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Assessment of physical environment factors for mobility of elderlies: A case study in Hong Kong

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Abstract

To cope with the challenges of increasing older adults residing in cities, the World Health Organization (WHO) introduced the "Age-Friendly City" framework in 2008 (World Health Organization, 2007). One of the main themes is about accessible physical environment that has major impacts on mobility, independence and quality of life of older adults, and their ability to "age in place".

Mobility of older adults is conducive to their physical, emotional, and social wellbeing. Mobility patterns of older adults, how built environment impacts older adults' mobility have been well studied by academics. These studies often required advanced research technique and substantial data collection, it is challenging to incorporate these study approaches into the Age-Friendly City (AFC) framework that emphasizes bottom-up participation and engagement of stakeholders. On the other hand, studies led by stakeholders often relied too much on subjective data sources. To facilitate formulation of strategies and action plans towards age-friendly city, a concise set of age-friendly city indicators needs to be developed: a set of indicators that is objective but agrees well with subjective views of local elderlies, that could be easily understood, and is easy to implement.

This study piloted the adoption of the core indicators set proposed in "*Measuring the age-friendliness of cities: a guide to using core indicators*" (World Health Organization, 2015) in an old urban district in Hong Kong. This study focused on factors related to mobility: walking environment, public transport, and accessible public buildings and spaces. Objective assessments have shown generally high level of performance in these physical environment attributes, the subjective ratings by local older adults were found to have medium relationship to respective objective indicators. However, the relationship is weak in the subdomains of "neighbourhood walkability" and "accessible public spaces and buildings". Actions taken by the government and providers of facilities and services that contributed to the evaluation results are reviewed. Suggestions on how to improve the evaluation framework are discussed.

Age-friendly City, Elderly Mobility, Walking, Public Transport, Assessment

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1 Introduction

1.1 Demographic trends

Population ageing puts economic and social pressure to countries (World Health Organization, 2002). According to reports by the World Health Organization, the proportion of people aged 60 in the global population will double from 11% in 2006 to 22% by 2050. Right now, populating ageing is more a challenge to developed regions than developing regions, such as Europe, North America and Japan. Yet, developing regions are ageing at a faster rate, within five decades, just over 80% of the world's older people will be living in developing countries compared with 60% in 2005 (World Health Organization, 2002, 2007).

As of 2016, out of Hong Kong's 7.33million total population, 15.9% are aged 65 and above. 32.3% of households in Hong Kong are with household members who are aged 65 and above, and around one-third of these households composed of people aged 65 an above only (Census and Statistics Department, 2017). The percentage of population aged 65 and above is expected to increase from 15% in 2014 to 28% in 2034 and 33% in 2064 (Census and Statistics Department, 2015). The situation of population ageing in Hong Kong is similar to other developed regions. How to adequately serve the needs and enhance the quality of life of older people in the urban setting is an urgent challenge for Hong Kong. Hong Kong Government recognizes the importance of age-friendly city and announced initiatives in developing an age-friendly environment in the 2016 Policy Address (Hong Kong Special Administrative Region Government, 2016), these initiatives will be discussed in Section 4 of this paper.

1.2 Age-friendly City

The discussions about strategies and resources that allow cities or communities to respond to population ageing began in North America and Europe in 2000s (Lui, Everingham, Warburton, Cuthill, & Bartlett, 2009; World Health Organization, 2002). World Health Organization (WHO) gathered international experts from 21 countries in 2002 and introduced the notion of "*active ageing*" as: "*Active ageing is the process of optimizing opportunities for health, participation and security in order to enhance quality of life as people age*"(World Health Organization, 2002). After a thorough review active-ageing initiatives since then in North America (Plouffe, Kalache, & Voelcker, 2016), "*Global Age-Friendly City: A Guide"(World Health Organization, 2007)* was published that coined the term "*Age-Friendly City"* with eight focus areas[1]. Apart from defining the focus areas, "*Global Age-Friendly City: A Guide*" emphasized bottom-up participation rather than top-down planning lead by authorities and governments.

