical Travel Time for Different Trip Purposes in a Medium-Sized City. *International Conference on Transportation and Development*, 269–279.
- Ding, P., & Feng, S. (2022). How School Travel Affects Children’s Psychological Well-Being and Academic Achievement in China. *International Journal of Environmental Research and Public Health*, 19(21). <https://doi.org/10.3390/ijerph192113881>
- Dowling, L., Arthurs-Hartnett, S., Ortegon-Sanchez, A., Lewer, D., Hutton, A., James, R., Smith, A., Bates, E., Jones, S., Christie, N., & McEachan, R. R. C. (2025). The Effect of a School Street Intervention on Children’s Active Travel, Satisfaction with their Street, and Perception of Road Safety: A Natural Experimental Evaluation. *BMC Public Health*, 25(1). <https://doi.org/10.1186/s12889-025-23236-8>
- Duncan, M. J., Al-Nakeeb, Y., Woodfield, L., & Lyons, M. (2007). Pedometer-determined physical activity levels in primary school children from central England. *Preventive Medicine*, 44(5), 416–420. <https://doi.org/10.1016/j.ypmed.2006.11.019>
- Economic Planning Unit. (2021). *Twelfth Malaysia Plan 2021-2025*.

https://pulse.icdm.com.my/wp-content/uploads/2021/09/Twelfth-Plan-Document_compressed-1.pdf

- Ellizar, E., Larastiti, S., Titis, E. B., Mulyana, W., & Kurniawan, C. (2023). Youth Participation in School Safety Zones Assessment: A Case Study in Indonesia. *Journal of Road Safety*, 34(2). <https://doi.org/10.33492/JRS-D-22-00033>
- Fin, L. S., Mohd Suhaimi, N. N., Mohmood Nor, N. A. A., & Abdul Ghani, A. H. (2019). Road Safety Case Studies: Safe Pedestrian Behaviours among Children Aged 7 to 9 in Malaysia. *Journal of the Australasian College of Road Safety*, 30(2).
- Frisbee, N. C. (2024). *Pathways to Active School Travel: The Influence of Individual, Sociodemographic, and School Neighbourhood Factors* [Western University]. <https://ir.lib.uwo.ca/etdhttps://ir.lib.uwo.ca/etd/10189>
- Fyhri, A., & Hjorthol, R. (2009). Children's independent mobility to school, friends and leisure activities. *Journal of Transport Geography*, 17(5), 377–384. <https://doi.org/10.1016/j.jtrangeo.2008.10.010>
- Gebremariam, D., Kuhilen, T., Seboka, H., & Grum, B. (2024). Effect of Sidewalk Design and Obstructions on Pedestrian Mobility: A Case Study of the Main Streets of Mekelle City, Northern Ethiopia. *Advances in Civil Engineering*, 2024. <https://doi.org/10.1155/2024/5672280>
- Gemmell, E., Ramsden, R., Brussoni, M., & Brauer, M. (2023). Influence of Neighbourhood Built Environments on the Outdoor Free Play of Young Children: a Systematic, Mixed-Studies Review and Thematic Synthesis. *Journal of Urban Health*, 100(1), 118–150. <https://doi.org/10.1007/s11524-022-00696-6>
- González-Gómez, K., & Castro, M. (2019). Evaluating pedestrians' safety on Urban Intersections: A Visibility Analysis. *Sustainability (Switzerland)*, 11(23), 1–16. <https://doi.org/10.3390/su11236630>
- Guliani, A., Mitra, R., Buliung, R. N., Larsen, K., & Faulkner, G. E. J. (2015). Gender-based differences in school travel mode choice behaviour: Examining the relationship between the neighbourhood environment and perceived traffic safety. *Journal of Transport and Health*, 2(4), 502–511. <https://doi.org/10.1016/j.jth.2015.08.008>
- Guzauskas, D., & Sukys, S. (2019). A Critical Study of Interventions to Increase Physical Activity of Children. *Society, Integration, Education. Proceedings of the International Scientific Conference*, 4, 163–173. <https://doi.org/10.17770/sie2019vol4.3964>

- Hamdan, N. F. N. M., Ponrahono, Z., & Sabri, S. A. M. (2025). Characteristics and Strategic Implementation of Low-Carbon Initiatives in Shah Alam, Selangor, Malaysia: Insights from Key Stakeholders. *Journal of the Malaysian Institute of Planners*, 23(1), 202–214.
- Harumain, Y. A. S., Koting, S., Rosni, N. A., & Ibrahim, N. (2022). The Influence of Sociodemographic Background on Active Transportation: A Case Study of Bangsar and Shah Alam, Malaysia. *Frontiers in Built Environment*, 8. <https://doi.org/10.3389/fbuil.2022.925956>
- Hatamzadeh, Y. (2020). A walking mode choice analysis of school trips across morning and afternoon period students in Rasht, Iran: Does it matter? *Transportation Research Procedia*, 48, 3431–3438. <https://doi.org/10.1016/j.trpro.2020.08.111>
- Hawley, G., Witten, K., Hosking, J., Mackie, H., & Smith, M. (2019). The Journey to Learn: Perspectives on Active School Travel from Exemplar Schools in New Zealand. *Journal of Transport and Health*, 14, 1–13. <https://doi.org/10.1016/j.jth.2019.100600>
- Herrador-Colmenero, M., Cadenas-Sánchez, C., Labayen, I., Muntaner-Mas, A., Moliner-Urdiales, D., Lozano-Berges, G., Benito, P. J., Rodríguez-Pérez, M. A., Delgado-Alfonso, Á., Sanchís-Moysi, J., Martínez-Vizcaíno, V., & Chillón, P. (2021). Patterns of Active Commuting to School in Spanish Preschool Children and its Associations with Socio-economic Factors: The PREFIT Project. *International Journal of Environmental Research and Public Health*, 18(21), 1. <https://doi.org/10.3390/ijerph182111180>
- Hillman, M., Adams, J., & Whitelegg, J. (1990). *One false move: a study of children's independent mobility*. PSI.
- Hosokawa, R., Fujimoto, M., & Katsura, T. (2023). Parental support for physical Activity and Children's Physical Activities: A Cross-sectional Study. *BMC Sports Science, Medicine and Rehabilitation*, 15(1). <https://doi.org/10.1186/s13102-023-00700-9>
- Huang, F. Y., & Huang, P.-C. (2025). Enhancing Urban Traffic Safety: An Evaluation of Taipei's Neighbourhood Traffic Environment Improvement Program. *ArXiv Preprint*. <https://doi.org/https://doi.org/10.48550/arXiv.2401.16752>
- Huang, W. Y., Feng, J., & Wong, S. H. (2024). Independent mobility and Physical Activity among Children Residing in an Ultra-dense Metropolis. *Translational Exercise Biomedicine*, 1(3–4), 236–243. <https://doi.org/10.1515/teb-2024-0006>

- Huppertz, C., Bartels, M., de Geus, E. J. C., van Beijsterveldt, C. E. M., Rose, R. J., Kaprio, J., & Silventoinen, K. (2017). The effects of parental education on exercise behaviour in childhood and youth: a study in Dutch and Finnish twins. *Scandinavian Journal of Medicine and Science in Sports*, 27(10), 1143–1156. <https://doi.org/10.1111/sms.12727>
- Ibrahim, N. M., Harumain, Y. A., & Rosni, N. A. (2024). Children's Independent Mobility to School in Malaysia. *Journal of the Malaysian Institute of Planners Volume*, 22(4), 141–155.
- Ison, J., Forsdike, K., Henry, N., Hooker, L., & Taft, A. (2025). "I will Try and Make Myself as Small as Possible": Women and Gender-Diverse People's Safety Work on Public Transport. *Violence Against Women*, 31(11), 2830–2852. <https://doi.org/10.1177/10778012241270279>
- Javadpoor, M., Soltani, A., Fatehnia, L., & Soltani, N. (2023). How the Built Environment Moderates Gender Gap in Active Commuting to Schools. *International Journal of Environmental Research and Public Health*, 20(2). <https://doi.org/10.3390/ijerph20021131>
- Jin, L., Lu, W., & Sun, P. (2022). Preference for Street Environment Based on Route Choice Behaviour While Walking. *Frontiers in Public Health*, 10. <https://doi.org/10.3389/fpubh.2022.880251>
- Johnson, A. M., Zhou, C., Haviland, M., & Mendoza, J. A. (2024). Evaluation of a Walking School Bus Program: A Cluster Randomised Controlled Trial. *International Journal of Behavioral Nutrition and Physical Activity*, 21(1). <https://doi.org/10.1186/s12966-024-01602-w>
- Johnson, K., Jones, M., & Riveron, N. (2024). *Making Strides - 2024 State Report Cards*.
- Juul, V., & Nordbø, E. C. A. (2023). Examining Activity-friendly Neighborhoods in the Norwegian Context: Green Space and Walkability in Relation to Physical Activity and the Moderating Role of Perceived Safety. *BMC Public Health*, 23(1). <https://doi.org/10.1186/s12889-023-15170-4>
- Kasraian, D., Adhikari, S., Kossowsky, D., Luubert, M., Hall, G. B., Hawkins, J., Nurul Habib, K., & Roorda, M. J. (2021). Evaluating Pedestrian Perceptions of Street Design with a 3D Stated Preference Survey. *Environment and Planning B: Urban Analytics and City Science*, 48(7), 1787–1805. <https://doi.org/10.1177/2399808320946050>

- Kingsly, A., Timperio, A., Veitch, J., Salmon, J., Pradeepa, R., Ranjani, H., & Anjana, R. M. (2020). Individual, Social and Environmental Correlates of Active School Travel among Adolescents in India. *International Journal of Environmental Research and Public Health*, 17(20), 1–12. <https://doi.org/10.3390/ijerph17207496>
- Kontou, E., McDonald, N. C., Brookshire, K., Pullen-Seufert, N. C., & LaJeunesse, S. (2020). U.S. Active School Travel in 2017: Prevalence and Correlates. *Preventive Medicine Reports*, 17. <https://doi.org/10.1016/j.pmedr.2019.101024>
- Kumar. R. (2019). *Research Methodology - A Step-by-Step Guide for Beginners* (Fifth Edition). SAGE Publications Ltd.
- Kweon, B. S., Shin, W. H., & Ellis, C. D. (2023). School Walk Zone: Identifying Environments That Foster Walking and Biking to School. *Sustainability (Switzerland)*, 15(4). <https://doi.org/10.3390/su15042912>
- Lam, H. Y., Jayasinghe, S., Ahuja, K. D. K., & Hills, A. P. (2023). Active School Commuting in School Children: A Narrative Review of Current Evidence and Future Research Implications. *International Journal of Environmental Research and Public Health*, 20(20), 1–20. <https://doi.org/10.3390/ijerph20206929>
- Larouche, R., Mammen, G., Rowe, D. A., & Faulkner, G. (2018). Effectiveness of active school transport interventions: A systematic review and update. *BMC Public Health*, 18(1). <https://doi.org/10.1186/s12889-017-5005-1>
- Lavergne, V., Butler, G., Prince, S. A., & Contreras, G. (2023). Associations between School-level Environment and Individual-level Factors of Walking and Cycling to School in Canadian Youth. *Preventive Medicine Reports*, 36. <https://doi.org/10.1016/j.pmedr.2023.102489>
- Laverty, A. A., Hone, T., Goodman, A., Kelly, Y., & Millett, C. (2021). Associations of Active Travel with Adiposity among Children and Socioeconomic Differentials: A Longitudinal Study. *BMJ Open*, 11(1). <https://doi.org/10.1136/bmjopen-2019-036041>
- Levenson Boodlal. (2003). *Accessible Sidewalks and Street Crossings - An Informational Guide*. U.S. Department of Transportation. <https://www.mendeley.com/reference-manager/reader/009eae20-524d-303b-b232-9b8a7f9f0291/63a89a5c-a188-ff4f-132f-d15c06004037>
- Masoumi, H., Rooijen, M. van, & Sierpiński, G. (2020). Children's Independent Mobility to School in Seven European Countries: A Multinomial Logit Model.

