Walkability Assessment of First Mile Last Mile Public Transport System of Neighbourhood in Kuala Lumpur, Malaysia and Singapore for Persons with Disabilities: A Comparative Study

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Information on public transport infrastructure factors affecting mobility and walkability within neighbourhoods among PWD in cities of Kuala Lumpur, Malaysia and Singapore is limited. The study objective was to explore the accessibility of numerous facilitators and barriers in built environment within first mile last mile (FMLM) public transport in naturally occurring retirement community (NORC) neighbourhood within Kuala Lumpur and using Singapore as a benchmark. The research using Direct Observation technique was conducted through Access Audit on six routes at two locations, namely Malaysia (i.e., MY1, MY2, MY3) and Singapore (i.e., SG1, SG2, SG3), with a particular focus on five groups of PWD (Physical, Learning, Blind, Deaf, Elderly). The collected data were analysed for various environmental facilitators and barriers concerning connectivity, comfort, attitude, legibility, and safety of the FMLM public transport in the neighbourhoods. Four FMLM access to public transport determinants emerged and described in order of occurrence frequency in Malaysia case study: transportation service determinant, built environment characteristic, social environment determinant and individual attributes determinant. Different PWD groups had different vulnerabilities and prone to environmental barriers of FMLM in public transport system in Kuala Lumpur as opposed to Singapore. Therefore, it is proposed that walkability of FMLM neighbourhood to be integral component of PWD accessibility, connectivity, and safety when designing built environment in Malaysia.

Keywords: Inclusive Mobility, First Mile Last Mile, Persons with Disabilities, Neighbourhood Environmental Barriers, Walkability

1. INTRODUCTION

The Sustainable Development Goals (SDGs) of the United Nations (UN) seek to motivate action by 2030 to ensure that no one is left behind (United Nations, 2015). The SDG places high importance on enabling environments to be included into strategies encompassing, but not limited to, inclusive, safe, resilient, and sustainable industry, innovation, and infrastructure (SDG 9), reduced inequalities (SDG 10) and safe, resilient, and sustainable communities and cities (SDG 11). Malaysia is moving towards a developed country after achieving its independence in the past six decades. Citizen's movement and mobility using public transport system is an important component of daily life in Kuala Lumpur, Malaysia. Advanced countries like Japan, Germany and Australia have good public transport system including good walking facilities for the pedestrian.

Government of Malaysia has pledged to provide access to public transport to 40 per cent of its urban population by 2030 (Suruhanjaya Pengangkutan Awam Darat, 2016). The public transport system in Kuala Lumpur has continuously improved over the last few decades to meet society's demand. However, the rapid advancement of Kuala Lumpur needs a further up-to-date public transport system; for an example, travel demand to and from Kuala Lumpur city centre continues to grow, which results in congestion and stagnant road traffic, particularly during daily peak hours. The demand is partly due to low public transport model share based on survey results in 2010 of 17 per cent trips daily and high reliance on private transportation to travel (Onn, Karim, & Yusoff, 2014). However, to date, there is scarce information and data available in Kuala Lumpur regarding walking facilities in the FMLM neighbourhood particularly for the PWD.

The number of registered PWD in Malaysia was 497,390 (1.6% of Malaysian population) in 2018 (Department of Social Welfare, 2018). However, this number did not represent the actual total number of PWD in Malaysia due to the voluntary registration system. Registration of PWD in Malaysia does not reflect WHO's projection of 1 billion or 15% of the population based on the 2010 world population estimate (World Health Organisation, 2011). The current population of Malaysia is around 32 million, therefore, based on this projection, the PWD population should be around 4.8 million. In addition, global ageing has had a significant impact on disability patterns. An average lifespan for Malaysian male is 72.8 and female is 78.2 and Malaysia now has an estimated 3.6 million persons over the age of 60 or 11.2% of the population (Department of Statistics Malaysia, 2020). The connection is straightforward: older adults have a greater risk of impairment, country populations are ageing at record rates (World Health Organisation, 2011) and ageing population are more susceptible to sustaining a basic quality of live including health that likely contribute to an increase in the number of PWD in Malaysia. Therefore, as an inclusive society, Malaysia should pay attention to the welfare of PWD including the connectivity, comfort, attitude, legibility, safety, and health of the public transport system.

An accessible environmental facility for public transport system not only is critical for PWD but also complements the broader spectrum of people in the society. There is a risk that accessibility for PWD would be neglected and that costly assistive new technologies will be chosen above universal design to cater the prospecting diverse capacity and capability of a society. The repercussion of improper planning and implementation would be alarming and create public transport barriers among PWD and older adults, subsequently, limit their ability to commute safely to carry out their social activities and needed services. Further to this, social isolation, decrease quality of life and housebound as they age are among the consequences faced by the PWD groups. Mobility within neighbourhoods, especially the FMLM journey, is essential, among other aspects, to ensure seamless commuting for transit users. According to Guerra, Cervero, and Tischler (2012), FMLM refers to the mode of transportation (walking or cycling) around a quarter radius to access the transit services. It is established that every transit trip will begin and end with walking (Ratner & Goetz, 2013; Tilahun, Thakuriah, Li, & Keita, 2016). Walking is a component or journey which may include public transport to reach a destination. Some PWD would need more help than another person. The quality of FMLM affects the quality of transit service (Tilahun et al., 2016). Therefore, FMLM

is a crucial component of a safe and comfortable transit service for users from home to their destinations.

1.1 First Mile Last Mile in Malaysia

There are two main factors affecting walkability for transport, namely health and functional limitations and environmental barriers (Clark & Scott, 2016; Van Cauwenberg et al., 2012). The former consists of age and physical attributes, while the latter consists of barriers and facilitators within the FMLM journey. According to Perry (1929) and Barton, Grant, and Guise (2003), it took approximately 5 minutes to cover 400 meters walk. The finding of a study by Azmi, Karim, and Amin (2013) on walking behaviour of urban and rural residents in Malaysia was agreeable with those of researchers mentioned above; however, the latter indicated that age and obstacle factors could contribute to the walking speed. Naharudin, Ahamad, and Sadullah (2017) showed that the frequency of built environment elements present along the walking route could influence pedestrian attractiveness score based on public preferences. Their findings indicated that routes with higher preferred parameters scored higher pedestrian attractiveness.

In Malaysia, there is a vast difference between urban area versus rural area in terms of public transport system. People were willing to walk 600 meters in the rural area as compared to 400 meters in the urban area (Azmi et al., 2013). To date, studies involved PWD on public transport system in FMLM neighbourhood in Malaysia are scarce. Additionally, the information on built environment components such as facilitators and barriers with regards to walkability for PWD groups are presently not easily available in the literature. In this regard, for examples, data on policy, perception of PWD and accessibility determinants are available however, it may need to be reviewed regularly as well as constant monitoring and implementation to improve for inclusive public transport system including walkability in FMLM neighbourhood in tandem with the rapid socio-economic development of Malaysia.

1.2 Factors influencing the pedestrian-friendliness

Conventionally, a good walking environment comprises of three elements, namely Design, Density and Diversity. As for street walkability, a good street design would allow people to walk easily to their destination. These facilities include a walking path having good access to the station from origin and a continuous path as described by the previous researchers (Cheng & Chen, 2015; Papa & Bertolini, 2015; Sarkar et al., 2015). As for street density, the preferred walking environmental factors include the number of facilities and furniture along the path as well as traffic aids consisting of traffic light and crossing to enhance the safety of walking (Guo & Loo, 2013; Karim & Azmi, 2013; Landis, Vattikuti, Ottenberg, McLeod, & Guttenplan, 2001). In the case of street diversity, various land uses should be connected to transit services by walking paths including access to workplace or leisure activities for the local society. In a survey on convenience and safety of walking experience in Putrajaya, Malaysia neighbourhood area conducted by Karim and Azmi (2013), personal safety, traffic safety and neighbourhood surroundings were the determinants of walkability in a neighbourhood area.

1.3 Travel behaviour and patterns of PWD: facilitators and barriers

Previous studies on travel behaviour among PWD suggest the determinants of transportation for PWD include: (1) transportation service determinants such as availability, accessibility, connectivity, acceptability and affordability; (2) built environment characteristics such as quality of pedestrian and bicycling infrastructure etc., and (3) individual attributes such as living arrangement, health status, etc. (Cerin, Nathan, Van Cauwenberg, Barnett, & Barnett, 2017; Ragland, MacLeod, McMillan, Doggett, & Felschundneff, 2019; Shrestha, Millonig, Hounsell, & Mcdonald, 2017). Kett, Cole, and Turner (2020) notes that the challenge is how to measure and monitor transport access and inclusion for people and children with disabilities in a range of context and impairments, taking into consideration concerns of safety, security, independence, and autonomy. In Malaysia, information and data on travel behaviour and

pattern of PWD related to facilitators and barriers are not well documented. In this work, walkability assessment on FMLM in Taman Tun Dr Ismail (TTDI), Kuala Lumpur, Malaysia was carried out focusing on the facilitators and barriers for the PWD groups. This work focusses on selected PWD groups as classified in conceptual framework and method sections below. The findings from this research would provide the information on public transport service determinants, FMLM built environment determinants and individual attributes of the PWD groups. Specifically, this study was aimed to (1) evaluate the pedestrian walking facilities for PWD, (2) identify patterns of mobility among PWD groups and (2) understand mobility needs among PWD groups concerning connectivity, comfort, attitude, legibility, and safety within FMLM of public transport system in neighbourhoods.