The concepts and approaches proposed by WHO have been heavily referenced to since "*Global Age-Friendly City: A Guide"* was published. The guide proposed qualitative assessments of the built, social, and service environments covering the eight focus areas and

[1] The eight focus areas are: 1. outdoor spaces and public buildings; 2. transportation; 3. housing; 4. social participation; 5. respect and social inclusion; 6. civic participation and employment; 7. communication and information; 8. community support and health services.

introduced a handy checklist for self-assessment by cities or communities. Cities who are committed to Age-Friendly City movement began to conduct baselines assessments and develop programmes in their own way, with plenty of examples in WHO's global network of age-friendly cities and communities (GNACC) homepage (World Health Organizaion, n.d.) and in the book "*Age-Friendly Cities and Communities in International Comparison*" (Moulaert & Garon, 2016).

The published baseline studies highlighted that there is no widely-agreed norm on what kinds of subjective or objective data should be used in the assessment of age-friendliness, depending on whether the study is more inclined towards raising public awareness for bottom-up participation, or for the sake of top-down policy and strategy formulation. There are two general observations regarding these baseline assessments by cities or communities:

- Over-dependence on subjective data: Majority of studies are based on comments in focus groups (such as the City of Waterloo (Lewis & Groh, 2016), Quebec (Garon, Veil, Paris, & Rémillard-Boilard, 2016), Hong Kong (Chan, Lou, & Ko, 2016) and France (Pennec & Le Borgne-Uguen, 2016), among others) or subjective Likert-scale rating (Hong Kong (Jockey Club Age-Friendly City, 2018)). Although objective demographic and socio-economic data have been reported, the use of objective data attempting to quantify the degree of age-friendliness can only be seen in very few cases (Philadelphia (Huang & Horstmann, 2012), Cleveland (The Center for Community Solutions, 2016), and Esquimalt (Township of Esquilmalt, 2016)).
- The approach used might be too broad, leading to excessively long survey questionnaires, for example, the 53-item Likert scale questionnaire in Jockey Club Age-Friendly City (2018) and the 60 to 90 minute interviews in Lewis and Groh (2016); errors due to fatigue of respondents is inevitable, and the study results might be overloaded with details .

In view of the diverse approaches adopted and data being reported, WHO recently proposed a core indicator set to establish common understanding, and to set goals and objectives in "*Measuring the Age-Friendliness of Cities: A Guide to Using the Core Indicators*" (World Health Organization, 2015). The desirable qualities in each of the eight age-friendly city (AFC) focus areas are consolidated into "accessible physical environment" and "inclusive social environment" respectively.

1.3 Mobility of Elderlies

Gerontologist might have different views on the definitions and validity on some of the WHO's age-friendly city focus areas, yet, "physical environment" is an aspect that has been agreed unanimously (Plouffe et al., 2016). Mobility (ability to move from one place to another in an independent and a safe way) is indispensable to active ageing. Physical environment (buildings and public spaces, transportation, housing) have major impacts on the mobility, independence and quality of life of older people, and their ability to "age in place" (World Health Organization, 2007).

Mobility of older people contributes to their social wellbeing through getting in touch with family and friends or participating in community activities; being able to move around

independently facilitates their control in the pursuit of activities and thus emotional wellbeing, such as satisfaction and self-esteem; furthermore, walking promotes physical health (Koohsari, Badland, & Giles-Corti, 2013), these all attributes to the quality of life of older people (Flece & Perry, 1995). The review by Whelan, Langford, Oxley, Koppel, and Charlto (2006) also supported the importance of mobility in fulfilling basic needs as well as social and psychological needs of older people; the decline in mobility creates burden to individuals, their families, the community and the society in which they live, and can result in an increase in isolation, loneliness and depression and overall a poorer quality of life (Musselwhite, Holland, & Walker, 2015).