- International Journal of Environmental Research and Public Health*, 17(23).
<https://doi.org/10.3390/ijerph17239149>
- Maulida, R., Goel, R., Labib, S. M., Oni, T., & van Sluijs, E. M. (2023). Environmental correlates of Adolescent Active Travel to School in Asia: An Ecological Study. *Health and Place*, 81. <https://doi.org/10.1016/j.healthplace.2023.103024>
- McDonald, N. C. (2012a). Is There a Gender Gap in School Travel? An Examination of US Children and Adolescents. *Journal of Transport Geography*, 20(1), 80–86. <https://doi.org/10.1016/j.jtrangeo.2011.07.005>
- McDonald, N. C. (2012b). Is there a gender gap in school travel? An examination of US children and adolescents. *Journal of Transport Geography*, 20(1), 80–86. <https://doi.org/10.1016/j.jtrangeo.2011.07.005>
- McDonald, N. C., Yang, Y., Abbott, S. M., & Bullock, A. N. (2013). Impact of the Safe Routes to School program on walking and biking: Eugene, Oregon study. *Transport Policy*, 29, 243–248. <https://doi.org/10.1016/j.tranpol.2013.06.007>
- McLeod, S. (2024). *How to Present Thematic Analysis Results*. <https://doi.org/10.13140/RG.2.2.18799.96160>
- McMillan, T., Day, K., Boarnet, M., Alfonzo, M., & Anderson, C. (2006). Johnny Walks to School - Does Jane? Sex Differences in Children's Active Travel to School. *Children, Youth and Environments*, 16(1), 75–89. <http://www.colorado.edu/journals/cye/>.
- McMillan, T. E. (2007). The Relative Influence of Urban Form on a Child's Travel Mode to School. *Transportation Research Part A: Policy and Practice*, 41(1), 69–79. <https://doi.org/10.1016/j.tra.2006.05.011>
- Mehdizadeh, M., Mamdoohi, A. R., & Nordfjaern, T. (2017). Walking time to school, children's active school travel and their related factors. *Journal of Transport and Health*, 6, 313–326. <https://doi.org/10.1016/j.jth.2017.01.012>
- Meneses, N. A. I., & Buluran, J. S. (2022). Analysis of Pedestrian Performance by Integrating both Quantitative and Qualitative Factors. *Civil Engineering Journal (Iran)*, 8(6), 1100–1114. <https://doi.org/10.28991/CEJ-2022-08-06-02>
- Michail, N., Ozbil, A., Parnell, R., & Wilkie, S. (2021). Children's Experiences of Their Journey to School: Integrating Behaviour Change Frameworks to Inform the Role of the Built Environment in Active School Travel Promotion. *International Journal of Environmental Research and Public Health*, 18(9). <https://doi.org/10.3390/ijerph18094992>

- Mitra, R. (2013). Independent Mobility and Mode Choice for School Transportation: A Review and Framework for Future Research. *Transport Reviews*, 33(1), 21–43. <https://doi.org/10.1080/01441647.2012.743490>
- Muhammad, S. N. (2015). *Tahap Keselamatan Pejalan Kaki dalam Kalangan Pelajar Sekolah: Kajian Kes di Sekolah-sekolah Terpilih di Wilayah Persekutuan Kuala Lumpur dan Kelantan*. Universiti Pendidikan Sultan Idris.
- Mulyadi, M., A., Verani Rouly Sihombing, A., Hendrawan, H., Vitriana, A., & Nugroho, A. (2022). Walkability and Importance Assessment of Pedestrian Facilities on Central Business District in Capital City of Indonesia. *Transportation Research Interdisciplinary Perspectives*, 16. <https://doi.org/10.1016/j.trip.2022.100695>
- Muromachi, Y. (2017). Experiences of Past School Travel Modes by University Students and their Intention of Future Car Purchase. *Transportation Research Part A: Policy and Practice*, 104, 209–220. <https://doi.org/10.1016/j.tra.2017.01.026>
- Murphy, M. H., O’Kane, S. M., Carlin, A., Lahart, I. M., Doherty, L. C., Jago, R., McDermott, G., Faulkner, M., & Gallagher, A. M. (2024a). Effectiveness of the Walking in Schools (WISH) Study, a Peer-led Walking Intervention for Adolescent Girls: Results of a Cluster Randomised Controlled Trial. *International Journal of Behavioral Nutrition and Physical Activity*, 21(1). <https://doi.org/10.1186/s12966-024-01563-0>
- Nasrudin, N., Khalid, N. S., Abdullah, Y. A., Marzukhi, M. A., & Lim, S. B. (2023). Model of Pedestrian Crossing Behaviour based on Road Traffic and Human Factors: A Case Study of Malaysia’s Shah Alam City. *Journal of the Malaysian Institute of Planners*, 21(5), 32–47.
- Nguyen, H., Christian, H., Le, H., Connelly, L., Zubrick, S. R., & Mitrou, F. (2022). Causal Impact of Physical Activity on Child Health and Development.
- Nyström, M., Henriksson, M., Lindqvist, A. K., & Rutberg, S. (2023). Making the Right Decision for our Children’s Future: Parents’ Perceptions of Active School Travel in Disadvantaged Neighborhoods. *Journal of Transport and Health*, 30, 1–10. <https://doi.org/10.1016/j.jth.2023.101617>
- NZ Transport Agency. (2009). *Pedestrian Planning and Design Guide*. NZ Transport Agency.
- Orellana, D., Hermida, C., Quezada, A., Andrade, J., & Ballari, D. (2024). Children’s Active Mobility to School: Evidence from Two Andean Cities. *Sustainability*

- (Switzerland), 16(7). <https://doi.org/10.3390/su16072745>
- Oreskovic, N. M., Blossom, J., Robinson, A. I., Chen, M. L., Uscanga, D. K., & Mendoza, J. A. (2014). The influence of the Built Environment on Outcomes from a “Walking School Bus Study”: A Cross-sectional Analysis using a Geographical Information System. *Geospatial Health*, 9(1), 37–44. <https://doi.org/10.4081/gh.2014.4>
- Osuret, J., Van Niekerk, A., Kobusingye, O., Atuyambe, L., & Nankabirwa, V. (2024). Child Pedestrian Crossing Behaviour and Associated Risk Factors in School Zones: A Video-based Observational Study in Kampala, Uganda. *Injury Prevention*, 30(3), 216–223. <https://doi.org/10.1136/ip-2023-044932>
- Ozbil, A., Yesiltepe, D., Argin, G., & Rybarczyk, G. (2021). Children’s active school travel: Examining the combined perceived and objective built environment factors from space syntax. *International Journal of Environmental Research and Public Health*, 18(1), 1–22. <https://doi.org/10.3390/ijerph18010286>
- Panter, J., Corder, K., Griffin, S. J., Jones, A. P., & van Sluijs, E. M. F. (2013). Individual, socio-cultural and environmental predictors of uptake and maintenance of active commuting in children: Longitudinal results from the SPEEDY study. *International Journal of Behavioral Nutrition and Physical Activity*, 10. <https://doi.org/10.1186/1479-5868-10-83>
- Panter, J. R., Jones, A. P., Van Sluijs, E. M. F., & Griffin, S. J. (2010). Attitudes, Social Support and Environmental Perceptions as Predictors of Active Commuting Behaviour in School Children. *Journal of Epidemiology and Community Health*, 64(1), 41–48. <https://doi.org/10.1136/jech.2009.086918>
- Patel, N., Nguyen, H.-H., van de Geest, J., Wagtendonk, A., Raju, M. J., Dadvand, P., de Hoogh, K., Cirach, M., Nieuwenhuijsen, M., Lam, T. M., & Lakerveld, J. (2025). *A Walk across Europe: Development of a High-resolution Walkability Index*. <http://arxiv.org/abs/2504.17897>
- Patton, M. Q. (1999). Enhancing the Quality and Credibility of Qualitative Analysis. *HSR: Health Services Research*, 34(5), 1189–1208.
- Pinkerton, B., Rosu, A., Janssen, I., & Pickett, W. (2013). Active Transportation Safety Features around Schools in Canada. *International Journal of Environmental Research and Public Health*, 10(11), 5711–5725. <https://doi.org/10.3390/ijerph10115711>
- Pont, K., Ziviani, J., Wadley, D., & Abbott, R. (2011). The Model of Children’s Active

- Travel (M-CAT): A Conceptual Framework for Examining Factors Influencing Children's Active Travel. *Australian Occupational Therapy Journal*, 58(3), 138–144. <https://doi.org/10.1111/j.1440-1630.2010.00865.x>
- Pont, K., Ziviani, J., Wadley, D., Bennett, S., & Abbott, R. (2009). Environmental correlates of children's active transportation: A systematic literature review. *Health and Place*, 15(3), 849–862. <https://doi.org/10.1016/j.healthplace.2009.02.002>
- Qi, J., Mazumdar, S., & Vasconcelos, A. C. (2024). Understanding the Relationship between Urban Public Space and Social Cohesion: A Systematic Review. *International Journal of Community Well-Being*, 7(2), 155–212. <https://doi.org/10.1007/s42413-024-00204-5>
- Qin, J., Feng, Y., Sheng, Y., Huang, Y., Zhang, F., & Zhang, K. (2025). Evaluation of Pedestrian-Perceived Comfort on Urban Streets Using Multi-Source Data: A Case Study in Nanjing, China. *ISPRS International Journal of Geo-Information*, 14(2), 1–24. <https://doi.org/10.3390/ijgi14020063>
- Ramlee, N., Abdul Hamid, N. H., Othmani, N. I., Wan Mohamad, W. S. N., Yeo, L. B., Mohamed, S. A., Zahari, Z., & Ramlee, M. F. (2024). Encouraging Factors of Walkability among Students in the Tropical Campus. *BIO Web of Conferences*, 131. <https://doi.org/10.1051/bioconf/202413103002>
- Rashid, Q., Zhang, A., & Mohd Nor, M. (2024). Pedestrian Priorities: Unraveling Walkability Challenges in Shah Alam's Neighborhoods. *International Journal of Environment, Architecture, and Societies*, 4(01), 37–49. <https://doi.org/10.26418/ijeas.2024.4.01.37-49>
- Reid, S., & Mash, B. (2014). African Primary Care Research: Qualitative Interviewing in Primary Care. *African Journal of Primary Health Care and Family Medicine*, 6(1), 1. <https://doi.org/10.4102/phcfm.v6i1.632>
- Riazi, N. A., Blanchette, S., Trudeau, F., Larouche, R., Tremblay, M. S., & Faulkner, G. (2019). Correlates of Children's Independent Mobility in Canada: A Multi-site Study. *International Journal of Environmental Research and Public Health*, 16(16). <https://doi.org/10.3390/ijerph16162862>
- Riazi, N. A., Wunderlich, K., Yun, L., Paterson, D. C., & Faulkner, G. (2022). Social-Ecological Correlates of Children's Independent Mobility: A Systematic Review. *International Journal of Environmental Research and Public Health*, 19(3). <https://doi.org/10.3390/ijerph19031604>

- Roberts, L. E., Bushover, B., Mehranbod, C. A., Gobaud, A. N., Fish, C., Eschliman, E. L., Gao, X., Zadey, S., & Morrison, C. N. (2024). Physical Environmental Roadway Interventions and Injury and Death for Vulnerable Road Users: a natural Experiment in New York City. *Injury Prevention*. <https://doi.org/10.1136/ip-2023-045219>
- Rosenberg, D. E., Sallis, J. F., Conway, T. L., Cain, K. L., & McKenzie, T. L. (2006). Active Transportation to School Over 2 Years in Relation to Weight Status and Physical Activity. *Obesity*, *14*, 1771–1776.
- Ruiz-Hermosa, A., Álvarez-Bueno, C., Cavero-Redondo, I., Martínez-Vizcaíno, V., Redondo-Tébar, A., & Sánchez-López, M. (2019a). Active Commuting to and from School, cognitive performance, and Academic Achievement in Children and Adolescents: A Systematic Review and Meta-analysis of Observational Studies. *International Journal of Environmental Research and Public Health*, *16*(10). <https://doi.org/10.3390/ijerph16101839>
- Saltarin-Molino, M. A., Moros-Daza, A., & Camacho-Sanchez, C. (2023). Taking Steps Forward: Innovative Evaluation of Pedestrian Infrastructure through a Multivariate Analysis. *Case Studies on Transport Policy*, *14*. <https://doi.org/10.1016/j.cstp.2023.101091>
- Sasayama, K. (2025). Contribution of Walking to and from School on Overall Physical Activity: A One-year Follow Up Study. *PLoS ONE*, *20*(3 March), 12. <https://doi.org/10.1371/journal.pone.0318355>
- Saunders, R. P., Dowda, M., Dishman, R. K., & Pate, R. R. (2024). A Longitudinal Examination of Direct and Indirect Influences of Parental Behaviors on Child Physical Activity. *Journal of Child and Family Studies*, *33*(7), 2262–2270. <https://doi.org/10.1007/s10826-024-02830-1>
- Schepers, P., van Loo, W., Mieras, W., Drolenga, H., de Waard, D., & Helbich, M. (2025). Built Environment Characteristics and Driving Speed in 30 Km/h Zones: A Dutch National Analysis. *Traffic Safety Research*, *9*. <https://doi.org/10.55329/dlam1892>
- Schoeppe, S., Duncan, M. J., Badland, H. M., Oliver, M., & Browne, M. (2014). Associations between Children's Independent Mobility and Physical Activity. *BMC Public Health*, *14*(1). <https://doi.org/10.1186/1471-2458-14-91>
- Schönbach, D. M. I., Brindley, C., Reimers, A. K., Marques, A., & Demetriou, Y. (2020). Socio-demographic correlates of cycling to school among 12-to 15-year-

- olds in Southern Germany. *International Journal of Environmental Research and Public Health*, 17(24). <https://doi.org/10.3390/ijerph17249269>
- Shabadin, A., Jamil, H. M., Poi, A., Hoong, W., Hamidun, R., Roslan, A., Nemmang, M. S., & Ishak, S. Z. (2022). Evaluation of School Children Crossing Facilities and Traffic Conflicts in The Vicinity of Schools in Selangor. *International Journal of Built Environment and Sustainability*, 9(3), 11–17. <https://doi.org/10.11113/ijbes>
- Shah Alam. (n.d.).
- Sharma, S. K., Mudgal, S. K., Gaur, R., Chaturvedi, J., Rulaniya, S., & Sharma, P. (2024). Navigating Sample Size Estimation for Qualitative Research. *Journal of Medical Evidence*, 5(2), 133–139. https://doi.org/10.4103/jme.jme_59_24
- Sharmin, S. (2020). The Impact of Built Environment on Children's Independent Mobility: A Comparative Analysis between Discretionary and Nondiscretionary Activities.
- Shaw, B., Bicket, M., Elliott, B., Fagan-Watson, B., Mocca, E., & Hillman, M. (2015). *Westminster Research Children's Independent Mobility: an international comparison and recommendations for action*. http://www.psi.org.uk/children_mobilityTheWestminsterResearchonlinedigitalarchiveattheUniversityof
- Shaw, B., Bicket, M., Elliott, B., Fagan-Watson, B., Mocca, E., Mayer Hillman, with Ben Shaw, Behrens, R., Björklid, P., Carver, A., Cordovil, R., Provi Drianda, R., Elias, W., Fotel, T., Frauendienst, B., Fyhri, A., Gummesson, M., Healy, M., Hirvonen, J., Yamashita, Y. (2015). Children's Independent Mobility: an international comparison and recommendations for action Children's Independent Mobility: an international comparison and recommendations for action was written.
- Sims, D., & Bopp, M. (2020). Using parental active travel behaviour and beliefs to predict active travel to school among children. *International Journal of Sustainable Transportation*, 14(5), 343–348. <https://doi.org/10.1080/15568318.2018.1558469>
- Sirard, J. R., Alhassan, S., Spencer, T. R., & Robinson, T. N. (2008). Changes in Physical Activity from Walking to School. *Journal of Nutrition Education and Behaviour*, 40(5), 324–326. <https://doi.org/10.1016/j.jneb.2007.12.002>
- SMR, S. A., J N., H N. Z., & R A. (2020). Drop-off and Pick-up Zone in Selected