2. CONCEPTUAL FRAMEWORK

To better understand walking for transportation among PWD, we adopted the "bio-psycho-social" model or The International Classification of Functioning and Health (ICF) that encapsulates a viable middle ground between medical and social models. Human functioning issues are classified into three interrelated categories: impairments, activity limitations, and participation restrictions (World Health Organisation, 2011). Thus, disability refers to problems in one or more of these three domains of functioning. The ICF is universal because it covers all human functioning and treats disability as a continuum rather than categorizing people with disabilities as a separate group. PWD groups in Malaysia can be categorised into 7 categories; hearing disability (DE), visual disability (BL), speech disability (SD), physical disability (PH), learning disability (LD), mental disability (ME) and multiple disabilities (MD) (Department of Social Welfare, 2021). In Singapore, PWD is defined as those who have reduced chances of securing, retaining and progressing in education and training institutions, employment and recreation, due to physical, intellectual, sensory and developmental impairments (Ministry of Social and Family Development, 2018).

Traditionally, the social model of disability suggests people are disabled by social and physical environments, also identified as barriers to wellbeing (Oliver, 2013). Social model of disability includes measuring health and disability to the environment, and individuals are considered handicapped by the barriers in the society rather than their impairment, thus deflates traditional biomedical model. When it comes to defining disability, the UNCRPD emphasises that disability is the consequence between people with impairments, and the behavioural and environmental obstacles that prevent them from participating fully and effectively in society on an equal footing with others (United Nations, 2006).

Disability occurs when health problems interact with contextual variables such as environmental and personal factors. Accessibility is highly dependent on the surroundings. Inaccessible settings foster impairment by creating obstacles to participation and inclusion in society. The ICF listed environmental factors are either facilitators or barriers (World Health Organisation, 2011). Environmental factors affecting walking accessibility include products and technology; natural and built environment; support and relationships; attitudes; and services, systems, and policies. Conversely, personal factors include capacity, motivation, and self-esteem of an individual to act, which may influence how much that individual participates in society that commensurate with the model of accessibility in seamless public transport system.

3. METHODS

The goal of this study was to evaluate the pedestrian walking facilities for PWD groups using standard criteria. The PWD groups were identified and categorised in this research are as follows: physical disability (PH), blind (BL), learning disability (LD), deaf (DF) and older adult (OL). Table 1 shows the list of walking facilities captured on site involving the criteria as follows: pavement quality, shelter, motorist parking, signage, vertical connectivity, and pedestrian safety. The sub-criteria mainly involved the kerb ramp, even pavement, pavement material, width of pavement, unobstructed pavement, step-free access, drain cover, bus drop-off and layby, waiting area and seating, landscaping, motorcycle parking, car parking, directional signage, bus service information, announcement in bus, temporary signage, lift, continuous pavement, and

pedestrian crossing. The geometric types were based on point and line groups, while the types of data were based on location, name, and length. The data from the walking facilities criteria and sub-criteria were collected and analysed to determine the accessibility and inaccessibility of selected routes of FMLM neighbourhood.

Table 1: List of walking facilities captured on site.

Criteria	Sub-criteria	Geometric Types	Types of Data
Pavement quality (Horizontal connectivity)	• Kerb ramp or step • Even pavement • Pavement material • Width of pavement • Unobstructed pavement • Step-free access • Drain cover	Point	• Location • Name
Shelter (Comfort)	• Bus drop-off and layby • Waiting area and seating • Landscaping	Point	• Location • Name
Motorist parking (Attitude)	• Motorcycle parking • Car parking	Point	• Location • Name
Signage (Legibility)	• Directional signage • Bus service information • Announcement in bus • Temporary signage and warning	Point	• Location • Name
Vertical connectivity	• Lift	Point	• Location • Name
Pedestrian safety (Safety & horizontal connectivity)	• Continuous pavement • Pedestrian crossing	Line	• Location • Name • Length

3.1 Study approach

The approach of this study was to evaluate the walking facilities and environmental condition based on transportation services, built and social environment and individual attributes within the FMLM journey in TTDI, Kuala Lumpur, Malaysia and Bedok, Singapore. The data were collected using direct observation method on site by the researchers based on the selected criteria of walking facilities for the PWD groups studied. The data were analysed to determine the degree accessibility of selected routes based on the barriers and facilitators for the PWD groups.

3.2 Case studies sample site, justification on selected case study and benchmark site

The samples were routed from a naturally occurring retired community (NORC) neighbourhood in Malaysia and Singapore. NORC are communities or cluster of housing not designed for older adults but organically evolve as the residents age (Hunt & Gunter-Hunt, 1986). The rationale behind choosing NORC neighbourhoods are because the growing trend of aging-in-place in Southeast Asia specifically Malaysia and Singapore and the opportunities and challenges within existing built environment to support its ageing and disabled residents. The purpose of area sampling was to collect information in a particular or localised area (Sekaran & Bougie, 2016). The routes were selected to emulate three travel scenarios between Mass Rapid Transit (MRT) Station and commercial, recreational, and educational needs. Maps shown in Fig. 1 are the illustration of routes selected and legends of nearby community facilities of the two case study sites in TTDI, Kuala Lumpur, Malaysia (Case Study A) and

Bedok, Singapore (Case Study B). Fig. 2 shows the three Examination Travelling Routes (ETRs) in Case Study A which were TTDI MRT to TTDI Commercial Area (MY1), TTDI MRT to Lembah Kiara Park (MY2) and TTDI Secondary School to TTDI MRT (MY3). In addition, replication of similar routes was made for benchmarking in Case Study B; Kembangan MRT to Kembangan Commercial Area (SG1), Bedok MRT to East Coast Park (SG2) and Opera Estate Primary School to Kembangan MRT (SG3) (Fig. 2).

Focusing on a specific site of study in Kuala Lumpur, TTDI was selected due to the diverse users and visitors, including PWD within the community. In addition, the complexity of the infrastructure in TTDI fulfils the requirement of this study. Two neighbourhoods (TTDI, Malaysia and Bedok, Singapore) through direct observation were investigated to evaluate the impact of neighbourhood environmental factors on travel needs, such as feasibility, accessibility, safety & security, cost, pleasure, and health, to identify the determinants of a PWD-friendly neighbourhood.

Singapore was chosen as a corresponding benchmarking city due to its historical background being like Malaysia which were both under the British colony as well as climatic and geographical location. Singapore is a reasonably advanced city in terms of a holistic public transport system for its diverse society. In addition, Singapore has fulfilled the three elements of a good walking environment, namely design, density and diversity as described in Section 1.2 above. Therefore, Singapore is justifiable to be selected as a reference for inclusive public transport connectivity strategies linking suburban and urban areas, specifically for subsequent upgrading the FMLM of NORC neighbourhood. Additionally, the findings from this study, may provide new information specific to developing countries that may be applied to other similar fast developing countries globally, taking into consideration aspects of physical, social, economic, safety and health of inclusive modern society.