Public transport takes a central role in supporting the mobility of older people. In car-oriented regions such as United States and Europe, public transport takes a dominating role when older people have to cease from driving after around 75 years old (Alsnih & Hensher, 2003; Kim, 2011; Ryan, Wretstrand, & Schmidt, 2015). In transit-oriented cities like Hong Kong, an abrupt change in transport mode is not observed, public transport remained as the most popular way of travel although there's a small change in preference between metro and buses, and there are evolving requirements concerning choice of travel (Wong, Szeto, Yang, Li, & Wong, 2017). Older people in Hong Kong preferred traveling by buses and metro because of their reliable and convenient services (Szeto, Yang, Wong, Li, & Wong, 2017).

Apart from enhancing public transport provision and quality of services to address the mobility needs of older people, the importance of walking should not be overlooked: (i) access to public transport and transfers between vehicles or modes are basically fulfilled by walking; (ii) walking can be the primary travel mode (i.e. covered the most distance of the trip) for short trips (Alsnih & Hensher, 2003; Huang & Horstmann, 2012; Koohsari et al., 2013), and (iii) walking maybe a recreation activity as well. Engel et al. (2016) concluded that older people's wellbeing was associated with street connectivity and social cohesion. Marquet and Miralles-Guasch (2015) identified walking as a mode choice in 69.8% of trips of senior population and they walk more if they live in a more walkable environment.

1.4 Physical Environment and Mobility

Although mobility of older adults also depends on demographic (such as age and household composition), and personal resources (such as health condition, competence (e.g. being licensed to drive), material resources (e.g. income)) (Alsnih & Hensher, 2003; Ryan et al., 2015; Szeto et al., 2017; Wong, Szeto, Yang, Li, & Wong, 2018), the physical environment factors are what local authorities and transport operators can readily influence, and is thus chosen to be the focus of this paper.

There are ample amount of literatures discussing aspects of physical environment that has major impacts on elderlies' mobility.

Rosenberg, Huang, Simonovich, and Belza (2013) explained that for older adults with mobility disabilities (canes, walkers, or wheelchairs), when the built environment is supportive, individuals can use the outdoors for multiple activities including exercises and utilitarian

purposes. Key built environment features were curb ramps, parking spaces, aesthetics, lighting, ramps, crosswalks, sidewalks, amenities, walking paths/trails, safety, and geographical features (e.g. hills). Clarke and Gallagher (2013) confirmed that older adults residing in a more accessible environments have a 18% higher odds of being in the more mobile group, particular mobility-enhancing features include availability of sidewalks, quality of sidewalk (smooth, flat, unbroken, free from obstruction, adequate width), and availability of public transport on streets.

Rosso, Auchincloss, and Michael (2011) concluded that mobility is associated with objective and measurable factors in transportation (street network, public transport), land-use pattern (density and land-use mix), and urban design (safety, attractiveness, and site design). Hwang and Ziebarth (2015) proposed a descriptive and qualitative tool (named Senior Walking Environmental Assessment Tool–Revised (SWEAT-R)) in assessing walkability features in Minnesota and British Columbia; Cerin, Saelens, Sallis, and Frank (2006) introduced another self-reporting tool (Neighbourhood Environment Walkability Scale) including similar factors such as land-uses, urban design, safety, and availability of services. Wong et al. (2018) identified older adults' choice of public transport mode is related to fare level, walking time, and availability of seats.

The research studies reported in the above aimed to identify the relationship between mobility and physical environment attribute, whereas attributes like availability and quality of public transport, urban design, and walking environment are in common. Yet, these physical environment attributes are defined differently in various studies, they may be subjective or objective, quantitative or qualitative, resulting in substantial differences in the analysis approaches.