- Primary Schools in Selangor. *International Journal of Academic Research in Progressive Education and Development*, 9(3). <https://doi.org/10.6007/ijarped/v9-i3/8261>
- Srivastava, A. K., Sharma, S., & Sahay, A. (2025). Determinants of Active Travel to School in Cities: A Systematic Review on Sustainable Travel. *Sustainable Communities*, 2(1). <https://doi.org/10.1080/29931282.2024.2449263>
- Su, J. G., Jerrett, M., McConnell, R., Berhane, K., Dunton, G., Shankardass, K., Reynolds, K., Chang, R., & Wolch, J. (2013). Factors influencing whether children walk to school. *Health and Place*, 22, 153–161. <https://doi.org/10.1016/j.healthplace.2013.03.011>
- Swami, M., Pathak, C., Swami, S., & Jeihani, M. (2024). Promoting Sustainable Mobility: A Walkability Analysis for School Zone Safety. *Sustainability (Switzerland)*, 16(20). <https://doi.org/10.3390/su16209118>
- Swedler, D. I., Ali, B., Hoffman, R., Leonardo, J., Romano, E., & Miller, T. R. (2024). Injury and Fatality Risks for Child Pedestrians and Cyclists on Public Roads. *Injury Epidemiology*, 11(1). <https://doi.org/10.1186/s40621-024-00497-2>
- Tewahade, S., Li, K., Goldstein, R. B., Haynie, D., Iannotti, R. J., & Simons-Morton, B. (2019). Association between the Built Environment and Active Transportation among U.S. Adolescents. *Journal of Transport and Health*, 15. <https://doi.org/10.1016/j.jth.2019.100629>
- Timperio, A., Duncan, S., Akram, M., Molina-García, J., Van Dyck, D., Barnett, A., Salonna, F., RM, A., Sallis, J. F., Vorlíček, M., Hinckson, E., Cain, K. L., Conway, T. L., Wan Muda, W. A. M., Moran, M., Oyeyemi, A. L., Pizarro, A., Reis, R. S., Rezwan, S. M., Cerin, E. (2025). Associations between Parental Perceptions of Neighbourhood Environments and Active Travel to School: IPEN Adolescent Study. *International Journal of Behavioral Nutrition and Physical Activity*, 22(1). <https://doi.org/10.1186/s12966-025-01738-3>
- Tristram, C., Marzi, I., Beck, F., Diehl, K., Renninger, D., Demetriou, Y., Krieger, C., & Reimers, A. K. (2024). Parental and Adolescents' Perspectives on Environmental Predictors of Active Commuting to School – Findings from the ARRIVE Mixed-methods Study. *Frontiers in Built Environment*, 10. <https://doi.org/10.3389/fbuil.2024.1494837>
- Uddin, R., Mandic, S., & Khan, A. (2019). Active Commuting to and from School among 106,605 Adolescents in 27 Asia-Pacific Countries. *Journal of Transport*

- and Health*, 15. <https://doi.org/10.1016/j.jth.2019.100637>
- Veitch, J., Carver, A., Salmon, J., Abbott, G., Ball, K., Crawford, D., Cleland, V., & Timperio, A. (2017). What predicts children's active transport and independent mobility in disadvantaged neighbourhoods? *Health and Place*, 44, 103–109. <https://doi.org/10.1016/j.healthplace.2017.02.003>
- Villanueva, K., Giles-Corti, B., Bulsara, M., McCormack, G. R., Timperio, A., Middleton, N., Beesley, B., & Trapp, G. (2012). How far do children travel from their homes? Exploring children's activity spaces in their neighbourhood. *Health and Place*, 18(2), 263–273. <https://doi.org/10.1016/j.healthplace.2011.09.019>
- Vincenten, J. A., Draisin, N., & Sengoelge, M. (2022). *Technical Guidance for Child and Adolescent Road Safety*. https://www.unicef.org/media/130721/file/UNICEF_Child_and_Adolescent_Road_Safety_Technical_Guidance_2022.pdf?utm_source
- Wang, J. Y. T., Wu, Z., Kang, Y., Brown, E., Wen, M., Rushton, C., & Ehrgott, M. (2023). Walking school bus line routing for efficiency, health and walkability: A multi-objective optimisation approach. *Journal of Multi-Criteria Decision Analysis*, 30(3–4), 109–131. <https://doi.org/10.1002/mcda.1803>
- Wang, Y., Liu, Y., Song, S., Gittelsohn, J., Ouellette, M., Ma, Y., & Wen, D. (2022). Individual, parental and Built Environmental Features as Influencing Factors of Active Travel to School in Northeast China: Findings from a Cross-sectional Study. *BMJ Open*, 12(1). <https://doi.org/10.1136/bmjopen-2020-047816>
- Wangzom, D. (2025). The Validity and Reliability of Perception of the Traffic Safety Survey Questionnaire for Active School Travel: A Pilot Study. *Green Health*, 1(3), 25. <https://doi.org/10.3390/greenhealth1030025>
- Wangzom, D., White, M., & Paay, J. (2023). Perceived Safety Influencing Active Travel to School - A Built Environment Perspective. *International Journal of Environmental Research and Public Health*, 20(2), 1–12. <https://doi.org/10.3390/ijerph20021026>
- Whitney, G., Sonya, P., Laurel, C., Enderle, J., King, L., O'Neil, D., & Li, Y. (2023). Systems-Level Evaluation of Safe Routes to School Policies in El Paso, Texas: A Modelling Study on Health and Economic Outcomes. *Family and Community Health*, 46(9), S22–S29. <https://doi.org/10.1097/FCH.0000000000000374>
- Xing, R., Rachele, J. N., Matolic, T., Loh, V., Cerin, E., Jiao, J., Huang, W. Y., & Pedisic, Z. (2025). Associations between Parental Perceptions of Neighbourhood

- Environment and Physical Activity in Children and Adolescents: A Systematic Review including 149 Studies. *International Journal of Behavioral Nutrition and Physical Activity*, 22(1). <https://doi.org/10.1186/s12966-025-01733-8>
- Zahidy, A. A., Sutanto, M. H., & Sorooshian, S. (2024). Examining the Relationship Between Road Service Quality and Road Traffic Accidents: A Case Study on an Expressway in Malaysia. *Traffic Safety Research: An Interdisciplinary Journal*, 8. <https://doi.org/10.55329/gzqy4926>
- Zhang, T., Li, M., Zhang, F., Yang, X., Sun, P., Yin, X., Liu, Y., & Guo, Y. (2025). Physical Activity in Adolescents of Different Family Socioeconomic Status: The Moderating Role of Gender. *Frontiers in Paediatrics*, 13. <https://doi.org/10.3389/fped.2025.1559554>
- Zhao, X., Li, J., Ma, J., & Rong, J. (2016). Evaluation of the Effects of School Zone Signs and Markings on Speed Reduction: A Driving Simulator Study. *SpringerPlus*, 5(1). <https://doi.org/10.1186/s40064-016-2396-x>
- Zhu, X., Lee, C., Yu, C.-Y., & Varni, J. (2014). *Active Living Research Annual Conference, March 11*. <http://sheepworkspublishing.com/>
- Zuo, J., Mu, T., Xiao, T. Y., & Luo, J. C. (2021). Evaluation of walking comfort in children's school travel at street scale: A case study in Tianjin (China). *International Journal of Environmental Research and Public Health*, 18(19). <https://doi.org/10.3390/ijerph181910292>

APPENDICES

APPENDIX 1
Questionnaire Survey Form

NO. SIRI

--	--	--

NAMA SEKOLAH: _____



UNIVERSITI TEKNOLOGI MARA

BORANG KAJI SELIDIK

TAJUK:
FAKTOR YANG MEMPENGARUHI KANAK-KANAK
BERJALAN KAKI KE SEKOLAH

PUSAT PENGAJIAN:
PUSAT PENGAJIAN SISWAZAH
KOLEJ ALAM BINA (KAB)
UNIVERSITI TEKNOLOGI MARA SHAH ALAM
SELANGOR DARUL EHSAN

KAWASAN KAJIAN:
SEKOLAH KEBANGSAAN SEKITAR SHAH ALAM

Objektif Kaji Selidik:

- Mengenalpasti latar belakang dan ciri-ciri murid yang berjalan kaki ke sekolah;
- Mengenalpasti faktor yang diambil kira murid yang berjalan kaki ke sekolah.

Responden yang dikasihi,

Anda diminta meluangkan sedikit masa bagi menjawab kaji selidik mengenai topik tersebut.

Borang kaji selidik ini perlu dijawab oleh murid bersama ibubapa atau penjaga.

Semua maklumat dari kaji selidik ini akan dirahsiakan

dan digunakan bagi tujuan akademik sahaja.

Kaji selidik ini akan mengambil masa
10 hingga 15 minit untuk dilengkapkan.

Terima kasih.

BAHAGIAN A: BUTIRAN PERIBADI MURID DAN IBU BAPA

Soalan 4 hingga 11 perlu dijawab oleh ibubapa atau penjaga.

Tandakan (/) di ruang yang sesuai.

1. Umur Murid

7 tahun	8 tahun	9 tahun	10 tahun	11 tahun	12 tahun

2. Jantina Murid

Lelaki	Perempuan

3. Bangsa Murid

Melayu	Cina	India	Lain-lain

Isikan jawapan di ruang berikut.

4. Ukuran Berat dan Tinggi Murid

Berat	_____ kg
Tinggi	_____ cm

Tandakan (/) di ruang yang sesuai.

5. Umur Ibu Bapa/ Penjaga

	Umur 26-30	Umur 31-40	Umur 41-50	Umur 50 Keatas
Ibu				
Bapa				
Penjaga				

6. Latar Belakang Pendidikan Tertinggi Ibu Bapa/ Penjaga

	Tiada Pendidikan Formal	Sekolah Rendah	Sekolah Menengah	Sijil/ Diploma/ Ijazah Sarjana Muda	Ijazah Sarjana / Doktor Falsafah
Ibu					
Bapa					
Penjaga					

7. Kelas Pekerjaan Ibu Bapa/ Penjaga

	Bekerja	Tidak Bekerja	Suri Rumah	Masih Belajar	Pesara
Ibu					
Bapa					
Penjaga					

8. Pendapatan Ibu Bapa/ Penjaga

	Ibu	Bapa	Penjaga
<RM2,500			
RM2,501-RM3,170			
RM3,171-RM3,970			
RM3,971-RM4,850			
RM4,851-RM5,880			
RM5,881-RM7,101			
RM7,101-RM8,700			
RM8,701-RM10,970			
RM10,971-RM15,040			
>RM15,041			

9. Status Lesen Memandu Ibu Bapa/ Penjaga

	Ibu	Bapa	Penjaga
Ada			
Tiada			

10. Bilangan Kenderaan di Rumah (*anda boleh tanda lebih dari satu jawapan*)

	Kereta	Motosikal	Van	Basikal	Tiada
Bilangan					

11. Kekerapan Ibu Bapa/ Penjaga Bersenam dalam Tempoh Seminggu

Tidak Bersenam	Kurang 1 jam	1-2 jam	2-3 jam	Lebih 3 jam

BAHAGIAN B: BUTIRAN PERJALANAN MURID BERJALAN KAKI KE SEKOLAH

Tandakan (/) di ruang yang sesuai. Anda boleh tanda lebih dari satu jawapan.

12. Saya pergi ke sekolah dengan

☐	berjalan kaki
☐	berbasikal
☐	menaiki kenderaan ibubapa
☐	menaiki pengangkutan awam (van sekolah / bas sekolah)

Isikan jawapan di ruang berikut.

13. Nyatakan Alamat Rumah Anda

Tandakan (/) di ruang yang sesuai.

14. Jarak dari Rumah ke Sekolah

Kurang 1km	2-3km	Lebih 3km

15. Tempoh Masa Berjalan Kaki ke Sekolah

Kurang 5 minit	6-10 minit	11-15 minit	Lebih 15 minit

16. Kekerapan berjalan kaki ke sekolah dalam tempoh seminggu

1-2 kali	3-4 kali	5 (setiap hari)

17. Dengan siapakah anda selalu berjalan kaki ke sekolah?

Kawan	Adik-beradik	Ibu bapa/ Penjaga	Berseorangan	Lain-lain

BAHAGIAN C: SIKAP DAN PERSEPSI

Tandakan (/) di ruang yang sesuai.