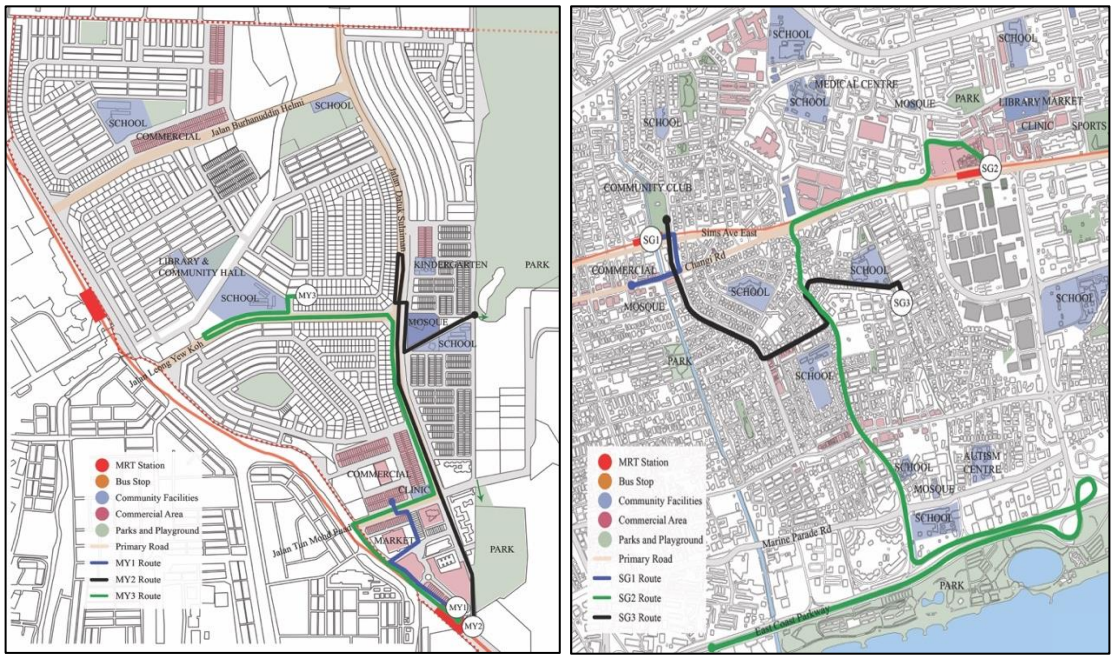

Fig. 1. Case study A: Routes MY1, MY2, MY3 (left) and Case Study B: Routes SG1, SG2, SG3 (right).

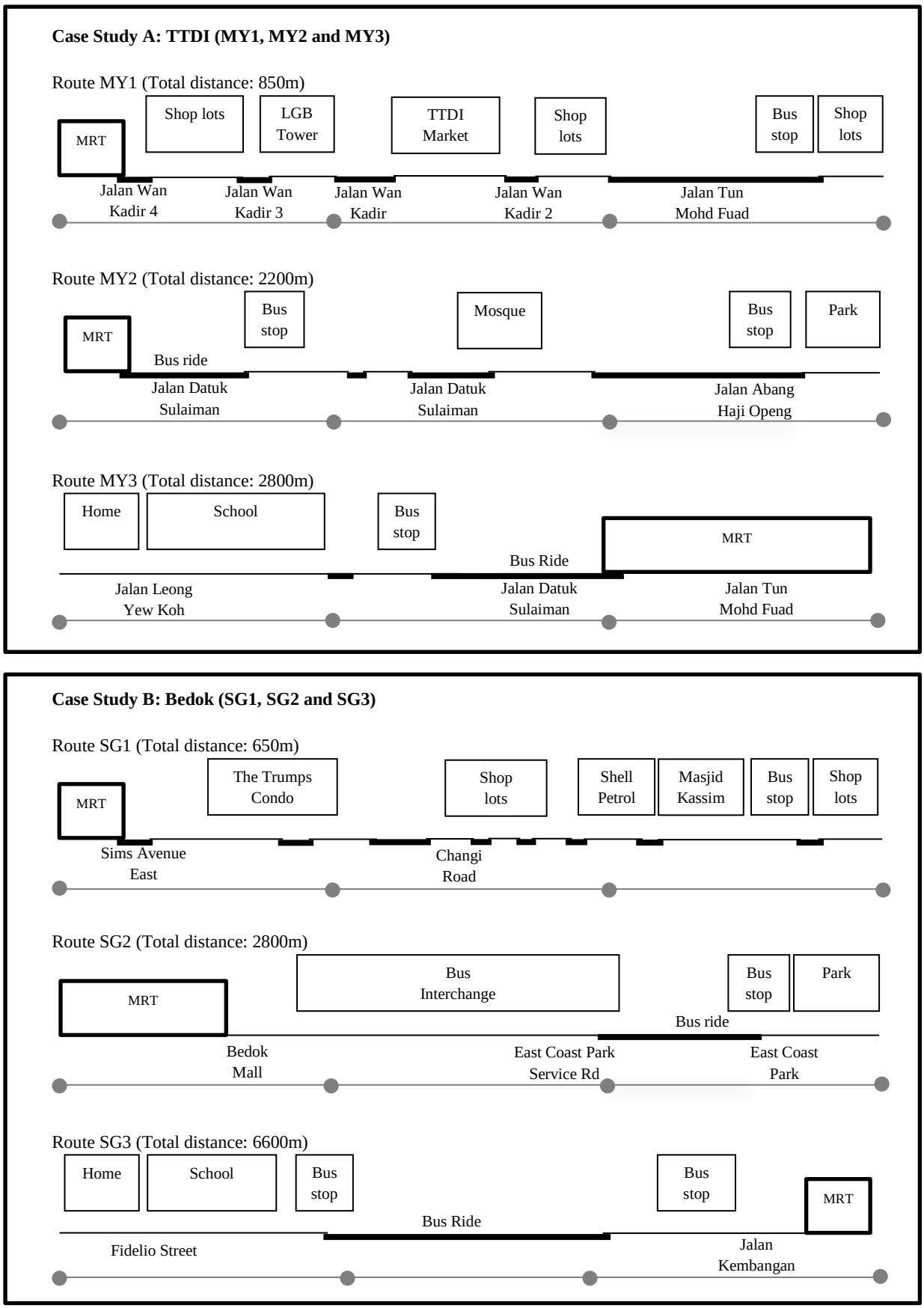

Fig. 2. Graphic illustration of journey along six routes: (top) TTDI (MY1, MY2, MY3) and (bottom) Bedok (SG1, SG2, SG3).

3.3 Data collection

Qualitative data were collected through direct observation using an access audit checklist. The direct observation instrument was to measure environmental characteristics as evidenced in case study research. Observation on the neighbourhood provided new contextual knowledge on the chosen phenomenon (Yin, 2014). Data were collected in TTDI site on the following dates, i.e., 1-3 November 2017, 26 January 2018, 20-22 March 2019, which included observations made through fieldwork and documentary evidence. Access audit and observations by the authors were documented through notetaking, sketches, measurements, and photographic evidence. The direct observation instrument was developed from the conceptual framework and existing standards and guidelines in Malaysia and Singapore, consisting of the following domains: connectivity, comfort, attitude, legibility, and safety. Benchmarking data were collected from Bedok, Singapore, on 11-14 July 2018 and 28 March - 3 April 2019.

3.4 Data analysis

Walking facilities were identified as facilitators or barriers with the intention to evaluate the relationship between the routes and the selected criteria of walking facilities pertaining to accessibility and connectivity in the FMLM neighbourhood for PWD. The parameters measured were the frequency and percentage of facilitators and barriers along the route, the level of accessibility and inaccessibility of built environment along the route, comparison of the accessibility and inaccessibility between TTDI and Bedok and identification of PWD category with their respective degree of difficulties based on barriers. The data for the point and line types were presented in tabular form and infographic illustration. The walking facilities criteria were organised using different colours, indicating the level of accessibility, i.e., not accessible (red), slightly accessible but unsafe (orange), accessible but with a movable barrier (yellow), and accessible (green). The findings of this work would provide the fundamental information on the degree of accessibility of walking routes that could be useful to enhance the FMLM for both TTDI and Bedok with regards to PWD groups.

4. RESULTS

In this research, Fig. 3 depicts visual evidence comparing physical infrastructure between TTDI, Kuala Lumpur, Malaysia and Bedok, Singapore. Fig. 3(a, c, e, g, i) show the barriers of kerb step at pavement, no pedestrian crossing, obstruction on pavement, no bus information at bus stop, landscape obstruction on pavement, and no walkway shelter, respectively. On the other hands, Fig. 3 (b, d, f, h, j) show the facilitators of kerb ramp at pavement, pedestrian crossing provided, unobstructed pavement, bus information at bus stop, and walkway shelter.

The tabular and infographic information of the collected data for the determinants of the study involving the transportation services, built environment, social environment, and individual attributes in the FMLM neighbourhood in TTDI and Bedok are presented in Tables 2 and 3 as well as Fig. 4 and 5, respectively. The data in the corresponding table were presented based on the descending frequency of sub-criteria occurrence for both countries by summarising the data for all three routes (i.e., f=MY1+MY2+MY3).