1.5 Summary

It has been two decades since the notion of age-friendly city has been introduced; now, many countries are aware of the need to make cities or communities more age-friendly to cope with the challenge of population ageing. Accessible physical environment is indispensable to active aging, how physical environment contributes to older adults' mobility and why mobility of elderlies is so important have been well-explained section 1.4.

Systematic assessment of age-friendliness helps to understand the current problems, setup performance standards, and support deliberation among stakeholders (government, service operators, elderlies, general public) regarding preferred vision, set priorities, develop strategies, and monitor progress. While age-friendly city assessments led by local stakeholders may be biased towards subjective views and perceptions of older people (section 1.2), the studies that assesses physical environment attributes led by academics (section 1.4) often demanded advanced research technique and substantial data collection.

Two decades is a good time to review and enhance the age-friendly city evaluation approach. To facilitate formulation of strategies and action plans towards age-friendly city:

- There should be a concise set of age-friendly city indicators

- The indicators should be objective but agrees well with subjective views of local elderlies
- The indicators can be easily understood by various stakeholders
- The data collection and data processing should be simple

To being with, a set of age-friendly indicators has been introduced in "*Measuring the Age-Friendliness of Cities: A Guide to Using the Core Indicators"*(World Health Organization, 2015), but not widely adopted yet. To contribute to the enhancement in age-friendly city baseline assessment approach, this study aims to pilot the adoption of the core indicators in the aspect of "physical environment" in an old urban district in Hong Kong. This study would:

(i) share the experience in how to adapt the operational definitions of the core indicators to the local context, and

(ii) comment on whether the core indicators are suitable, particularly, if it is an over-simplistic representation of a complexity of ageing in urban areas.

Moreover, with the data collected from this study, this paper also:

(iii) review current policy and management measures of the Hong Kong government and facility and service operators that shed light on how input resources might impact on age-friendliness evaluation.

2 Study methodology

2.1 Core indicators

This WHO guideline (World Health Organization, 2015) proposed methods to measure the effort towards age-friendly cities/ communities in a "input – output – outcome – impacts" framework. The desirable qualities in each of the eight age-friendly city domains have been consolidated into core outcome indicators under "accessible physical environment" and "inclusive social environment". The set of core indicators suggested under "accessible physical environment" includes – accessibility of public transportation vehicles, accessibility of public transportation stops, neighbourhood walkability, accessible public spaces and buildings, and affordable housing (Figure 1). Apart from "affordable housing", the other four indicators under "accessible physical environment" are clearly measuring how the community's physical environment is supportive to older people's mobility.

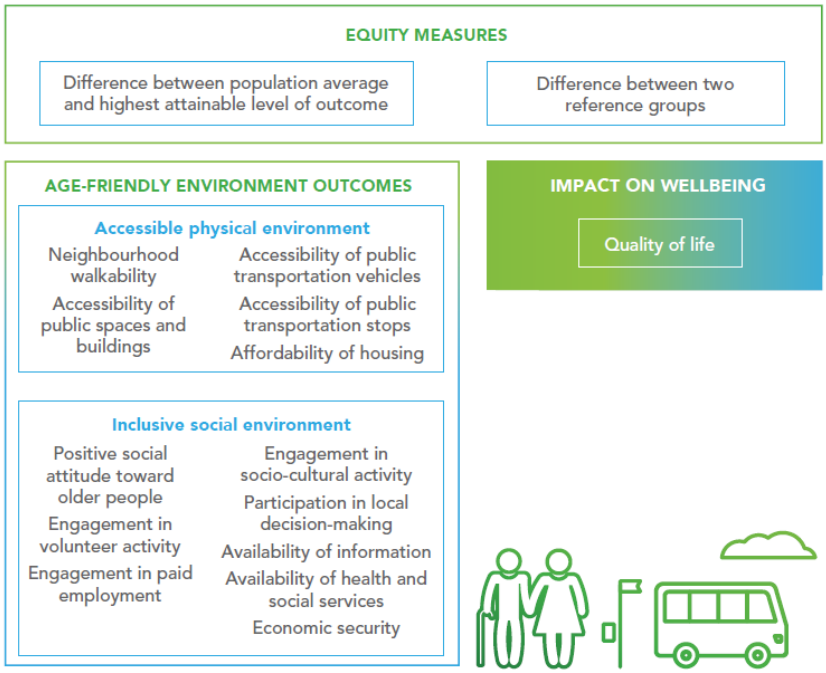

Figure 1 Core indicators of age-friendly cities (World Health Organization, 2015)