18. Berjalan kaki adalah kaedah pengangkutan yang saya akan gunakan dan cadangkan kepada orang lain.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

19. Saya suka berjalan kaki dari menaiki kenderaan.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

20. Berjalan kaki ke sekolah menjimatkan masa saya.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

21. Saya lebih suka berjalan kaki untuk pergi ke lokasi yang berdekatan jaraknya.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

22. Kawasan kejiranan saya selamat untuk pejalan kaki.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

23. Saya berasa lebih santai apabila berjalan kaki ke destinasi yang dituju.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

24. Berjalan kaki ke sekolah sangat menggembirakan saya.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

25. Berjalan kaki ke sekolah dapat menyihatkan tubuh badan saya.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

26. Berjalan kaki ke sekolah sangat mudah dan selesa.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

27. Saya berjalan kaki ke sekolah kerana jarak rumah ke sekolah adalah dekat.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

28. Cuaca panas tidak menghalang saya untuk berjalan kaki ke sekolah.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

29. Berjalan kaki ke sekolah tiada sebarang halangan.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

30. Ibu bapa/ penjaga menyuruh saya berjalan kaki ke sekolah.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

31. Pihak sekolah menggalakkan murid untuk berjalan kaki ke sekolah.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

BAHAGIAN D: INFRASTRUKTUR DAN KEMUDAHAN PEJALAN KAKI

Tandakan (/) di ruang yang sesuai

32. Adakah terdapat kemudahan pejalan kaki disediakan disepanjang perjalanan ke sekolah?

Tidak	Tidak pasti	Ya, di kawasan tertentu	Ya, disepanjang jalan	Tidak berkaitan

33. Saya lebih suka berjalan kaki di atas rumput walaupun kemudahan pejalan kaki disediakan.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

34. Saya lebih suka berjalan kaki di atas jalan raya walaupun kemudahan pejalan kaki disediakan.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

35. Saya mengguna pakai kemudahan pejalan kaki yang disediakan.

Sangat kerap	Kadang-kadang	Tidak pasti	Jarang kali	Tidak pernah

36. Kemudahan pejalan kaki dijaga dengan baik dan bersih.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

37. Sumber pencahayaan di sepanjang laluan pejalan kaki adalah baik.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

38. Saya seronok menggunakan kemudahan pejalan kaki yang diselenggara dengan baik.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

39. Rekabentuk kemudahan pejalan kaki yang baik menjadikan aktiviti berjalan kaki menyeronokkan.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

40. Berjalan kaki selama 20 minit adalah sesuatu yang menggembirakan saya.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

41. Kemudahan pejalan kaki yang kotor dan rosak membuatkan saya tidak suka menggunakannya.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

42. Asap kenderaan di jalan raya mengganggu saya berjalan kaki di laluan pejalan kaki yang disediakan.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

BAHAGIAN E: ASPEK KESELAMATAN

Tandakan (/) di ruang yang sesuai.

43. Saya pernah diganggu oleh orang asing.

Sangat kerap	Kadang-kadang	Tidak pasti	Jarang kali	Tidak pernah

44. Saya pernah diserang haiwan liar di luar kawasan sekolah.

Sangat kerap	Kadang-kadang	Tidak pasti	Jarang kali	Tidak pernah

45. Saya pernah mendengar kejadian kes ragut berlaku di luar kawasan sekolah.

Sangat kerap	Kadang-kadang	Tidak pasti	Jarang kali	Tidak pernah

46. Terdapat jalan yang bahaya untuk dilalui dalam perjalanan ke sekolah.

Tidak	Tidak pasti	Ya, di kawasan tertentu	Ya, disepanjang jalan	Tidak berkaitan

47. Pemandu yang memandu kenderaan di jalan raya memandu dengan kelajuan maksima.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

48. Saya sentiasa berwaspada dengan kenderaan lain ketika berjalan kaki di laluan pejalan kaki.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

49. Saya berasa selamat berjalan bersendirian semasa pergi atau pulang dari sekolah.

Sangat tidak setuju	Tidak setuju	Tidak pasti	Setuju	Sangat setuju

50. Saya hampir dilanggar kenderaan yang sedang lalu lintas di jalan raya.

Sangat kerap	Kadang-kadang	Tidak pasti	Jarang kali	Tidak pernah

51. Saya pernah terlibat dalam kemalangan semasa dalam perjalanan pergi atau pulang dari sekolah.

Sangat kerap	Kadang-kadang	Tidak pasti	Jarang kali	Tidak pernah

52. Jalan di hadapan sekolah dikawal dengan baik oleh pengawal lalu lintas.

Sangat kerap	Kadang-kadang	Tidak pasti	Jarang kali	Tidak pernah

53. Tahap keselamatan bagi kemudahan pejalan kaki di luar sekolah anda.

Tidak selamat	Kurang selamat	Tidak pasti	Selamat	Sangat selamat

54. Saya tinggal di kawasan kejiranan yang selamat untuk berjalan kaki.

Sangat kerap	Kadang-kadang	Tidak pasti	Jarang kali	Tidak pernah

55. Jika jawapan anda sangat tidak setuju dan tidak setuju, pada pandangan anda, apakah masalah utama kawasan kejiranan anda tidak selamat untuk pejalan kaki?
(anda boleh tanda lebih dari satu jawapan)

Tiada lampu isyarat untuk pejalan kaki melintas	
Keadaan kemudahan pejalan kaki yang tidak elok (konduktiviti)	
Pemandu yang memandu kenderaan di kawasan kejiranan memandu dengan kelajuan maksimum	
Lintasan zebra tidak disediakan bagi memudahkan pejalan kaki melintas	
Tiada sumber pencahayaan yang mencukupi	
Kes jenayah ragut yang tinggi	
Ketiadaan penghadang pejalan kaki disediakan bagi mengasingkan laluan pejalan kaki dan jalan raya	
Lain-lain - Nyatakan:	
Tidak berkaitan	

Terima kasih atas respon anda.

APPENDIX 2

Observation and Inventory Survey Form

SITE OBSERVATION CHECKLIST: DESIGN CONSIDERATIONS

Space for pedestrians

- ❖ Footpaths at least 1.8m wide
- ❖ Footpaths outside schools should be wider, if possible, due to peak loading.
- ❖ Reduce street clutter.
- ❖ Is it possible to create space for cycling by making the street one way or restricting vehicular traffic during school opening and closing times (e.g. create a school street).
- ❖ Combine seating, landscaping, and street lighting to reduce the footprint.

Safe places to cross

- ❖ Consider additional visibility requirements for children.
- ❖ Provide crossings at pedestrian desire lines.
- ❖ Side Road Junction tightening with raised crossings/ continuous crossings/dished crossings (refer to NTA Active Travel Guidance Note on Low-Cost Junction Tightening Schemes) 1
- ❖ Reduce crossing distance/reduce radii.
- ❖ Provide crossing on all arms of junctions.
- ❖ Toucan/zebra crossings.
- ❖ Informal/courtesy crossings.
- ❖ No guardrail (as per DMURS).

Reduced traffic speeds

- ❖ Reduce carriageway width and corner radii.
- ❖ Use traffic management measures such as horizontal and vertical deflections.
- ❖ Use Vertical elements, such as trees, to narrow the perceived width of the road.
- ❖ Surface colour/texture changes.
- ❖ Consider periodic pinch points to reduce rat running and bring the speeds and volumes down to a level where cyclists can share the street (e.g., 30kph/<2000AADT).

Permeability shortcuts

- ❖ Look for attractive traffic-free shortcut access to schools (e.g. paths across parks/sports grounds).
- ❖ Shared paths for cycling and walking should be 4m wide and well-lit.
- ❖ Is it possible to provide/open a back entrance/gate with links through sports fields?
- ❖ Ideally, permeability links should be open to all, but if needed, gates could be time-limited and auto-controlled.
- ❖ Formalising informal links and desire lines (tracks in the grass).

Encourage Park 'n' stride

- ❖ Look for park 'n' stride locations within 600m (e.g. church car parks, supermarkets, local shops).
- ❖ Park 'n' stride can support local businesses.
- ❖ Ensure the route is safe from the car park to the school, including crossings.
- ❖ Discourage on-site or school-adjacent drop-off zones.

Landscaping and public realm improvements

- ❖ Street trees.
- ❖ Planting and rain gardens.
- ❖ Quick-build/mobile elements (e.g. planter's boxes).
- ❖ Footpath and carriageway materials.
- ❖ Quick-build footpath buildouts.

Key measurements to consider:

Width:

- ✓ Measure the width of the pedestrian walkway to ensure it is wide enough to accommodate pedestrians comfortably.
- ✓ It should have enough space for people to pass each other in both directions without feeling crowded.
- ✓ The recommended minimum width for a pedestrian walkway is typically around 1.5 to 2 meters, but this may vary depending on local regulations and specific needs.

Clearances:

- ✓ Measure the vertical clearances to determine if there are any obstructions such as tree branches, utility cables, or signs that could hinder the safe passage of pedestrians.
- ✓ To ensure safety, there should be a sufficient overhead clearance to prevent any accidental collisions.

Surface evenness:

- ✓ Assess the surface evenness of the walkway by measuring any deviations or irregularities.
- ✓ A level and smooth surface is essential to provide a comfortable walking experience for pedestrians, especially for those with mobility challenges.

Slope and gradient:

- ✓ Measure the slope and gradient of the walkway to ensure it is within acceptable limits.
- ✓ Pedestrian walkways should have gentle slopes to improve accessibility for people with disabilities, strollers, and other wheeled devices.
- ✓ The slope should typically not exceed a certain percentage, as dictated by local regulations.

Curvature:

- ✓ Assess the curvature of the walkway to ensure it follows a path that is logical and intuitive for pedestrians.
- ✓ Sharp turns or sudden changes in direction can be confusing and may disrupt the flow of pedestrian traffic.

Lighting:

- ✓ Evaluate the lighting conditions along the walkway.
- ✓ Measure the amount of illumination provided to ensure pedestrians have sufficient visibility, especially during nighttime or in low-light conditions.

Signage and markings:

- ✓ Evaluate the presence and visibility of signage, markings, and symbols along the walkway.
- ✓ Measure the readability and positioning of signs to ensure they provide clear instructions and information to pedestrians.

Note:

Remember, these measurements can serve as a starting point, and local regulations and guidelines may provide more specific requirements for pedestrian walkways in your area. Additionally, considering input from pedestrians and observing usage patterns can help identify any further improvements needed for the walkway.

Element	Standard	On-site
Width of the pathway	1.8m – 4m	
Width of the road		
Way of the road	One way or 2 ways	
Material of the pathway		
Material of the road		
Street lighting		
Distance between street lighting		
Covered / well-lit		
Obstacles		
Traffic speed		
Traffic volume		
Signage		
Zebra Crossing		
Speed Humps or Speed Bumps		
Patrol / Guard assists children to cross		
Traffic light		
Condition of pedestrian walkway		

APPENDIX 3

Interview Form - Local Authorities

Time:

Serial No.

--	--

Date:



**APP991 DOCTOR OF PHILOSOPHY
(BUILT ENVIRONMENT)**

**Influencing Factors of Children Walking to School
Case Study: Shah Alam City, Malaysia**

*Faktor-Faktor yang Mempengaruhi Kanak-kanak Berjalan Kaki ke Sekolah
Kajian Kes: Bandaraya Shah Alam, Malaysia*

LOCAL AUTHORITIES AND STAKEHOLDERS

The research is mainly for academic purposes only. Therefore, answers given will be treated as **confidential**. Respondents can answer in English or Bahasa Melayu.

Thank you.

INTERVIEW QUESTIONS

SOALAN TEMUBUAL

Instruction: Answer all the questions in the space provided.

Arahan: Jawab semua soalan pada ruangan yang telah disediakan.

Name: _____
Organization: _____
Position: _____
Education Level: _____
Years of Experiences: _____
Date of Response: _____

SECTION A: CURRENT PRACTICES

BAHAGIAN A: AMALAN SEMASA

- 1) What can you say about the practice of walking among schoolchildren in our country in general? *Apakah yang dapat anda katakan berkenaan dengan amalan berjalan kaki dalam kalangan murid sekolah di negara kita secara amnya?*

- 2) What is your opinion on the practice of active travel mode to school? Do you agree or disagree with this practice?

Apakah pendapat anda tentang amalan mod perjalanan aktif ke sekolah? Adakah anda bersetuju atau tidak dengan amalan ini?

- 3) In general, is the provision of pedestrian facilities outside the school grounds safe for students?

Secara amnya, adakah penyediaan kemudahan pejalan kaki di luar kawasan sekolah selamat untuk digunakan oleh murid sekolah?

- 4) Are there any complaints you received from people regarding the provision of pedestrian facilities? OR facilities are provided, but people refuse to use them.

Adakah terdapat sebarang aduan yang anda terima daripada orang ramai mengenai penyediaan kemudahan pejalan kaki? ATAU kemudahan telah disediakan, tetapi orang ramai enggan menggunakannya?

SECTION B: PROVISION OF PEDESTRIAN FACILITIES

BAHAGIAN B: PENYEDIAAN KEMUDAHAN PEJALAN KAKI

- 5) What standard elements need to be provided for every pedestrian facility?

Apakah elemen standard yang perlu disediakan untuk setiap kemudahan pejalan kaki?

- 6) What are the standard guidelines for providing pedestrian facilities in school areas?

Apakah garis panduan selaras yang digunakan semasa menyediakan kemudahan pejalan kaki di kawasan sekolah?

SECTION C: ISSUES AND CHALLENGES

BAHAGIAN C: ISU DAN CABARAN

- 7) What are the common issues and challenges the authorities face while providing pedestrian facilities?
Apakah isu dan cabaran biasa yang dihadapi oleh pihak berkuasa semasa menyediakan kemudahan pejalan kaki?

SECTION D: SUGGESTIONS

BAHAGIAN D: CADANGAN

- 8) Are there any additional insights on factors influencing children to walk to school?
Adakah terdapat sebarang pandangan tambahan tentang faktor yang mempengaruhi kanak-kanak untuk berjalan ke sekolah?