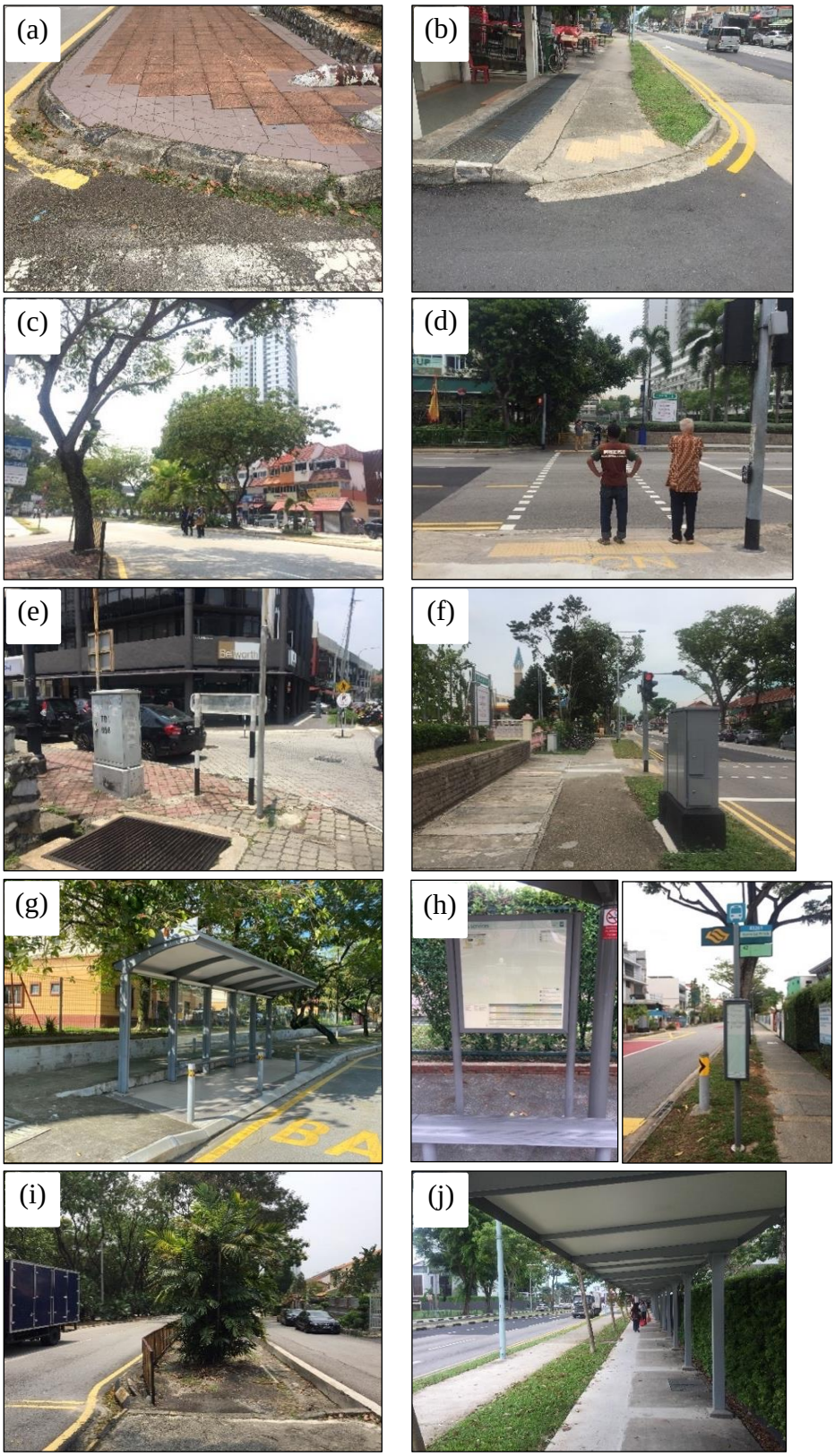

Fig. 3. Visual evidence of physical attributes between TTDI, Kuala Lumpur and Bedok, Singapore. (a) kerb step on pavement at TTDI; (b) kerb ramp on pavement at Bedok; (c) no pedestrian crossing at TTDI; (d) pedestrian crossing at Bedok; (e) obstruction on pedestrian pavement at TTDI; (f) buffer zone for amenities and street furniture at Bedok; (g) no bus stop information at TTDI; (h) bus stop information at Bedok; (i) poor pavement condition with landscape obstruction and without walkway shelter; (j) good pavement condition with walkway shelter at Bedok.

Table 2 : Summary of facilitator and barrier types in Study A, Malaysia (Case Study MY1, MY2, MY3 combined). Data based on the descending frequency of sub-criteria occurrence for all three routes (f=MY1+MY2+MY3).

	Not accessible						Accessible						Total n (100%)
PWD Groups	PH	BL	LD	DF	OL	Sub-total n (%)	PH	BL	LD	DF	OL	Sub-total n (%)	
Kerb ramp or step	27	28	26	18	19	118 (84.4)	1	0	2	10	9	22 (15.6)	140
Pedestrian crossing	11	11	11	11	11	55 (91.5)	1	1	1	1	1	5 (8.5)	60
Motorcycle parking attitude	9	9	9	9	9	45 (100)	0	0	0	0	0	0 (0)	45
Even pavement	3	3	3	3	3	15 (37.5)	5	5	5	5	5	25 (62.5)	40
Pavement material	3	3	3	2	2	13 (37.2)	4	4	4	5	5	22 (62.8)	35
Width of pavement	4	3	3	2	3	15 (42.9)	3	4	4	5	4	20 (57.1)	35
Car parking attitude	6	6	6	6	6	30 (100)	0	0	0	0	0	0 (0)	30
Unobstructed pavement	2	2	2	2	2	10 (40)	3	3	3	3	3	15 (60)	25
Bus drop-off and layby	0	0	0	0	0	0 (0)	4	4	4	4	4	20 (100)	20
Continuous pavement	3	3	3	3	3	15 (100)	0	0	0	0	0	0 (0)	15
Landscaping	3	3	3	3	3	15 (100)	0	0	0	0	0	0 (0)	15
Directional signage	0	0	0	0	0	0 (0)	3	3	3	3	3	15 (100)	15
Drain cover	3	3	3	3	3	15 (100)	0	0	0	0	0	0 (0)	15
Step-free access	1	2	1	0	0	4 (40)	1	0	1	2	2	6 (60)	10
Lift	0	0	0	0	0	0 (0)	2	2	2	2	2	10 (100)	10
Bus service information	1	2	1	1	1	6 (60)	1	0	1	1	1	4 (40)	10
Announcement in bus	0	1	0	0	0	1 (20)	1	0	1	1	1	4 (80)	5
Waiting area and seating	0	0	0	0	0	0 (0)	1	1	1	1	1	5 (100)	5
Temporary signage and warning	0	0	0	0	0	0 (N/A)	0	0	0	0	0	0 (N/A)	0
Total	76	79	74	63	65	357 (67.4)	30	27	32	43	41	173 (32.6)	530

Table 3: Summary of facilitator and barrier types in Study B, Singapore (Case Study SG1, SG2, SG3). Data based on the descending frequency of sub-criteria occurrence for all three routes (f=SG1+SG2+SG3).

	Not accessible						Accessible						Total n (100%)
PWD Groups	PH	BL	LD	DF	OL	Sub-total n (%)	PH	BL	LD	DF	OL	Sub-total n (%)	
Kerb ramp or step	0	2	1	0	0	3 (3.2)	19	17	18	19	19	92 (96.8)	95
Directional signage	0	3	0	0	0	3 (5.5)	11	8	11	11	11	52 (94.5)	55
Width of pavement	0	0	0	0	0	0 (0)	10	10	10	10	10	50 (100)	50
Bus service information	0	2	0	0	0	2 (4.4)	9	7	9	9	9	43 (95.6)	45
Pavement material	1	1	1	1	1	5 (14.5)	6	6	6	6	6	30 (85.5)	35
Unobstructed pavement	0	0	0	0	0	0 (0)	6	6	6	6	6	30 (100)	30
Pedestrian crossing	0	0	0	0	0	0 (0)	5	5	5	5	5	25 (100)	25
Step-free access	0	0	0	0	0	0 (0)	5	5	5	5	5	25 (100)	25
Bus drop-off and layby	1	1	1	1	1	5 (25)	3	3	3	3	3	15 (75)	20
Waiting area and seating	0	0	0	0	0	0 (0)	4	4	4	4	4	20 (100)	20
Even pavement	0	0	0	0	0	0 (0)	3	3	3	3	3	15 (100)	15
Landscaping	0	0	0	0	0	0 (0)	3	3	3	3	3	15 (100)	15
Lift	0	0	0	0	0	0 (0)	3	3	3	3	3	15 (100)	15
Continuous pavement	0	0	0	0	0	0 (0)	2	2	2	2	2	10 (100)	10
Drain cover	0	0	0	0	0	0 (0)	2	2	2	2	2	10 (100)	10
Announcement in bus	0	2	0	2	0	4 (40)	2	0	2	0	2	6 (60)	10
Motorcycle parking	1	1	1	1	1	5 (100)	0	0	0	0	0	0 (0)	5
Temporary signage and warning	0	0	0	0	0	0 (0)	1	1	1	1	1	5 (100)	5
Car parking	0	0	0	0	0	0 (N/A)	0	0	0	0	0	0 (N/A)	0
Total	3	12	4	5	3	27 (5.6)	94	85	93	92	94	458 (94.4)	485