The assessment comprises of objective data obtained from government, operator/ service providers, and field surveys, supplemented by self-reporting surveys of local older residents. As noted in p.23 of (World Health Organization, 2015): "*… administratively reported data are often found to differ from the perceptions reported by local residents in surveys and focus groups, or from the actual conditions observed through field surveys. As such, using more than one data source can help improve both the quality and quantity of data, and contribute to a more holistic and accurate assessment of the indicators.*", therefore, both objective and subjective data sources are used in the evaluation. Operational definitions to these items have been provided in (World Health Organization, 2015), the local adaptations will be discussed in section 2.4.

2.2 Study Area

Yau Tsim Mong district is situated in the Kowloon Peninsula of Hong Kong. In its compact area of 6.99km^2, it houses 343,000 population (Census and Statistic Department, 2017; Survey and Mapping Office - Lands Department, 2016), that is a population density of 49,065 person per km^2, the second highest in Hong Kong. Apart from residential, Yau Tsim Mong district is also a major business and tourism center. Yau Tsim Mong district is a mix of old and new, some older areas are undergoing urban renewal, there are also developments under planning, it offers excellent opportunities to bring in and to enhance age-friendly elements in this district. Yau Tsim Mong district can be further divided into 19 Tertiary Planning Units (which is one level higher than street block)[2]. Data have been collected according to the tertiary planning unit (TPU) due to its better statistical basis (Figure 2).

[2] For town planning purpose, the whole territory of Hong Kong is divided into 289 Tertiary Planning Units (TPUs). Each TPU is identified by a unique three-digit number (e.g. 2.1.1). The TPU boundaries are mainly delineated by the nature of the geographic features or zoning boundaries of town plans. Statistical data from the population census/by-census are produced using this basic system (Census and Statistic Department, 2011; Lands Department, 2018).