- 9) In your opinion, what are the approaches to encourage school children to use pedestrian facilities that already exist outside the school grounds?
Pada pendapat anda, apakah pendekatan untuk menggalakkan murid sekolah menggunakan kemudahan pejalan kaki yang sedia ada di luar kawasan sekolah?

- 10) In your opinion, what are the mechanisms for protecting the safety of children who use active transport to school?
Pada pendapat anda, apakah mekanisme untuk melindungi keselamatan kanak-kanak yang menggunakan pengangkutan aktif ke sekolah?

APPENDIX 4

Interview Form - School Representatives

Time:

Serial No.

Date:



**APP991 DOCTOR OF PHILOSOPHY
(BUILT ENVIRONMENT)**

**Influencing Factors of Children Walking to School
Case Study: Shah Alam City, Malaysia**

***Faktor-Faktor yang Mempengaruhi Kanak-kanak Berjalan Kaki ke Sekolah
Kajian Kes: Bandaraya Shah Alam, Malaysia***

SCHOOL REPRESENTATIVES

The research is mainly for academic purposes only. Therefore, answers given will be treated as **confidential**. Questions can be answered in English or Bahasa Melayu.

Thank you.

INTERVIEW QUESTIONS

SOALAN TEMUBUAL

Instruction: Answer all the questions in the space provided.

Arahan: Jawab semua soalan pada ruangan yang telah disediakan.

Name: _____
School Name: _____
Position: _____
Date of Response: _____

SECTION A: FACTORS INFLUENCING THE MODE OF TRANSPORT
SEKSYEN A: FAKTOR-FAKTOR YANG MEMPENGARUHI MOD PENGANGKUTAN

- 1) What is the most common mode of transport used by students to get to school?
Apakah mod pengangkutan utama yang digunakan oleh murid untuk ke sekolah?
-
-
-
- 2) In your view, what prevents students from walking to school?
Pada pandangan pihak sekolah, apakah halangan utama yang menyebabkan murid tidak berjalan kaki ke sekolah?
-
-
-
- 3) Do you think parents feel safe letting their children walk to school? Why or why not?
Adakah ibu bapa berasa selamat untuk membenarkan anak mereka berjalan kaki ke sekolah? Kenapa?
-
-
-

SECTION B: SAFETY CONCERNS
SEKSYEN B: KEBIMBANGAN ASPEK KESELAMATAN

- 4) Are there any safety concerns for students walking to school? (e.g., traffic, road crossing, stray dogs)
Adakah pihak sekolah menyedari sebarang isu keselamatan untuk murid yang berjalan kaki ke sekolah? (contohnya, trafik, lintasan jalan, anjing liar)
-
-
-
- 5) Have there been any past incidents involving students walking to school?
Pernahkah berlaku sebarang insiden yang melibatkan murid berjalan kaki ke sekolah?
-
-
-
- 6) Are there personnel, such as traffic wardens or RELA, to manage student safety during peak hours?
Adakah terdapat petugas seperti pengawal trafik atau RELA yang membantu keselamatan semasa waktu puncak?
-
-
-

- 7) How is the collaboration with local authorities regarding student safety?
Bagaimana kerjasama dengan pihak berkuasa tempatan dalam isu keselamatan murid?

SECTION C: PEDESTRIAN INFRASTRUCTURE AND SCHOOL SURROUNDINGS
SEKSYEN C: INFRASTRUKTUR PEJALAN KAKI DAN PERSEKITARAN SEKOLAH

- 8) What is your opinion on the condition of pedestrian facilities (e.g., sidewalks, zebra crossings, signage) near the school?
Apakah pandangan pihak sekolah terhadap kemudahan pejalan kaki di sekitar sekolah (contohnya, laluan pejalan kaki, lintasan belang, papan tanda)?

- 9) Have there been any recent upgrades or complaints regarding these facilities?
Adakah terdapat sebarang penambahbaikan atau aduan berkaitan kemudahan tersebut?

- 10) Are there obstacles near the school (e.g., hawkers, parked vehicles) that disrupt student walkways?
Adakah terdapat sebarang halangan seperti gerai, kenderaan parkir yang mengganggu laluan murid?

SECTION D: SCHOOL INITIATIVES AND PARENTAL INVOLVEMENT
SEKSYEN D: INISIATIF SEKOLAH DAN PENGLIBATAN IBU BAPA

- 11) Does the school promote any walking initiatives or awareness programs for students?
Adakah pihak sekolah menjalankan sebarang kempen atau program galakan berjalan kaki ke sekolah?

- 12) Are students educated about road and pedestrian safety?
Adakah murid diberikan pendidikan mengenai keselamatan jalan raya dan pejalan kaki?

- 13) Does the school work with the PTA or community regarding walk-to-school issues?

Adakah pihak sekolah bekerjasama dengan PIBG atau komuniti dalam isu keselamatan murid berjalan kaki?

SECTION E: ENVIRONMENTAL AND LOCATIONAL CONTEXT

SEKSYEN E: KONTEKS ALAM SEKITAR DAN LOKASI

- 14) How would you describe the surrounding area of the school? (e.g., residential, high-traffic, commercial)

Bagaimana pihak sekolah menggambarkan kawasan persekitaran sekolah? (contohnya, kawasan perumahan, trafik tinggi, komersial)

- 15) Are there any environmental or social factors you believe affect the students' ability to walk to school?

Adakah faktor persekitaran atau sosial yang mempengaruhi kemampuan murid untuk berjalan kaki ke sekolah?

SECTION F: CLOSING

SEKSYEN F: PENUTUP

- 16) In your opinion, what are the most important improvements needed to make walking to school safer and more attractive for students?

Pada pandangan pihak sekolah, apakah penambahbaikan paling penting untuk menjadikan berjalan kaki ke sekolah lebih selamat dan menarik bagi murid?

APPENDIX 5

Approval Letter to Conduct Survey from the Ministry of Education (MOE)



KEMENTERIAN PENDIDIKAN MALAYSIA
BAHAGIAN PERANCANGAN DAN PENYELIDIKAN DASAR PENDIDIKAN
ARAS 1-4, BLOK E8
KOMPLEKS KERAJAAN PARCEL E
PUSAT PENTADBIRAN KERAJAAN PERSEKUTUAN
62604 PUTRAJAYA

TEL : 0388846591
FAKS : 0388846579

Ruj. Kami : KPM.600-3/2/3-eras(19104)
Tarikh : 26 Januari 2024

NAIMAH BINTI OSMAN
NO. KP : 910204085652

NO. 20, JALAN PIPIT 5/52, TAMAN BENTARA BATU 9, KAMPUNG KEBUN BARU,
42500 TELOK P. GARANG
SELANGOR

Tuan,

**KELULUSAN BERSYARAT UNTUK MENJALANKAN KAJIAN :
INFLUENCING FACTORS OF CHILDREN WALKING TO SCHOOL. CASE STUDY: SHAH ALAM CITY, MALAYSIA.**

Perkara di atas adalah dirujuk.

2. Sukacita dimaklumkan bahawa permohonan tuan untuk menjalankan kajian seperti di bawah telah diluluskan dengan syarat :

" KELULUSAN DAN PENGUTIPAN DATA TERMASUK SECARA DALAM TALIAN (CONTOH: GOOGLE FORM) PERLU MENDAPATKAN KEBENARAN PENGARAH JPN DAN PERTIMBANGAN PENTADBIR SEKOLAH. PENGLIBATAN, PEMERHATIAN SERTA RAKAMAN VIDEO TERHADAP AKTIVITI PENGAJARAN DAN PEMBELAJARAN MURID DI DALAM BILIK DARJAH TIDAK DIBENARKAN. "

3. Kelulusan adalah berdasarkan kepada kertas cadangan penyelidikan dan instrumen kajian yang dikemukakan oleh tuan kepada bahagian ini. Walau bagaimanapun kelulusan ini bergantung kepada kebenaran Jabatan Pendidikan Negeri dan Pengetua / Guru Besar yang berkenaan.

4. Surat kelulusan ini sah digunakan bermula dari **1 Februari 2024** hingga **27 Julai 2024**

5. Tuan dikehendaki menyerahkan senaskhah laporan akhir kajian dalam bentuk *hardcopy* bersama salinan *softcopy* berformat pdf dalam CD kepada Bahagian ini. Tuan juga diingatkan supaya mendapat kebenaran terlebih dahulu daripada Bahagian ini sekiranya sebahagian atau sepenuhnya dapatan kajian tersebut hendak diterbitkan di mana-mana forum, seminar atau diumumkan kepada media massa.

Sekian untuk makluman dan tindakan tuan selanjutnya. Terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan amanah,

Ketua Penolong Pengarah Kanan
Sektor Penyelidikan dan Penilaian Dasar
b.p. Pengarah
Bahagian Perancangan dan Penyelidikan Dasar Pendidikan
Kementerian Pendidikan Malaysia

salinan kepada:-

JABATAN PENDIDIKAN SELANGOR

* SURAT INI DIJANA OLEH KOMPUTER DAN TIADA TANDATANGAN DIPERLUKAN *

APPENDIX 6

Approval Letter to Conduct Survey from Jabatan Pendidikan Negeri Selangor (JPNS)



KEMENTERIAN PENDIDIKAN MALAYSIA

Jabatan Pendidikan Negeri Selangor
Jalan Jambu Bol 4/3E, Seksyen 4
40604 Shah Alam, Selangor

Tel : 03-5518 6500

Faks : 03-5510 2133

Laman Web : jpnselangor.moe.gov.my

Rujukan Kami : JPNS.SPD 600-1/1/2 JLD. 37 (S)

Tarikh : 14 Februari 2024

**NAIMAH BINTI OSMAN
NO. 20, JALAN PIPIT 5/52
TAMAN BENTARA BATU 9
KAMPUNG KEBUN BARU
42500 TELOK PANGLIMA GARANG
SELANGOR**

Tuan,

KELULUSAN BERSYARAT UNTUK MENJALANKAN KAJIAN: *INFLUENCING FACTORS OF CHILDREN WALKING TO SCHOOL. CASE STUDY: SHAH ALAM CITY, MALAYSIA*

Dengan segala hormatnya perkara di atas dirujuk.

2. Sukacita dimaklumkan bahawa permohonan tuan untuk menjalankan kajian seperti tersebut di atas telah diluluskan dengan syarat:

"KELULUSAN DAN PENGUTIPAN DATA TERMASUK SECARA DALAM TALIAN (CONTOH: GOOGLE FORM) PERLU MENDAPATKAN KEBENARAN PENGARAH JPN DAN PERTIMBANGAN PENTADBIR SEKOLAH. PENGLIBATAN, PEMERHATIAN SERTA RAKAMAN VIDEO TERHADAP AKTIVITI PENGAJARAN DAN PEMBELAJARAN MURID DI DALAM BILIK DARJAH TIDAK DIBENARKAN."

3. Pihak tuan diingatkan agar mendapat persetujuan daripada Pengetua/Guru Besar supaya beliau dapat bekerjasama dan seterusnya memastikan bahawa penyelidikan dijalankan hanya bertujuan seperti yang dimohon. Kajian/penyelidikan yang dijalankan juga tidak mengganggu perjalanan sekolah serta tiada sebarang unsur paksaan.

4. Surat kelulusan ini sah digunakan bermula dari **1 Februari 2024 hingga 27 Julai 2024**.

5. Tuan juga diminta menghantar senaskah hasil kajian ke Sektor Perancangan dan Pengurusan PPD, Jabatan Pendidikan Negeri Selangor sebaik selesai kajian/penyelidikan.

Sekian, terima kasih.

"MALAYSIA MADANI"

"BERKHIDMAT UNTUK NEGARA"

~~Saya yang menjalankan amanah,~~

(DR. JAFRI BIN ABU)
Pengarah Pendidikan
Jabatan Pendidikan Negeri Selangor

ISMS/08022024

APPENDIX 7

Approval Letter to Conduct Survey from the UiTM Research Ethics Committee



UNIVERSITI
TEKNOLOGI
MARA

Pejabat
Timbalan Naib Canselor
(Penyelidikan dan Inovasi)

Reference : 600-TNCPI (5/1/6)
Our reference : REC/07/2024 (PG/MR/332)
Date : 1445H محرم 20
26 July 2024

Ms Naimah Osman – 2017349993
(Supervisor: Dr Na'asah Nasrudin)
College of Built Environment (CBE)
Kompleks Tahir Majid
Universiti Teknologi MARA
40450 Shah Alam
SELANGOR

and Greetings سلام عليكم ورحمة الله وبركاته

Ms

APPROVAL LETTER - UiTM RESEARCH ETHICS COMMITTEE

Thank you for submitting your research proposal to the Research Ethics Committee (REC). After considering your application, the Committee approved your proposal titled "Influencing Factors of Children Walking to School. Case Study: Shah Alam City, Malaysia" at Sekolah Kebangsaan (SK) Seksyen 7, SK Seksyen 17, SK Seksyen 19, SK Seksyen 24 and SK Jalan U3, Shah Alam, Selangor. Details of the approval are as follows:

Ref. number:	REC/07/2024 (PG/MR/332)
Approval Period:	26 July 2024 until 1 March 2025
Authorised personnel:	1. Naimah Osman 2. Dr Na'asah Nasrudin

The UiTM Research Ethics Committee operates in accordance to the ICH Good Clinical Practice Guidelines, Malaysian Good Clinical Practice Guidelines and the Declaration of Helsinki. The approval of this project is conditional upon your continuing compliance with these guidelines and declaration.

We draw to your attention the requirement that a report on this research, must be submitted every 12 months from the date of the approval or on the completion of the project, whichever occurs first. Failure to submit reports will result in withdrawal of consent for the project to proceed. Amendments, if any, to the study documents are to be submitted to the REC for approval.