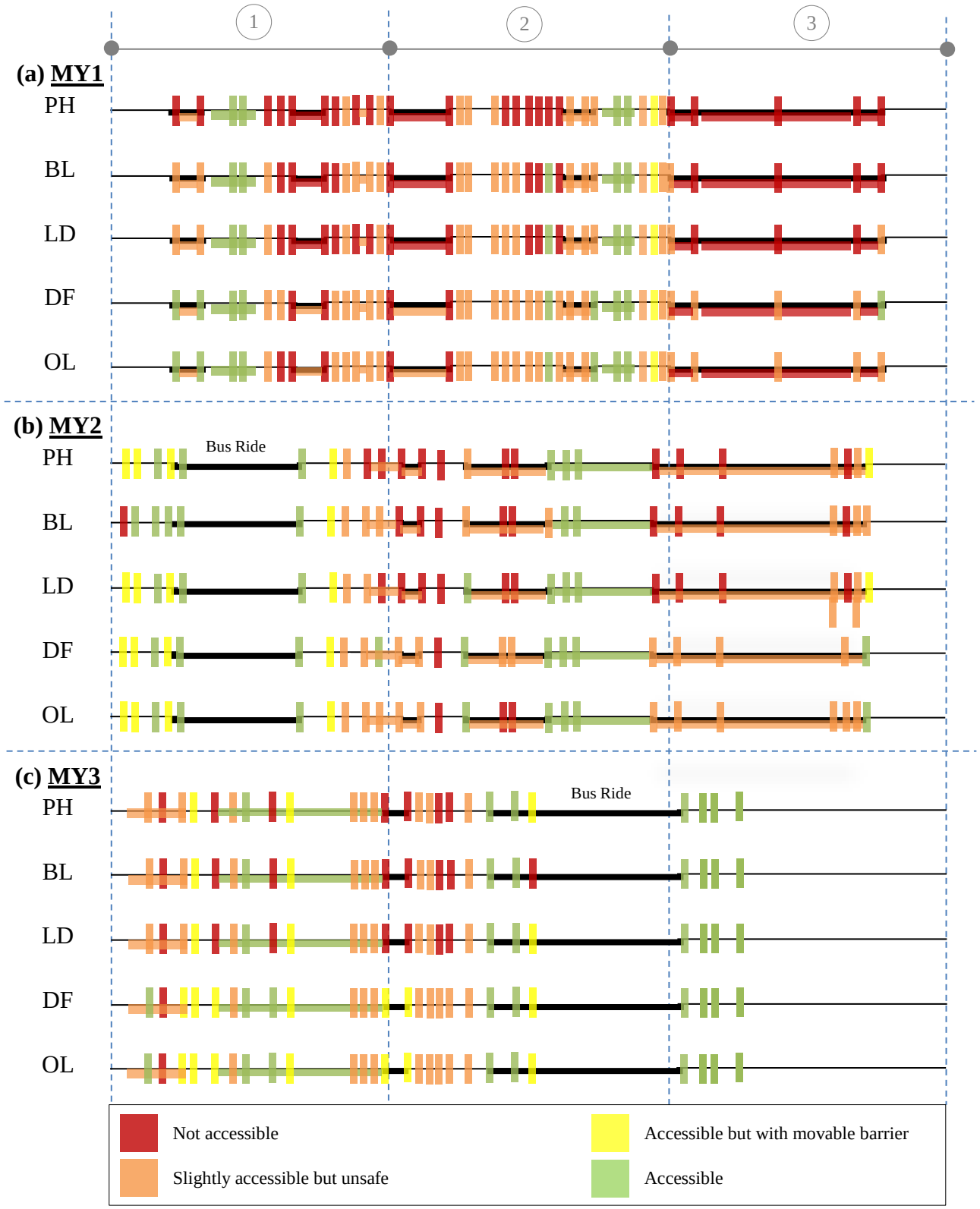

Fig. 4. Identification of obstacles within first mile last mile TTDI neighbourhood.
a) Route MY1, b) Route MY2 and c) Route MY3.

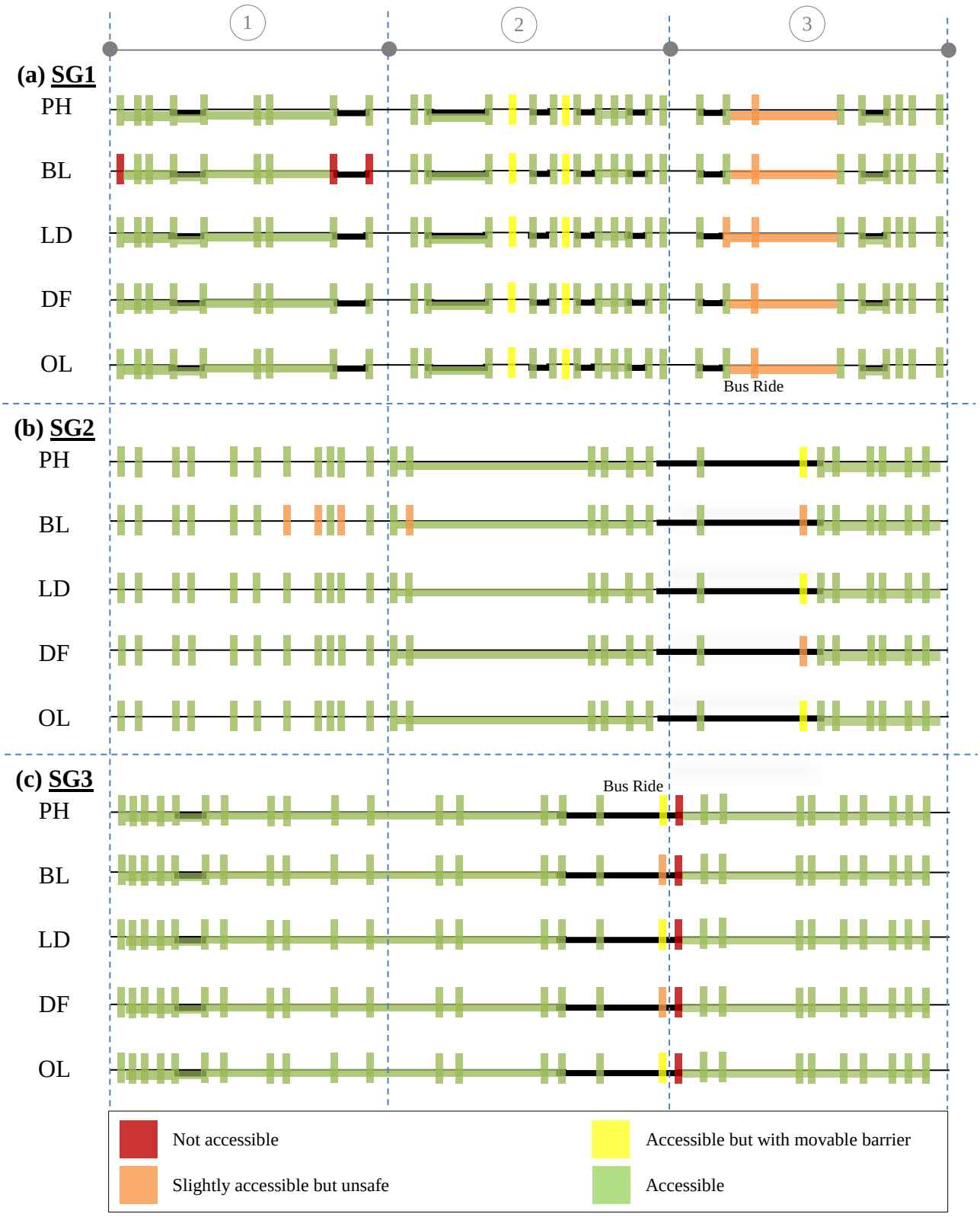

Fig. 5. Identification of obstacles within first mile last mile Bedok neighbourhood.
a) Route SG1, b) Route SG2 and c) Route SG3.

These findings revealed that a major difference in the walkability in the studied FMLM neighbourhoods. Majority of the PWD groups faced difficulties in walkability in TTDI which contrasted with the results for Bedok, Singapore. As shown in Table 2, in the case of TTDI, the major environmental facilitators and barriers subtotal occurrences for all PWD groups studied (out of 530) were numerous and are listed in descending order as follows: kerb ramp or step (140), pedestrian crossing(60), motorcycle parking attitude (45), even pavement (40), pavement material (35), width of pavement (35), car parking attitude (30), unobstructed pavement (25), bus drop-off and layby (20), continuous pavement (15), landscaping (15), directional signage (15), drain cover (15), step-free access (10), lift (10), bus service information (10), announcement in bus (5), waiting area and seating (5) and temporary signage and warning (0). As for Bedok, the descending order list is given as follows (out of 485): kerb ramp or step (95), directional signage (55), width of pavement (50), bus service information (45), pavement material (35), unobstructed pavement (30), pedestrian crossing (25), step-free access (25), bus drop-off and layby (20), waiting area and seating (20), even pavement (15), landscaping (15), lift (15), continuous pavement (10), drain cover (10), announcement in bus (10), motorcycle parking attitude (5), temporary signage and warning (5) and car parking attitude (0).