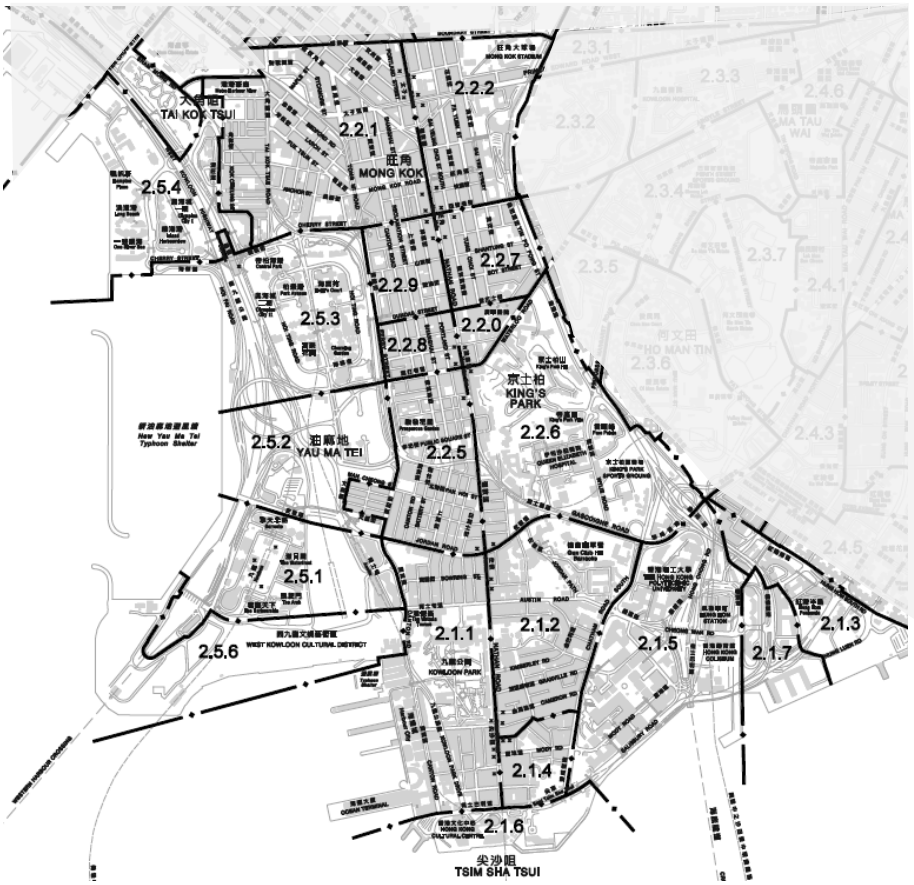

Figure 2 TPUs in Yau Tsim Mong district, excepted from (Planning Department, 2016)

2.3 Data collection

Raw data have been obtained from field measurements, service operators, government data, and questionnaire surveys by students from the Hong Kong Polytechnic University. They have been collaborating with elderly service agencies in Yau Tsim Mong district through a service-learning subject, *CSE3S01 – Built Environment Enhancement for Underprivileged Communities*, led by the Department of Civil and Environmental Engineering. 12 out of the 19 tertiary planning units were covered in this study. Data collection has been done in Jan to Apr 2018, and the subsequent compilation of data and report write-up was done in May – Aug 2018.

2.4 Indicators and modifications

The outcome indicators on age-friendly physical environment adopted in this study largely followed those suggested in (World Health Organization, 2015), including:

- Accessibility of public transportation vehicles
- Accessibility of public transportation stops
- Accessibility of public spaces and buildings
- Neighbourhood walkability
- Affordability of housing (not reported in this paper)

As suggested in (World Health Organization, 2015) and discussed at the end of section 2.1, using two types of operational definitions: objective data as well as subjective views from

older people allows for a more holistic view and accurate assessment of the age-friendly city indicators; moreover, it allows for checking for the level of consistency between the objective data and older people's perceptions. As suggested by WHO, some core indicators have been modified in this study for practical reason and to fit in local standards, and some additional indicators have also been introduced for better refinement and clarity, the local adaptations made shall be discussed ion sections 2.4.2 through 2.4.5.

2.4.1 Questionnaire survey

Although focus interview has been widely used in obtaining older people's views on age-friendliness in the baseline assessment (see section 1.2 for examples), it often requires long time to complete, expensive to be conducted with large sample size or frequently. To facilitate larger-scale data collection and avoid exhaustion of respondents, in this study, respondents indicated their views through 9 Likert-scale rating questions covering the four core indicators in the above, 1 yes-no question on housing expenditure, 1 multiple choice question on the age-group and 1 yes-no question for screening (whether the interviewee reside in the specific study area), i.e. there are 12 questions in total. Students have been tasked to obtain around 100 valid responses (the respondent is aged 60 or above, reside in the assigned study area, and completed all questions) from each of the 12 studied tertiary planning unit. Samples were obtained through street intercept surveys, mostly at parks, community centers, and sitting areas inside shopping malls or housing estates. Students read the questions to the respondents instead of handing the survey for self-completion, it took 1 to 5 minutes to complete the survey, some rare cases took close to 10 minutes if the respondent was illiterate or suffered from hearing impairments. A total of 1209 persons were interviewed and completed all questions, 1085 responses were valid response (the respondent is aged 60 or above, reside in the assigned study area, and completed all questions) and used in subsequent analysis. The demographic information is shown in Figure 3 below.