If you require further information, please contact the REC Secretariat at 03-55448069/03-55442794 or email at recsecretariat@uitm.edu.my.

اوسها، نقوى، موليا

"MALAYSIA MADANI"
"BERKHIDMAT UNTUK NEGARA"

Yours sincerely,

(EMERITUS PROFESSOR/DATO' DR RAYMOND AZMAN ALI)
Chairman
UiTM Research Ethics Committee

c.c.: Dean (Research and Innovation), College of Built Environment (CBE), UiTM

Universiti Teknologi MARA
Aras 3, Bangunan Wawasan
40450 Shah Alam, Selangor, MALAYSIA
Tel: (+603) 5544 2004/2255
Faks: (+603) 5544 2070



APPENDIX 8

Validation Form of Proposed Guideline

**ASSESSING INFLUENTIAL FACTORS AND PROPOSED SAFETY
GUIDELINES FOR CHILDREN WALKING TO SCHOOL: A CASE
STUDY IN SHAH ALAM CITY, MALAYSIA**

NAIMAH BINTI OSMAN

UNIVERSITI TEKNOLOGI MARA

RESEARCH BACKGROUND

Walking to school is a vital form of Active School Travel (AST) that benefits children's health, independence, and the environment. However, in Malaysia, the majority of children rely on motorised transport, while walking participation remains low. In Shah Alam, challenges such as inadequate pedestrian infrastructure, traffic hazards, and a lack of child-sensitive design guidelines limit safe and convenient walking to school.

This study, therefore, aims to identify the factors influencing children's decision to walk to school, evaluate the safety level of walking schoolchildren, and develop guidelines for safe pedestrian facilities in school zones.

The research objectives are to:

Analyse demographic, socio-economic, and built environment factors that influence walking to school.

1. Assess the current condition of pedestrian infrastructure and facilities in school zones.
2. Examine how safety conditions and behaviours affect walking schoolchildren.
3. Propose child-sensitive guidelines for planning and designing pedestrian facilities in school zones.

The research scope focuses on primary schoolchildren (aged 7–12 years) in six schools in Shah Alam, employing a mixed-methods approach that includes questionnaire surveys, field observations, and stakeholder interviews.

The expected outcome is a framework and practical guidelines to support planners, local authorities, and policymakers in creating safer, more walkable school environments that encourage children's independent mobility.

CHILD-SENSITIVE PLANNING AND DESIGN GUIDELINES FOR WALKABLE SCHOOL ZONES

Purpose

To create safer, more inclusive, and walkable environments for schoolchildren in Shah Alam by improving pedestrian facilities, safety measures, and child-friendly urban design around school zones.

Guiding Principles

1. Child-Centred Design – Prioritise children’s safety, comfort, and visibility as the most vulnerable road users.
2. Safe System Approach – Reduce risks through road design, traffic calming, and safe crossings.
3. Universal Accessibility – Ensure infrastructure serves children of all abilities (MS 1184:2014 compliance).
4. Environmental Sustainability – Encourage walking as an eco-friendly, healthy alternative to private cars.
5. Community Engagement – Involve parents, schools, and local communities in planning, monitoring, and maintenance.

Proposed Guidelines

PHASE 1: PLANNING					
No	Proposed Guideline			Cost Implications and Phasing Priorities	
1	Conduct walkability audits and safety risk assessments using reference to child-specific distance ranges. (300–400 meters for a 5–10-minute walk)			Low-Cost / Minimal Investment (Short-Term: 0-1 year)	
2	Identify high-risk school zones based on traffic speed, infrastructure gaps, and walking patterns.			Low to Medium-Cost (Short-Term: 0-2 years)	
3	Engage school authorities, parents, and local communities in participatory mapping and planning.			Low-Cost (Short to Medium-Term: 1-3 years)	
4	Embed school zone enhancements into Local Plans and Development Control guidelines.			Medium-Cost / Moderate Investments (Medium-Term: 3–5 years)	
PHASE 2: DESIGN					
No	Component	Finding	Issue	Proposed Guideline Guideline	Cost Implications and Phasing Priorities
1	Pedestrian Walkway Design	Lack of continuous pedestrian paths	Interrupted or unsafe walking routes	Provide continuous sidewalks (min. 1.5m, preferably 2.0m) in high-volume areas; ensure slip-resistant, obstruction-free surfaces; comply with MS 1184:2014.	Medium-Cost / Moderate Investments (Medium-Term: 3–5 years)
2	Accessibility	Inaccessible infrastructure for disabled or young children	Exclusion of vulnerable users	Install kerb ramps at crossings, intersections, and school entrances (gradient ≤ 1:12); provide handrails or tactile curbs along slopes; ensure tactile paving in accordance with MS 1184:2014.	Low-Cost / Quick Wins (Short-Term: 1–2 years)
3	Safe Road Crossings	Unsafe road crossings near school gates	Children face risks while crossing roads	Provide zebra crossings with reflective paint visible at child eye level; install raised crosswalks or speed tables near school gates; reduce crossing widths (<10m) and add refuge islands (if appropriate).	Low-Cost / Quick Wins (Short-Term: 1–2 years)
		High traffic volume and speed near schools create unsafe conditions	Children face a high risk when crossing busy or fast-moving roads at ground level.	Provide universally accessible pedestrian bridges with ramps or lifts, safety features,	High-Cost / Long-Term Investments (5

		for children at road crossings.		lighting, and child-friendly elements in high-risk school zones.	years and beyond)
4	Traffic Calming	High traffic speed around schools	Children are exposed to an unsafe traffic environment	Enforce a 30 km/h speed limit in school zones with child-height signage; install speed humps, rumble strips, or chicanes within 300m of school zones.	- Speed limit & signage: Low-Cost / Quick Wins (Short-Term: 1–2 years) - Physical traffic calming measures: Medium-Cost / Moderate Investments (Medium-Term: 3–5 years)
5	Intersection and Connectivity	Poor connectivity between residential areas and schools	Children forced to take longer, unsafe routes	Improve street connectivity; provide continuous pedestrian walkways linking schools, homes, and local amenities; minimise conflict points at intersections.	High-Cost / Long-Term Investments (5 years and beyond)
6	Wayfinding and Signage	Lack of child-friendly navigation cues	Children are confused or disengaged with routes.	Install child-friendly signage (height ~1.2m), themed road markers (cartoon footprints and trails), and integrate educational cues (e.g., paw prints = walking distance).	Low-Cost / Quick Wins (Short-Term: 1–2 years)
7	Resting Areas and Shades	Fatigue among younger children	Children are unable to complete long walks comfortably	Provide shaded resting or seating every 250–300m; include trees or covered walkways for comfort during hot or rainy weather.	Medium-Cost / Moderate Investments (Medium-Term: 3–5 years)
8	Lighting and Visibility	Poor lighting in school zones	Reduced safety in early morning/evening	Install adequate, dedicated lighting for the pedestrian walkway at a child-appropriate height; maintain clear sightlines by preventing vehicle parking and trimming vegetation near crossings.	Low-Cost / Quick Wins (Short-Term: 1–2 years)
		Children and vulnerable users struggle to be seen and heard at crossings, especially in busy traffic conditions.	Limited visibility and a lack of auditory or visual cues increase the risk of accidents when children cross roads.	Install audible pedestrian signals and flashing beacons at school crossings to improve visibility and safety.	Medium-Cost / Moderate Investments (Medium-Term: 3–5 years)

9	Safety Enforcement	Safety concerns during peak hours	High congestion and child exposure to risks	Encourage CCTV in high-risk areas; deploy RELA / staff/volunteers as patrollers during peak hours; coordinate traffic enforcement with police.	Medium-Cost / Moderate Investments (Medium-Term: 3–5 years)
		School zones experience high congestion during pick-up and drop-off times, with vehicles crowding near school gates.	Children are exposed to traffic hazards and reduced walkability because motor vehicles dominate during peak hours.	Implement school street schemes that restrict motor vehicle access during peak hours to prioritise children's safety (if appropriate).	Low-Cost / Quick Wins (Short-Term: 1–2 years)

PHASE 3: MONITORING

Finding	Issue	Proposed Guideline	Cost Implications and Phasing Priorities
Inadequate monitoring of walking infrastructure	Deterioration of safety over time	Conduct biannual walkability audits with parents/students; track KPIs (walking rates, accident frequency); enable feedback reporting via schools/apps.	Low-Cost / Quick Wins (Short-Term: 1–2 years)

PHASE 4: MAINTENANCE

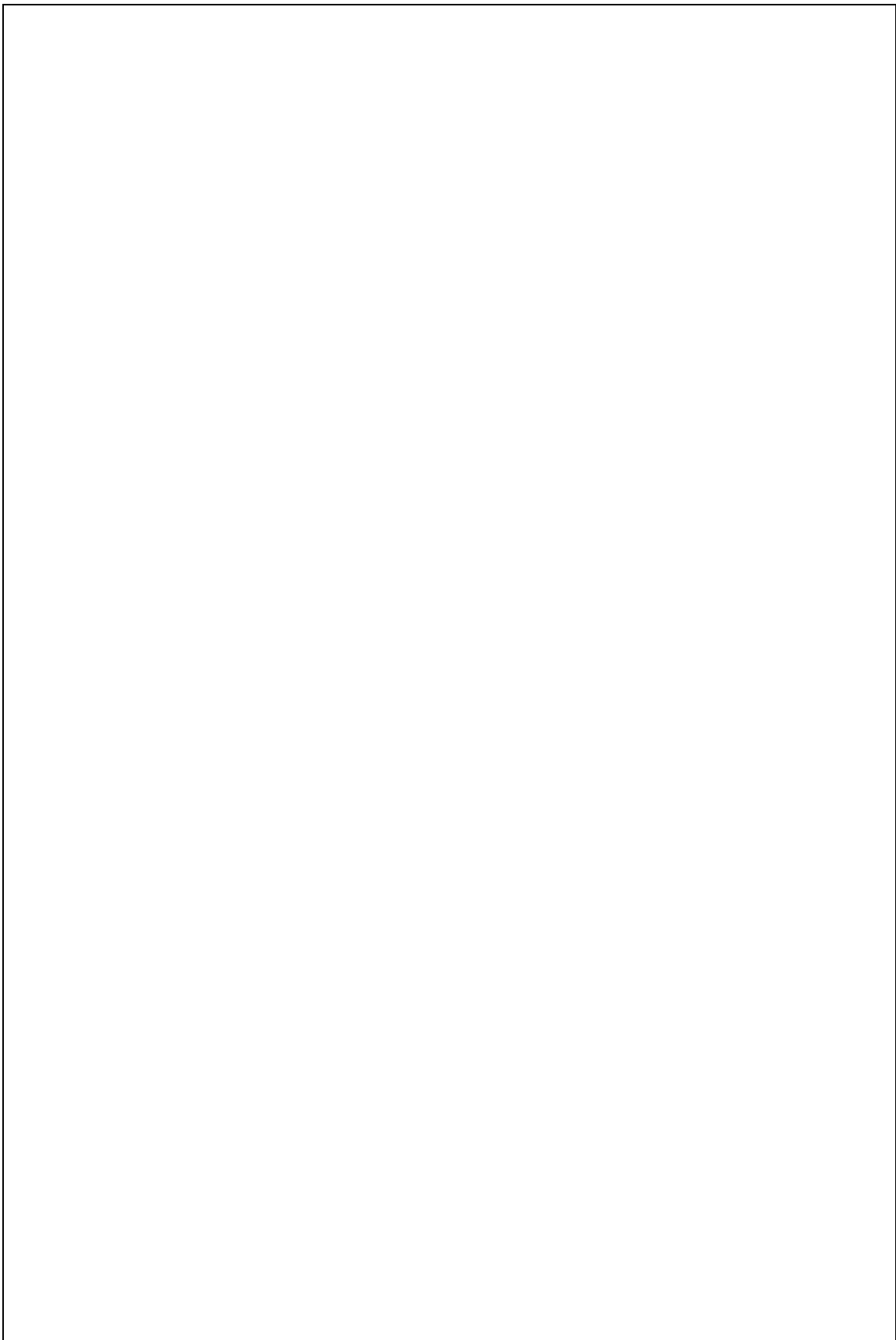
Finding	Issue	Proposed Guideline	Cost Implications and Phasing Priorities
Lack of ongoing maintenance	Rapid decline in infrastructure quality	Assign responsibility to councils/community teams; repair sidewalks, crossings, signage promptly; involve CSR programs in beautification/upgrades.	Low-Cost / Quick Wins (Short-Term: 1–2 years)

ADDITIONAL FINDINGS

No	Component	Finding	Issue	Proposed Guideline	Cost Implications and Phasing Priorities
1	Parental Perceptions and Social Norms	Parents and school communities consistently express concern about children's exposure to traffic hazards, unsafe crossings, and a lack of supervision in school zones.	Safety concerns discourage parents from allowing their children to walk to school, reducing independent mobility and walking rates.	Strengthen safety through supervised crossings (patrollers, volunteers), CCTV in high-risk areas, and traffic enforcement at peak hours.	- Patrollers, volunteers, and enforcement: Low-Cost / Short-Term (1–2 years) - CCTV installation and: Medium-Cost / Medium-Term (3–5 years)