It indicated that the major issues of walking facilities for PWD groups in TTDI (Table 2) involved criteria of pavement quality (horizontal connectivity), motorist parking (attitude), and pedestrian safety (safety and horizontal connectivity); while in Bedok (Table 3), conversely the similar walking facilities were less of an issue, except for signage (legibility). TTDI showed higher inaccessible walking facilities (67.4%) than Bedok (5.6%). Out of 67.4% inaccessible walking facilities in TTDI, for the PWD groups were further divided into PH (14.3%), BL (14.9%), LD (14%), DF (11.9%), and OL (12.3%); whereas in Bedok, out of 5.6% inaccessible walking facilities, the PWD subgroups were BL (2.6%), DF (1.1%), LD (0.9%), PH (0.6%), and OL (0.6%). The actual detailed data on walking facilities are not shown in the tables for the individual route for the reason to simplify and appropriation of the presentation.

4.1 Summary of facilitators and barriers based on routes in Study A (Case Study MY) and Study B (Case Study SG)

Illustrations on Fig. 4 and 5 were derived from the access audit checklist and the assessment levels indicated by different colours (as described in the Method section) were part of an assessment mapping of environmental facilitators and barriers (based on number of occurrence) for each PWD groups along the routes studied.

The data analysis revealed four significant underlying themes: transportation service determinants, built environment characteristics, individual attributes, and social environment. Subsequently, all these determinants are described below to detail out the elements involved in the facilitators and barriers for the PWD groups for the different routes understudied.

4.2 Transportation service determinant

Transportation service determinant consists of the following subthemes: accessibility, availability, connectivity, safety, information. The description is given in the following subsection.

4.2.1 Availability

Walking facilities within FMLM in TTDI were available along MY1, MY2, MY3, connecting the TTDI MRT station to residential area, commercial, and community facilities. In addition, MRT feeder buses servicing the neighbourhood as a transportation option were available, thus reduced the walking barriers as observed in Route MY2 and MY3. Similarly, walking facilities and infrastructure were available in Bedok which connects Kembangan MRT station and Bedok MRT station to residential area, commercial and community facilities and were supported by several bus service options including MRT Feeder Bus.

4.2.2 Connectivity

Routes MY1 and MY2 showed examples of lack of continuity between pedestrian walkways. Seamless travels were not achievable due to steps at every intersection or crossing and unavailability of pedestrian pavement along

certain routes such as along Jalan Datuk Sulaiman in Route MY2 as shown in Fig. 3 (a,c,i).

Along the SG1, SG2, and SG3 routes, multiple crossings available and accessible with supporting infrastructure such as crossing information, crossing signage, warning tactile, visual signal and zebra crossing; and steps on both sides. Kerb cuts at every intersection or crossing, connectivity between pedestrian walkways were generally seamless especially for PH, BL, and LD as shown in Fig. 3 (b,d).

4.2.3 Safety

Along the MY1 journey, multiple crossings were available but not easily accessible with no crossing information, crossing signage, warning tactile, visual signal, zebra crossing, and steps on both sides. Kerb steps at every intersection or crossing were dangerous especially for PH, BL, LD, and OL groups. For example, no crossing along Jalan Tun Mohd Fuad main road (Fig. 3c) that connected the two commercial areas. Fast and heavy vehicular traffic along 5 lanes to cross from one side of the commercial area to another. Pedestrians used the island as a break between crossing the main road. Next crossing was 100 m apart at the traffic light. In addition, walking along the housing area was dangerous due to unavailability of pedestrian walkway (MY3).

In contrast, the pedestrian crossing at the Sims Avenue East main road, Singapore that connects the MRT to the commercial areas has pedestrian crossing with traffic light, audio signal, and visual signal as well as Green Man Plus feature for extension of crossing time using a special Singapore Land Transport Authority (LTA) concession card for PWD and older adults above 60 who may require more time crossing the road.

4.2.4 Information

Information within the route is critical for ensuring a seamless travel experience. Existing MRT feeder bus in service in TTDI had LED with incoming bus stop information display but did not have audio announcement facility in the bus ride to At-Taqwa Mosque (MY2) and TTDI MRT station (MY3). Similarly, in Bedok, no audio announcement facility was available for the BL group in the bus ride to the East Coast Park and Kembangan MRT station as observed in Route SG2 and SG3 respectively.

Additionally, access to information pre-travel is essential in managing expectation. Majority of TTDI bus stops did not have a bus information board. In contrast, bus stops in Bedok had a standardised bus information board which included bus service, bus stop code, frequency range, approximate arrival time, distance, bus stop description, information on transport apps and fares. Both TTDI and Bedok transit stations had website information on address, train schedule, feeder bus service, available station facilities and surrounding attractions. However, the Singapore case study had additional useful information on station layout, accessible features and exits and rail bridging service (in case of MRT service disruption); which would greatly benefit all users including PWD groups.

4.3 Built environment characteristics (quality of pedestrian infrastructure)

Based on Fig. 4, many barriers highlighted in Routes MY1, MY2 and MY3 that were faced by the PWD groups where due to the quality of pedestrian infrastructure. From the results, as for inaccessibility for various barriers in Malaysia, out of 530, the top frequencies of barriers were as follows: 118 (kerb step), 55 (pedestrian crossing), 45 (motorcycle parking), 30 (car parking), 15 (width of pavement), 15 (uneven pavement), 15 (continuous pavement), 15 (landscaping) and 15 (drain cover) for all PWD groups. However, similar environmental elements were not an issue in Singapore as indicated in the following data: 3 (kerb step), 0 (pedestrian crossing), 1 (motorcycle parking), 0 (car parking), 0 (width of pavement), 0 (uneven pavement), 0 (continuous pavement), 0 (landscaping) and 0 (drain cover) for all PWD groups. Table 4 shows a general comparison between walking facilities condition of the two case studies in Malaysia and Singapore based on findings in the results section.

4.3.1 Quality of pedestrian infrastructure

Majority of walking facilities along Route MY1, MY2 and MY3, were inaccessible to all PWD groups with PH, BL and LD groups had a higher frequency of traveling inaccessibility. From the infographic illustration (Fig. 4), the kerb ramp or

step, pedestrian crossing, motorcycle parking attitude, even pavement, and pavement material were the main barriers for PH, BL and LD groups. Good accessible facilities (Fig. 4; highlighted in green) such as newly upgraded pedestrian pathway along commercial shop lots in MY1, pedestrian walkway along At-Taqwa Mosque in MY2 and TTDI MRT station in MY3 has taken into consideration most of the pavement quality sub criteria, thus further reduced the walking barriers for PWD groups.

As for Singapore, majority of the walking facilities along Route SG1, SG2 and SG3 were accessible to all PWD groups (Fig. 5; highlighted in green). At most, BL group had barriers along the route due to unavailability of warning tactile at several pedestrian crossings. BL group faced problems with wayfinding and direction getting to the bus exchange station from the shopping mall.

Table 4: List of walking facilities captured on site.

Criteria	Sub-criteria	TTDI, KL, Malaysia	Bedok, Singapore
Pavement quality (Horizontal connectivity)	Kerb ramp or step	Inadequate	Adequate
	Even pavement	Inadequate	Adequate
	Pavement material	Inadequate	Adequate
	Width of pavement	Inadequate	Adequate
	Unobstructed pavement	Inadequate	Adequate
	Step-free access	Inadequate	Adequate
	Drain cover	Inadequate	Adequate
Shelter (Comfort)	Bus drop-off and layby	Adequate	Adequate
	Waiting area and seating	Adequate	Adequate
	Landscaping	Inadequate	Adequate
Motorist parking (Attitude)	Motorcycle parking	Inadequate	Inadequate
	Car parking	Inadequate	N/A
Signage (Legibility)	Directional signage	Adequate	Adequate
	Bus service information	Inadequate	Adequate
	Announcement in bus	Inadequate	Inadequate
	Temporary signage and warning	N/A	Adequate
Vertical connectivity	Lift	Adequate	Adequate
Pedestrian safety (Safety & horizontal connectivity)	Continuous pavement	Inadequate	Adequate
	Pedestrian crossing	Inadequate	Adequate

4.3.2 Familiarity

No standardised design such as repetitive usage of material and warning tactile placement along the pedestrian walkway were observed in Routes MY1, MY2, and MY3. Therefore, not only create confusion but unfamiliar for the BL and LD groups. As for Singapore, no such issues were observed.

4.4 Social environment determinant (societal attitude)

In Route MY1, man-made movable obstruction on the newly made pedestrian walkway such as rubbish bin by operators, planter box, motorcycle, and cars blocked ramps to walkways. Illegal motorcycle and car parking along Routes MY1, MY2 and MY3 showed attitude towards other peoples' convenience. For Route MY3, man-made obstruction on the pedestrian walkway in front of the school such as rubbish bin blocked the ramps to walkways.

As for Singapore, along the route, the minor barriers for all PWD groups were mainly movable objects on pedestrian walkways. A special case of motorcycle illegal parking was observed in this route. In addition, bus passengers were not dropped off at the designated bus stop area resulting in inconsistent routine, thus inconvenience to the PWD groups (SG3).

4.5 Individual attributes determinant (persons with disabilities)

It was noted that PH, BL, and LD groups faced more walking barriers compared to DF and OL groups for Routes MY1, MY2, and MY3. Based on Case Study A; PH, BL, and LD groups had issues with barriers such as kerb step or ramp, steps on route and pavement evenness, width and material compared to DF and OL groups. Additional barriers existed for BL group pertaining bus service information and announcement in bus. On the other hand, no apparent difference was observed between the 5 groups on obstacles and safety with Route SG1, SG2, and SG3. Within the Case Study B routes, majority of the way was accessible with some obstacles for the BL group.

5. DISCUSSION

From the findings of this work, the walking facilities were available for both countries. However, TTDI, Kuala Lumpur, Malaysia had facilities that were less accessible to the PWD groups compared with Bedok, Singapore counterparts. From the detail of the studies, the main issues involved the quality of the facilities which was relatively inferior in TTDI than in Bedok. For examples, in TTDI, the Route MY1 (travelling to commercial) was the most inaccessible, followed by Route MY2 (travelling to park), and Route MY3 (journey to school). Routes MY2 and MY3 had newer upgraded public transport facilities such as TTDI MRT station and upgraded pedestrian walkway. Routes MY2 and MY3 included a bus ride instead of only walking. The MRT feeder bus was used as a transport option to the TTDI MRT station and a mode to get around the neighbourhood. A specific example of the actual situation of the FMLM neighbourhood in TTDI was illustrated in Route MY2. In this route, the distributions of this accessibility and non-accessibility were quite similar. The accessible portion was due to the new construction of infrastructures including one-third of the journey was serviced by the MRT Feeder bus; subsequently, fewer walking obstacles were encountered by the PWD groups.

According to Boakye-Dankwa et al. (2019), one of the primary causes for differences in older persons' participation in walking for transportation was the variation in destination accessibility of shops, commercial services, education and recreational destinations. Findings from their study suggested that offering necessary access and amenities for everyday living as well as strong transportation connections to other neighbourhoods could facilitate older adults who wanted to age in place and maintain an independent and active lifestyle. Therefore, to overcome the obstacles, duly attention on the upgrading of FMLM neighbourhood infrastructures and the multi-mode journey that includes buses to service routes to ensure seamless mobility and safe mode to travel, particularly the PWD groups in the future.

In comparison to Bedok, TTDI had inadequate walking infrastructure such as pavement quality, shelter, motorist parking, signage, and pedestrian

safety facilities (Table 4). In addition, from the visual evidence in Fig. 3, it shows the infrastructure at TTDI, Kuala Lumpur were less PWD-friendly when compared with Bedok, Singapore. For instance, pedestrian pavements were barriers to FMLM walkability due to poor design, quality, material, and maintenance. However, compared to Singapore, these infrastructures were facilitators to FMLM walkability. The objective approach used in this study to identify barriers and facilitators was essential in addressing limitations in a previous study on quality and liveability of Kuala Lumpur streets by Mahmoudi, Ahmad, and Abbasi (2015). Although there was substantial evidence for existence of physical problem on site, their study revealed subjective perception by questionnaire survey respondents who may have overlooked the implications of physical problems.

The critical findings from this study were the obstacles faced by specific PWD groups, mainly PH, BL and LD groups for all Route MY. Among the PWD groups, PH groups were severely affected concerning accessibility and connectivity in the FMLM of the public transport system in the Kuala Lumpur neighbourhood. This was probably due to the physical constraints which affected mobility during travel in the neighbourhood. For example, issues on seamless such as high kerb steps, unavailability of pedestrian crossing, narrow walkway width, and obstructed walkway posed total inaccessibility for PH group compared to other PWD groups studied. As for the BL group, the main issues faced were the lack of warning information such as warning tactile at kerb step or ramp and narrow walkway with obstructions could result in severe accidents. In addition, BL group faced issues without audio announcement in bus. Unlike the other PWD groups, the LD faced the challenges of adapting to the inconsistent and unfamiliar infrastructure design to enable them to travel independently in the neighbourhood. As expected, the DF group had relatively more minor issues regarding barriers than the other PWD groups. As for the OL, despite similar obstacles, the extent of barrier issues faced was less compared with PH, BL, and LD. Therefore, the related authorities should pay attention to barriers and other physical constraints, warning information, and wayfinding should be monitored and overcomed regularly. These findings would be a valuable addition to the present body of knowledge, which primarily focused on comparing disabled and non-disabled population, with little study comparing the different groups of PWD to as mentioned by Kett et al. (2020). This finding agreed with Kett et al.'s study which noted that even with limited evidence of what works for specific populations, it was evident that there was no one-size-fits-all answer to these problems of FMLM public transport in Kuala Lumpur, Malaysia.

On the other hand, the findings for Bedok, Singapore showed that the walking facilities were accessible to the PWD groups. It was found out that the similar facilities were user friendly and easily accessible to the inclusive society of Singapore that could be due to up-to-date facilities, well maintained as well as disciplined and civic-minded citizens. This was probably due to the human values of Singaporeans with high public awareness towards inclusive, respectable, and mutually responsible society in tandem with the philosophy of Singapore to strive for excellence and meritocracy to maintain the high standard of an advanced country.

Naharudin et al. (2017) hypothesised that increasing the number of built environments was positively related to the pedestrian-attractiveness score (%). They also suggested that a station with more preferred built environment (such as signage showing direction, row of roof, and signage showing distance) had higher pedestrian-attractiveness score. In this work, the quality of the built environment played important role to assess the walkability of a route particularly of the PWD groups. For examples, height and gradient of kerb ramp, pedestrian crossing indicator, and pavement evenness and width influenced the scoring category, whereby the better the built environment quality, the higher the accessibility score. Therefore, while the findings from the present research agreed with that of Naharudin (2017), other detailed considerations should be emphasised such as the quality of the built environment as well as the complementary inaccessible walking facilities should be taken into account in making a more reliable and reputable walkability assessment score. It was interesting to note that despite similar studies between Malaysia and Singapore with generally similar walking facilities for PWD groups, the accessibility of FMLM walking facilities was

more favourable in the latter than the former. The findings on inaccessibility of related facilities were higher in Malaysia than in Singapore for all routes. For examples, similar facilities (such as pavement quality, shelter, signage, and pedestrian safety) in Singapore were accessible (94.4%) to the PWD but less accessible (32.6%) in Malaysia. The reasons were not known; however, it could be due to the quality of the available facilities, attitude of users, and the inadequate maintenance of the facilities. In addition, value added features such as Green Man Plus for extension of the crossing time would allow older adults pedestrians and PWD to complete the crossing at a more comfortable pace. Furthermore, homes at Opera Estate must adhere to strict Urban Design Guidelines such as limitation to gate opening to allow for buffer islands and pedestrian walkway in front of all houses. This is to ensure that pedestrians including PWD groups do not have to use the road as means of walking.

It is worth noting that currently FMLM at TTDI has one of the best walking facilities among other NORC neighbourhoods in Kuala Lumpur due to the availability of transit station MRT, MRT Feeder Bus serving the neighbourhood and regular pedestrian walkway upgrading as evident in MY3. Route MY3 was comparatively better than Routes MY1 and MY2 that was observed to be availability and the quality of the facilities was better in the former, leading towards a more inclusive FMLM public transport system for the users. Therefore, we believed that the information obtained from this study would provide new comprehensive approach to a better walkability assessment of FMLM neighbourhood for PWD in various cities in Malaysia.

Generally, the policy and walking infrastructures in Kuala Lumpur, Malaysia are already in place, and they have been updated from time to time. Given the above identification of the barriers, it is suggested that the local authorities and service providers should work hand in hand to upgrade the facilities with the right and standardised specifications on Malaysian Standards (MS 1184) with special attention on proper design and implementation as well as regular maintenance to overcome the barriers and ensuring the accessibility, connectivity, and safety of all users including PWD groups on par with the advanced global standards of public transport system.