2	Governance and Institutional Support				Introduce an insurance or protection scheme for walking schoolchildren to cover accidents or incidents during their journey, providing reassurance to parents and promoting safer, independent mobility.	Schoolchildren insurance scheme: Medium-Cost / Medium-Term (3–5 years)
					Community and School Collaboration: - Neighbourhood volunteer teams shall be established to monitor and assist schoolchildren along designated walking routes. - Schools shall collaborate with nearby commercial premises and residences to designate watch points for community supervision. - Collaboration with the public health sector shall be strengthened to promote walking to school as part of a healthy lifestyle initiative.	
					Promote walking through awareness campaigns, walk-to-school days, and community initiatives like “walking school buses.” Embed road safety and active mobility education in school curricula to normalise walking as a healthy and safe practice.	Low-Cost / Quick Wins (Short-Term: 1–2 years)
		Walking to school is often undervalued compared to motorised modes, and cultural norms may prioritise convenience and safety over walking.	Low social acceptance reduces participation in walking, even when schools are within walking distance.			
		Different agencies (local councils, JKR, MOT, MOE, police, schools, and communities) work in silos with limited integration of responsibilities in school zone planning.	Lack of coordination leads to gaps in infrastructure provision, inconsistent enforcement, and weak policy implementation.		Establish a stakeholder coordination framework that clearly defines roles and responsibilities (planning, funding, enforcement, maintenance). Form inter-agency task forces or committees to streamline decision-making and ensure integrated child-friendly planning.	Low-Cost / Quick Wins (Short-Term: 1–2 years)

Instructions
<ol style="list-style-type: none"> 1. You are required to provide comments on the proposed guidelines for a child-centric pedestrian walkway in school zones, as presented in the report. 2. Your comments may focus on the practicality, relevance, and adequacy of the guidelines in addressing children’s safety, comfort, and accessibility needs. 3. You may also reflect on how these guidelines contribute to new knowledge in the field of pedestrian planning and child mobility, particularly within the Malaysian context, and how they may support the strengthening of local policies, standards, and design practices related to school-area walkability. 4. Your feedback can further clarify whether the guidelines align with current practices, international standards, and local realities, and suggest any areas where the framework may be refined or improved. 5. If relevant, you may also comment on the feasibility of implementation (e.g., cost, institutional support, community acceptance) and how the guidelines could be adapted to different school environments.
Reviewer Feedback or Comments
<div></div>



Validation and Endorsement by Reviewer

I hereby confirm that I have reviewed the document entitled:

“Child-Sensitive Planning and Design Guidelines for Walkable School Zones”

and provided my comments and feedback as part of the validation process.

Reviewer Details

- Name: _____
- Designation / Position: _____
- Institution / Organisation: _____
- Contact (optional): _____

Reviewer's Endorsement

- Signature: _____
- Date: _____

Thank you for your feedback.

APPENDIX 9

Validation of the Proposed Guideline from the Town Planner Representative

Instructions
<ol style="list-style-type: none"> 1. You are required to provide comments on the proposed guidelines for a child-centric pedestrian walkway in school zones, as presented in the report. 2. Your comments may focus on the practicality, relevance, and adequacy of the guidelines in addressing children's safety, comfort, and accessibility needs. 3. You may also reflect on how these guidelines contribute to new knowledge in the field of pedestrian planning and child mobility, particularly within the Malaysian context, and how they may support the strengthening of local policies, standards, and design practices related to school-area walkability. 4. Your feedback can further clarify whether the guidelines align with current practices, international standards, and local realities, and suggest any areas where the framework may be refined or improved. 5. If relevant, you may also comment on the feasibility of implementation (e.g., cost, institutional support, community acceptance) and how the guidelines could be adapted to different school environments.
Reviewer Feedback or Comments
<ol style="list-style-type: none"> 1. Phase 2 : Design <ol style="list-style-type: none"> i. Resting areas and shades component : Evaluation on the suitability of covered walkway provision proximity to school area. ii. Creating School Zones and incorporate with the proposed pedestrian planning guideline for the particular identified zone. The zone radius can be marked in the master plan or local plan/special area plan for the effectiveness of guideline implementation. Designated special safe route for enhance the walkability and safety. <p>Please refer to the related case study in Japan for primary school independently walking to school for literature review and application.</p> 2. Additional Findings : Add on 1 component : 'Active Participation by Neighbourhood / Teams of Community Volunteers'. Include the initiative / programme by school as follows : <ol style="list-style-type: none"> i. Collaboration school with shops and houses along the pathway to school (creating watch over checkpoint for supervising by the volunteers); ii. Collaboration with public health sector in promoting healthy lifestyle via benefits of walking to school; iii. Encourage walking to school by forming students walking in groups following to their address rather than walking alone.

3. Consider on the possibilities of advantages/benefits in the application of current information technology(IT)for instance tracking device as a parents/guardian supervision tools for monitoring children.

Validation and Endorsement by Reviewer

I hereby confirm that I have reviewed the document entitled:

“Child-Sensitive Planning and Design Guidelines for Walkable School Zones”

and provided my comments and feedback as part of the validation process.

Reviewer Details

- Name: TPr.CHE MOHAMED BIN CHE IDRIS
- Designation / Position: TOWN PLANNER (PRINCIPAL CMIPLANNERS)
- Institution / Organisation: CMIPLANNERS
- Contact (optional): _____

Reviewer's Endorsement



- Signature: _____
- Date: 26/9/2025

Thank you for your feedback.

APPENDIX 10

Validation of the Proposed Guideline from the Local Authority Representative

Instructions

1. You are required to provide comments on the **proposed guidelines for a child-centric pedestrian walkway in school zones**, as presented in the report.
2. Your comments may focus on the **practicality, relevance, and adequacy** of the guidelines in addressing children's safety, comfort, and accessibility needs.
3. You may also reflect on how these guidelines contribute to **new knowledge in the field of pedestrian planning and child mobility**, particularly within the Malaysian context, and how they may support the **strengthening of local policies, standards, and design practices** related to school-area walkability.
4. Your feedback can further clarify whether the guidelines align with **current practices, international standards, and local realities**, and suggest any areas where the framework may be refined or improved.
5. If relevant, you may also comment on the **feasibility of implementation** (e.g., cost, institutional support, community acceptance) and how the guidelines could be **adapted to different school environments**.

Reviewer Feedback or Comments

- ① IN 'PHASE 2-DESIGN', 'PHASE 3-MONITORING' & 'PHASE 4-MAINTENANCE' :-
- a) COST IMPLICATION COULD BE HIGHER AS FOR ANY PROJECT IN LOCAL AUTHORITY IT IS IMPORTANT TO ENSURE CONTINUITY & CONNECTIVITY OF ANY PROJECT TO THE PRESENT AVAILABLE INFRASTRUCTURE.
 - b) 'PHASE 4' COULD PROVIDE THE BIGGEST QUESTION ON CBA & FUTURE COSTS.
- ② PAGE 3, GUIDING PRINCIPLES :-
- PBT / LOCAL AUTHORITY'S GUIDELINES & BY-LAWS SHALL ALSO STAND AS ONE OF GUIDING PRINCIPLES.

Validation and Endorsement by Reviewer

I hereby confirm that I have reviewed the document entitled:

“Child-Sensitive Planning and Design Guidelines for Walkable School Zones”

and provided my comments and feedback as part of the validation process.

Reviewer Details

- Name: AZHARUZZAMAN B. JAAFAR
- Designation / Position: PEN. PEGAWAI PENIBINA. (J29)
- Institution / Organisation: MBST
- Contact (optional): 017 2240884

Reviewer's Endorsement

- Signature: 
- Date: 12 / 11 / 2025

Thank you for your feedback.

APPENDIX 11

Validation of the Proposed Guideline from the Ministry of Works Representative

Instructions
<ol style="list-style-type: none"> 1. You are required to provide comments on the proposed guidelines for a child-centric pedestrian walkway in school zones, as presented in the report. 2. Your comments may focus on the practicality, relevance, and adequacy of the guidelines in addressing children's safety, comfort, and accessibility needs. 3. You may also reflect on how these guidelines contribute to new knowledge in the field of pedestrian planning and child mobility, particularly within the Malaysian context, and how they may support the strengthening of local policies, standards, and design practices related to school-area walkability. 4. Your feedback can further clarify whether the guidelines align with current practices, international standards, and local realities, and suggest any areas where the framework may be refined or improved. 5. If relevant, you may also comment on the feasibility of implementation (e.g., cost, institutional support, community acceptance) and how the guidelines could be adapted to different school environments.
Reviewer Feedback or Comments
<p>The Ministry of Works (KKR) appreciates the opportunity to review the proposed <i>Child-Sensitive Planning and Design Guidelines for Walkable School Zones</i> developed as part of the case study in Shah Alam. We commend the study's intent to enhance pedestrian safety, accessibility, and user experience for schoolchildren.</p> <p>Overall, the Ministry supports the direction of the proposed guidelines. The framework is generally consistent with national objectives to promote safe, inclusive, and sustainable mobility. However, several elements require refinement to ensure alignment with existing standards, improve feasibility, and strengthen inter-agency implementation.</p> <p>The Ministry's feedback below is presented to facilitate further enhancement of the document.</p>
<p>GENERAL POSITION OF THE MINISTRY</p> <p>The Ministry:</p> <ul style="list-style-type: none"> - Supports the development of general child-focused design principles for school zones - Acknowledges the relevance of creating walkable and safe environments for schoolchildren - Supports strengthened coordination across agencies <p>However, the Ministry:</p> <ul style="list-style-type: none"> - Recommends clarifying specific technical standards, institutional roles, and cost-prioritisation - Highlights implementation feasibility challenges, especially cost-intensive proposals
<p>SPECIFIC COMMENTS</p> <p>Guiding Principles</p> <p>The principles are consistent with KKR's road safety and inclusive design objectives. However, it is recommended to:</p> <ul style="list-style-type: none"> • Align Universal Accessibility definitions explicitly with <i>MS 1184:2014</i> and <i>JKR guidelines</i> (e.g., Arahan Teknik (Jalan) 8/86).

- Expand reference to **Safe System Approach** to reflect integration with national road safety strategies under MIROS and JKJR.

Phase 1 – Planning

- **Walkability Audits:**
Supported. KKR recommends incorporating JKR's existing safety audit frameworks to strengthen consistency.
- **High-risk Zone Identification:**
Clear criteria are required (traffic volume, past incident data, pedestrian movement intensity). MIROS crash data integration is recommended.
- **Community Engagement:**
Supported. However, project oversight must remain with technical authorities to avoid inconsistent outcomes.

Recommendation:

Include JKR and Local Authority (PBT) in all planning stages to ensure technical compliance.

Phase 2 – Design

Overall, design proposals are relevant; however, several items require alignment with national technical standards.

(1) Pedestrian Walkway Design

- Minimum width of 1.5m is consistent with MS1184 and JKR guidelines.
- Suggest clarity on:
 - Materials specification
 - Gradient allowance
 - Drainage requirements

(2) Accessibility Features

- Supported.
- The requirement for tactile paving and kerb ramp specifications should be linked to MS 1184 and existing JKR standards.

(3) Safe Road Crossings

- Proposal supported; however:
 - Raised crossings must comply with JKR road geometry standards to mitigate drainage and speed-impact issues.
 - Proposals for refuge islands should reflect local ROW constraints.

(4) Pedestrian Bridges

- High-cost items may not be feasible for many schools.

- Should include:
 - Prioritisation criteria
 - Traffic conflict studies
- Strongly recommend exploring *at-grade improvements first*.

(5) Traffic Calming

- Supported.
- Speed limit enforcement must be integrated with PDRM, JPJ, and the Local Authority.
- Specific placement guidelines (e.g., distance from the school gate) require standardisation.

(6) Wayfinding and Signage

- Supported; however, child-themed elements should not compromise regulatory clarity.
- Must comply with *JKR/horizontal signage requirements*.

(7) Shade / Resting Areas

- Supported; however:
 - Maintenance responsibility must be stated.
 - PBT should guide landscaping standards (e.g., species selection, root spread).

(8) Lighting and Visibility

- Supported; ensure alignment with:
 - lighting standards
 - energy-efficiency policies

Use of flashing beacons is supported; maintenance requirements must be stated.

(9) Safety Enforcement

- CCTV and patrollers are supported, but the funding source and SOPs must be clearly identified.

Phase 3 – Monitoring

- Biannual tracking is encouraged. KKR recommends:
 - Standardised KPIs
 - Integration with PBT reporting protocols
 - Involvement of state-level JKR

Phase 4 – Maintenance

- Supported.

- KKR recommends that the document specify:
 - Asset ownership
 - Maintenance funding streams
 - Minimum maintenance interval

Additional Findings & Governance Coordination

- Ministry agrees that inter-agency coordination is essential.
- Suggest formalising:
 - Roles among KKR, KPKT, MOE, LLM, PDRM, MIROS
 - Apparent authority for approval and maintenance

COST AND IMPLEMENTATION CONSIDERATIONS

The document's cost classification is helpful.
However, the Ministry recommends:

- More apparent justification for high-cost infrastructure (e.g., bridges, CCTV)
- Provision of funding models (e.g., cross-agency, CSR, PIBG support)
- A phased implementation prioritising:
 1. Low-cost quick wins
 2. Medium-cost safety upgrades
 3. Long-term capital projects

RECOMMENDATIONS / SUGGESTED AMENDMENTS

1. **Align all technical design parameters with JKR manuals & MS standards**
2. **Strengthen feasibility analysis**, including:
 - Cost estimation ranges
 - Land requirement considerations
3. **Add a prioritisation framework** for schools based on risk severity
4. **Clarify governance roles**
 - Who plans?
 - Who funds?
 - Who authorises?
 - Who maintains?
5. **Incorporate MIROS safety audit tools.**

6. Add monitoring checklist templates for PBT use.
7. Expand the guidelines to address rural school settings, where conditions differ from those in urban Shah Alam.

CONCLUSION

The Ministry supports the overall intent and majority of the proposed guidelines, particularly:

- Safe System Approach
- Universal accessibility
- Traffic calming
- Child-centred design

The guidelines will improve safety and walkability in school zones.