Even when physical obstacles are eliminated and has met the global standard, inevitably bad attitudes can create obstacles across all areas. Motorists and land users' attitude should be re-evaluated through proper education system and awareness campaign in the country. Due to unavailability of assistance or services on ground, there should be constant surveillance for crime prevention as well as general safety and help in case of emergency. Awareness through education within the society should be embedded within the education system particularly the early education system. To combat disability-related ignorance and discrimination, through awareness-raising education towards the livelihood and safety of PWD are needed at all levels of society. This kind of education should be an integral part of regular professional training in architecture, building, design, information technology, and marketing. In this regard, policymakers as well as related stakeholders and advocates for disabled persons must be informed on the critical nature of accessibility of public transport system to make Malaysia a truly inclusive advanced society in par with other established modern societies.

It is hoped that the outcomes of this research would provide inroads for better walking facilities to ensure connectivity, comfort, attitude, legibility, safety and health for the shared users in the FMLM neighbourhoods in tandem with a developed and vibrant city of Kuala Lumpur, Malaysia.

6. CONCLUSION

Inclusive neighbourhood could be achieved by taking into consideration the determinants of various multitudes, such as transportation service determinant, built environment characteristics, social environment, and individual attributes in improving the social wellbeing of PWD in Kuala Lumpur, Malaysia. In this work, the understanding of the walkability of FMLM neighbourhood indicated that the PWD groups were facing more problems compared with Singapore PWD groups with regards to usability and safety of the walking facilities. The major inaccessibility issues were the built environment characteristics and social environment determinants concerning quality of walking facilities as well of the attitude of the public that make the dissatisfaction faced by the PWD in

Malaysia particularly persons with physical disabilities, blind, and learning disabilities. In view of the understanding of issues and perspectives of seamless public transport system in Malaysia, systematic changes in approach such as transparency, objectivity, and real-time problem solving should be given a high priority in government policy, government agencies, transport provider, and businesses in planning and designing the built environment. The findings from this study were hoped to improve the knowledge on mobility and productivity of the society involved as well as providing inroads for future studies in public transport planning in general and inclusive walkability, accessibility, and safety in FMLM neighbourhood in Kuala Lumpur, Malaysia in particular. The outcome of this focused research could be a model to be applied to other developing and under-developed countries of the world before achieving a sustainable and inclusive developed country status including diversified categories of people with disabilities.

7. REFERENCES

1. Azmi, D. I., Karim, H. A., & Amin, M. Z. M. (2013). Walking behaviour of urban and rural residents. *Journal of Asian Behavioral Studies, 11*, 97-110.

2. Barton, H., Grant, M., & Guise, R. (2003). *Shaping neighbourhoods: A guide for health, sustainability and vitality*: Taylor & Francis.

3. Boakye-Dankwa, E., Nathan, A., Barnett, A., Busija, L., Lee, R. S., Pachana, N., . . . Cerin, E. (2019). Walking behaviour and patterns of perceived access to neighbourhood destinations in older adults from a low-density (Brisbane, Australia) and an ultra-dense city (Hong Kong, China). *Cities, 84*, 23-33.

4. Cerin, E., Nathan, A., Van Cauwenberg, J., Barnett, D. W., & Barnett, A. (2017). The neighbourhood physical environment and active travel in older adults: a systematic review and meta-analysis. *International Journal of Behavioral Nutrition and Physical Activity, 14*(1), 1-23.

5. Cheng, Y. H., & Chen, S. Y. (2015). Perceived accessibility, mobility, and connectivity of public transportation systems. *Transportation Research Part A: Policy and Practice, 77*, 386-403.

6. Clark, A. F., & Scott, D. M. (2016). Barriers to walking: an investigation of adults in Hamilton (Ontario, Canada). *International Journal of Environmental Research and Public Health, 13*(2), 179.

7. Department of Social Welfare. (2018). Social welfare statistics report 2018. Retrieved from www.jkm.gov.my

8. Department of Social Welfare. (2021, 14 April 2021). Persons with disabilities registration. Retrieved from https://www.jkm.gov.my/jkm/index.php?r=portal/left&id=UnN2U3dtUHhacVN4aHNPbUlPayt2QT09

9. Department of Statistics Malaysia. (2020). Current population estimates, Malaysia, 2020 [Press release]

10. Guerra, E., Cervero, R., & Tischler, D. (2012). Half-mile circle: Does it best represent transit station catchments? *Transportation Research Record, 2276*(1), 101-109.

11. Guo, Z., & Loo, B. P. (2013). Pedestrian environment and route choice: evidence from New York City and Hong Kong. *Journal of Transport Geography, 28*, 124-136.

12. Hunt, M. E., & Gunter-Hunt, G. (1986). Naturally occurring retirement communities. *Journal of Housing for the Elderly, 3*(3-4), 3-22.

13. Karim, H. A., & Azmi, D. I. (2013). Convenience and safety of walking experience in Putrajaya neighbourhood area. *Procedia-Social and Behavioral Sciences, 101*, 318-327.

14. Kett, M., Cole, E., & Turner, J. (2020). Disability, mobility and transport in low- and middle-income countries: a thematic review. *Sustainability, 12*(2), 589.

15. Landis, B. W., Vattikuti, V. R., Ottenberg, R. M., McLeod, D. S., & Guttenplan, M. (2001). Modeling the roadside walking environment: pedestrian level of service. *Transportation Research Record, 1773*(1), 82-88.

16. Mahmoudi, M., Ahmad, F., & Abbasi, B. (2015). Livable streets: The effects of physical problems on the quality and livability of Kuala Lumpur streets. *Cities, 43*, 104-114.

17. Ministry of Social and Family Development. (2018). *Definition of disability and prevalence rate of persons with disabilities in Singapore* Retrieved from https://www.msf.gov.sg/research-and-data/Research-and-Statistics/Documents/EM_Chapter1.pdf

18. Naharudin, N., Ahamad, M. S. S., & Sadullah, A. F. M. (2017). *Pedestrian-attractiveness score for the first/last mile transit route using spatial data collected with a mobile positioning application.* Paper presented at the 2017 European Navigation Conference (ENC).

19. Oliver, M. (2013). The social model of disability: Thirty years on. *Disability & Society, 28*(7), 1024-1026.

20. Onn, C. C., Karim, M. R., & Yusoff, S. (2014). Mode choice between private and public transport in Klang Valley, Malaysia. *The Scientific World Journal, 2014*.

21. Papa, E., & Bertolini, L. (2015). Accessibility and transit-oriented development in European metropolitan areas. *Journal of Transport Geography, 47*, 70-83.

22. Perry, C. A. (1929). *Neighborhood and Community Planning, Volume 7 of Regional Survey of New York and Its Environs*. New York: Committee on the Regional Plan of New York and its Environs.

23. Ragland, D. R., MacLeod, K. E., McMillan, T., Doggett, S., & Felschundneff, G. (2019). Assessing and Addressing the Mobility Needs of an Aging Population. doi:https://doi.org/10.7922/G2GT5KCS.

24. Ratner, K. A., & Goetz, A. R. (2013). The reshaping of land use and urban form in Denver through transit-oriented development. *Cities, 30*, 31-46.

25. Sarkar, C., Webster, C., Pryor, M., Tang, D., Melbourne, S., Zhang, X., & Jianzheng, L. (2015). Exploring associations between urban green, street design and walking: Results from the Greater London boroughs. *Landscape and Urban Planning, 143*, 112-125.

26. Sekaran, U., & Bougie, R. (2016). *Research methods for business: A skill building approach*: John Wiley & Sons.

27. Shrestha, B. P., Millonig, A., Hounsell, N., & Mcdonald, M. (2017). Review of public transport needs of older people in European context. *Journal of Population Ageing, 10*(4), 343-361.

28. Suruhanjaya Pengangkutan Awam Darat. (2016). Railing up for the future. Retrieved from http://www.spad.gov.my/land-public-transport/rail/railing-future

29. Tilahun, N., Thakuriah, P. V., Li, M., & Keita, Y. (2016). Transit use and the work commute: Analyzing the role of last mile issues. *Journal of Transport Geography, 54*, 359-368.

30. United Nations. (2006, 6 July 2021). Convention on the rights of people with disabilities. Retrieved from https://www.un.org/development/desa/disabilities/convention-on-the-rights-of-

persons-with-disabilities/convention-on-the-rights-of-persons-with-disabilities-2.html

31. United Nations. (2015, 22 June 2021). Transforming our world: The 2030 agenda for sustainable development. Retrieved from https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf

32. Van Cauwenberg, J., Van Holle, V., Simons, D., Deridder, R., Clarys, P., Goubert, L., . . . Deforche, B. (2012). Environmental factors influencing older adults' walking for transportation: a study using walk-along interviews. *International Journal of Behavioral Nutrition and Physical Activity, 9*(1), 85. doi:10.1186/1479-5868-9-85

33. World Health Organisation. (2011). World report on disability 2011. Retrieved from www.who.int. Retrieved 16 June 2021 www.who.int

34. Yin, R. K. (2014). *Case Study Research Design and Methods* (Vol. 5th ed). Thousand Oaks, CA: Sage.