However, further technical alignment with JKR standards, clearer governance structures, and practical cost-phasing strategies are necessary to ensure a smooth implementation.

We look forward to continued collaboration to refine and operationalise these guidelines.

Validation and Endorsement by Reviewer

I hereby confirm that I have reviewed the document entitled:

“Child-Sensitive Planning and Design Guidelines for Walkable School Zones”

and provided my comments and feedback as part of the validation process.

Reviewer Details

- Name: Mohd Nazimuddin Mohd Naziruddin
- Designation / Position: Juliana Awam
- Institution / Organisation: JKR Putrajaya
- Contact (optional): _____

Reviewer's Endorsement


MOHD NAZIMUDDIN BIN MOHD NAZIRUDDIN
Jurutera Awam
Bahagian Bangunan Kerosakan 1
JKR WP Putrajaya

- Signature: _____
- Date: 17/2/2025

Thank you for your feedback.

APPENDIX 12

Validation of the Proposed Guideline from the School Representative

Instructions
<ol style="list-style-type: none"> 1. You are required to provide comments on the proposed guidelines for a child-centric pedestrian walkway in school zones, as presented in the report. 2. Your comments may focus on the practicality, relevance, and adequacy of the guidelines in addressing children's safety, comfort, and accessibility needs. 3. You may also reflect on how these guidelines contribute to new knowledge in the field of pedestrian planning and child mobility, particularly within the Malaysian context, and how they may support the strengthening of local policies, standards, and design practices related to school-area walkability. 4. Your feedback can further clarify whether the guidelines align with current practices, international standards, and local realities, and suggest any areas where the framework may be refined or improved. 5. If relevant, you may also comment on the feasibility of implementation (e.g., cost, institutional support, community acceptance) and how the guidelines could be adapted to different school environments.
Reviewer Feedback or Comments
<p>Saya bagi pihak yang menguruskan hal ehwal murid kawasan Sekolah Kebangsaan Seksyen 19 telah meneliti kajian ini yang berkaitan faktor-faktor yang mempengaruhi murid untuk memilih berjalan kaki ke sekolah.</p> <p>Pihak pengkaji berusaha untuk mencari jalan atau cara bagi meningkatkan bilangan murid berjalan kaki atas sebab-sebab yang difikirkan amat baik.</p> <p>Pihak kami amat bersetuju dengan cadangan kajian ini kerana bertepatan dengan tujuan pendidikan murid awal per sekolah untuk mempercepatkan perkembangan</p>

pemikiran dan akal murid zaman ini.

Murid yang banyak berjamah dan bergerak terbukti lebih sihat berbanding murid yang lebih banyak berada atas kenderaan. Pergerakan murid akan manusia dalam kenderaan amat terbatas.

Cadangan-cadangan dalam kajian ini boleh dibatalkan amat baik dan lengkap dengan memikirkan semua faktor murid di kawasan ini. Adalah amat bagus jika cadangan-cadangan ini dapat dilaksanakan bagi mencapai tujuan pengkaji.

Pihak kami yakin dengan kajian ini dapat meningkatkan kemenjadian murid sekiranya menambahkan lagi warganegara Malaysia yang sihat dan cerdas akal fikirannya. Semoga kajian ini akan berjaya mencapai matlamatnya.

Validation and Endorsement by Reviewer

I hereby confirm that I have reviewed the document entitled:

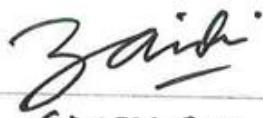
“Child-Sensitive Planning and Design Guidelines for Walkable School Zones”

and provided my comments and feedback as part of the validation process.

Reviewer Details

- Name: MOHD ZAIDI BIN ABD MAJID
- Designation / Position: GURU PENOLONG KANAN HAL EHWAL MURID
- Institution / Organisation: SEKOLAH KEBANGSAAN SEKSYEN 19
- Contact (optional): 012-3586257

Reviewer's Endorsement

- Signature: 
MOHD ZAIDI BIN ABD MAJID
Guru Penolong Kanan Hal Ehwal Murid
Sekolah Kebangsaan Seksyen 19
Shah Alam, Selangor
- Date: 24 SEPTEMBER 2025

Thank you for your feedback.

APPENDIX 13

Validation of the Proposed Guideline from the Parents' Representative

Instructions
<ol style="list-style-type: none"> 1. You are required to provide comments on the proposed guidelines for a child-centric pedestrian walkway in school zones, as presented in the report. 2. Your comments may focus on the practicality, relevance, and adequacy of the guidelines in addressing children’s safety, comfort, and accessibility needs. 3. You may also reflect on how these guidelines contribute to new knowledge in the field of pedestrian planning and child mobility, particularly within the Malaysian context, and how they may support the strengthening of local policies, standards, and design practices related to school-area walkability. 4. Your feedback can further clarify whether the guidelines align with current practices, international standards, and local realities, and suggest any areas where the framework may be refined or improved. 5. If relevant, you may also comment on the feasibility of implementation (e.g., cost, institutional support, community acceptance) and how the guidelines could be adapted to different school environments.
Reviewer Feedback or Comments
<p>Parents generally support the intent and approach of the proposed guidelines, especially those focusing on:</p> <ul style="list-style-type: none"> • Safer pedestrian routes • Traffic speed reduction • Improved crossings • Better lighting and visibility • Community participation <p>These elements directly enhance children’s safety and parents’ confidence in allowing children to walk to school. However, several components could be strengthened to better reflect the concerns and lived experiences of families whose children walk daily. Additional clarification and practical solutions are recommended.</p>
<p>Specific Feedback on Proposed Guidelines</p> <p>A. Phase 1 – Planning</p> <p>Support</p> <ul style="list-style-type: none"> • Walkability audits and safety risk assessments are welcomed. • Identification of high-risk zones is essential. <p>Parent Concerns / Suggestions</p> <ul style="list-style-type: none"> • Parental involvement should be explicitly required during audits (Section 1), not optional. Parents are often most aware of on-ground safety issues. • Walking distance reference (300–400 m) is reasonable; however, children's travel may exceed this range in many areas.

<p>→ Suggest including support strategies for longer walking distances (rest points, improved crossings).</p>
<p>B. Phase 2 – Design</p> <p>1) Pedestrian Walkway Design</p> <p>Parents strongly support continuous sidewalks, slip-resistant surfaces, and obstacle-free design.</p> <p>Suggestion:</p> <ul style="list-style-type: none"> • Emphasise regular removal of obstructions (e.g., parked motorcycles, overgrown vegetation) as these are persistent issues.
<p>2) Accessibility</p> <p>Important for children with disabilities.</p> <p>Suggestion:</p> <ul style="list-style-type: none"> • Parents request clearer indication of who ensures compliance (council / school / JKR).
<p>3) Safe Road Crossings</p> <p>Raised crosswalks, zebra crossings, and refuge islands are excellent.</p> <p>Serious Concern:</p> <ul style="list-style-type: none"> • Many existing zebra crossings near schools are faded or blocked by vehicles. → Maintenance guidelines must be clearer and more frequent. • Additional request: → Install school crossing guards during peak hours.
<p>4) Pedestrian Bridges</p> <p>Concern:</p> <ul style="list-style-type: none"> • While safe, bridges with stairs are often not used by children due to inconvenience. • Parents prefer at-grade (ground-level) solutions wherever possible. <p>→ Suggest that bridges be recommended only when no safe at-grade improvement can be provided.</p>
<p>5) Traffic Calming</p> <p>Very strongly supported.</p> <p>Parents particularly approve:</p> <ul style="list-style-type: none"> • 30 km/h school-zone limit • Speed humps

<ul style="list-style-type: none"> • Child-height signage <p>Suggestion:</p> <ul style="list-style-type: none"> • Enforcement is often weak. → Parents recommend closer collaboration with PDRM & local councils to ensure compliance.
<p>6) Wayfinding & Signage</p> <p>Child-friendly cues can make walking more enjoyable.</p> <p>Suggestion:</p> <ul style="list-style-type: none"> • Ensure signage does not distract children from watching traffic. • Consider distance markers so children know how far remains.
<p>7) Shaded Walkways / Rest Areas</p> <p>Strongly supported, especially in hot/rainy weather.</p> <p>Suggestion:</p> <ul style="list-style-type: none"> • Provide covered walkways near school entrances where congestion is highest.
<p>8) Lighting & Visibility</p> <p>Critical for early morning arrivals.</p> <p>Suggestion:</p> <ul style="list-style-type: none"> • Install lighting on both sides of the walkway, not only near crossings. • Trim vegetation regularly.
<p>9) Crossing Signals</p> <p>Audible and flashing signals are highly supported.</p> <p>Suggestion:</p> <ul style="list-style-type: none"> • Ensure pedestrian signals give enough time for young children to cross fully.
<p>10) Safety Enforcement</p> <p>Very important.</p> <p>Parent Concerns:</p> <ul style="list-style-type: none"> • Volunteer patrollers are not always reliable; parents prefer: → Clear enforcement structure (e.g., RELA / traffic wardens) → Accountability measures

- Suggest **school streets** be piloted first before full implementation.

C. Additional Findings and Governance

1) Parental Perceptions & Social Norms

The report acknowledges safety worries as a barrier.

Suggestion:

- Shifting norms will require schools to actively communicate walking benefits and create safe walking groups.

Parents strongly support:

- **Walking school bus programmes**
- **Regular safety campaigns**

Additional suggestion:

- **Accident insurance** is highly welcomed, but parents request clarity on:
 - Who funds it
 - Who qualifies
 - Coverage scope

3. Priority Concerns from Parents

Parents place the highest priority on:

1. **Well-maintained, safe road crossings**
2. **Strict speed control and enforcement**
3. **Continuous walkways without obstructions**
4. **Adequate lighting**
5. **Reliable adult supervision at peak hours**

4. Requests for Clarification

Parents would appreciate clarification on:

- Which agency is responsible for **monitoring and maintenance**
- Who provides and funds **crossing guards**
- Process for reporting unsafe conditions
- Time frame for repair of damaged walkways

5. Additional Parent Recommendations

Include "Safe School Gate Design" guidelines

- Vehicle congestion near gates is a major daily hazard.

Add Safe Walking Route Maps

- Schools could distribute maps showing recommended safe paths.

Provide pedestrian safety education

- To children and parents

Clear enforcement measures

- Fines for illegal parking blocking walkways
- Speeding enforcement via cameras

Encourage walking groups

- Buddy system reduces risks and increases confidence

Parents appreciate that the proposed guidelines strongly emphasise safety, accessibility, and universal design. The document is comprehensive and reflects many real concerns families face.

To strengthen the guidelines from a parent's viewpoint, we recommend:

- Stronger enforcement mechanisms
- Clearer maintenance responsibilities
- Prioritising at-grade crossings over bridges
- Consistent parental involvement in planning and monitoring
- Practical tools like route mapping and supervised crossings

With these refinements, parents will feel more confident in allowing children to walk to school independently.

Validation and Endorsement by Reviewer

I hereby confirm that I have reviewed the document entitled:

"Child-Sensitive Planning and Design Guidelines for Walkable School Zones"

and provided my comments and feedback as part of the validation process.

Reviewer Details

- Name: Amruth Arzi
- Designation / Position: _____
- Institution / Organisation: SEK 24
- Contact (optional): _____

Reviewer's Endorsement

- Signature:  _____
- Date: 1/2/2025 _____

Thank you for your feedback.

AUTHOR'S PROFILE



Naimah Osman is a PhD candidate majoring in Built Environment at the College of Built Environment, Universiti Teknologi MARA (UiTM) Shah Alam. She obtained a Bachelor of Town and Regional Planning (Hons.) in 2017 from Universiti Teknologi MARA (UiTM) Puncak Alam, MSc in Urban Development and Management (2018) from Universiti Teknologi MARA (UiTM) Shah Alam. Her PhD research focuses on children's mobility, specifically examining the factors that influence walking to school among primary school children in Shah Alam City. Her academic interests include urban mobility, child-friendly city planning, walkability, and the design of inclusive infrastructure.

LIST OF PUBLICATIONS:

- Osman, N., Nasrudin, N., and Abdullah, Y. A. (2024), Socioeconomic Influences and Pedestrian Infrastructure in Promoting Active Travel to School among Primary School Children. *Planning Malaysia Journal*.
- Osman, N., Nasrudin, N., and Abdullah, Y. A. (2024), Evaluating Pedestrian Facilities Outside School Areas: A Comparative Study of Site Observations Against Current Design Guidelines. *Urban Planning Symposium*.
- Osman, N., Nasrudin, N., and Abdullah, Y. A. (2020). Associations of Children's Active School Travel with Perceptions of the Built Environment: Preliminary Study. *International Journal of Psychosocial Rehabilitation*, ISSN: 1475-7192, 24 (2), 2165-2174.

- Osman, N., Nasrudin N., Abdullah, Y. A., & Khalid, N. S. (2020). Factors Influencing Active Travel Mode to School for Primary School Children. *Environment-Behaviour Proceedings Journal*, 5(13), 13-19.
- Nasrudin, N., Hashim, H., Khalid, N. S., Osman, N., and Hashim, S. F. (2020). Analysis of Pedestrian Crossing Behaviour at Pedestrian Crossings in Shah Alam City, Malaysia. *International Journal of Psychosocial Rehabilitation*, ISSN: 1475-7192, 24 (2), 1808-1815.
- Khalid, N. S., Nasrudin, N., and Osman, N. (2020). Evaluating Neighbourhood Accessibility: A Spatial Analysis of Walking Preferences. *International Journal of Psychosocial Rehabilitation*, ISSN: 1475-7192, 24 (2), 2395-2409.