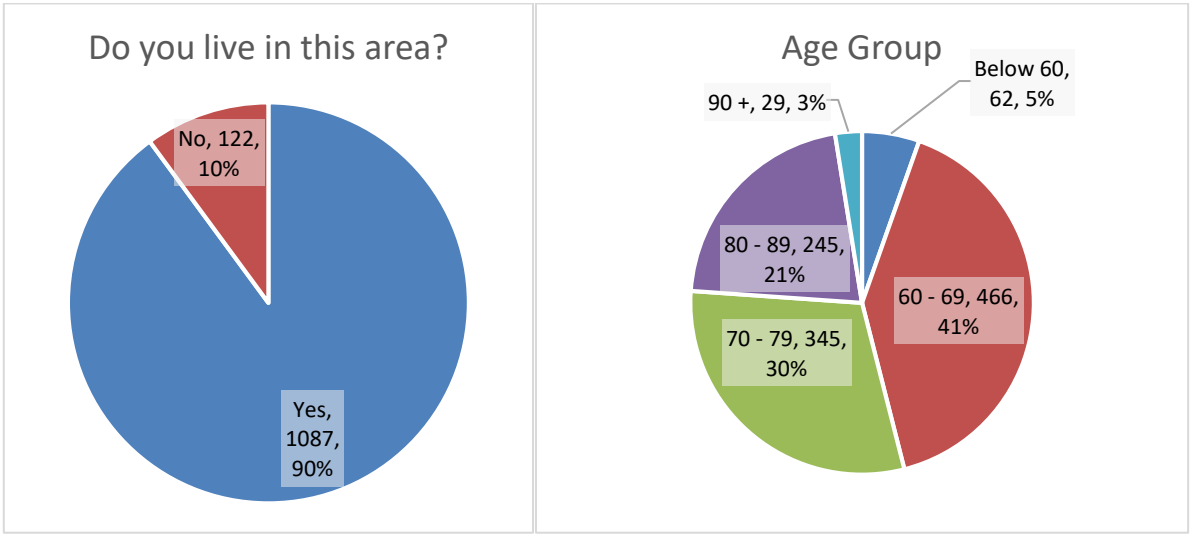

Figure 3 Demographic information of survey respondents

2.4.2 *Accessibility of Public Transport Vehicles*

According to the reviews in section 1.3 and 1.4, public transport is crucial to the mobility of older adults. In World Health Organization (2002), older adults see the following qualities in age-friendly public transport :

- Affordable price
- Quality: reliability, frequency, safety and comfort
- Coverage: route and stops to cover key destinations, connectivity of transport options
- Age-friendly public transport vehicles and stops

and that has been echoed by other scholars (Alsnih & Hensher, 2003; Szeto et al., 2017; Wong et al., 2018). The indicators (both objective and subjective) for evaluating the accessibility of public transport vehicles proposed in World Health Organization (2015) and the modifications adopted in this study has been summarized in Table 1 below.

Table 1 Indicators for Accessibility of Public Transport Vehicles

Suggested definition in World Health Organization (2015)	**Modification & additional indicators**	**Justification**
Objective Indicator		
Proportion of public transport vehicles with designated places for older people or people who have disabilities.	*Modification:* Percentage vehicles that has designated places <u>for older persons</u> Percentage vehicles that has designated places <u>for people with disability</u> *Addition:* Percentage of <u>low-floor</u> vehicles	Separate "designated places for older people or people who have disabilities" to have more distinctive comparison. Designated places for older persons (priority seat, Figure 3) is easy to implement for public transport operators, but places for disability (i.e. wheelchair position, Figure 3) and low-floor vehicle involves higher capital cost.
Self-reporting data		
<u>Proportion</u> of older people who report that public transport vehicles (e.g. train cars, buses) are physically accessible for all people, including those who have limitations in mobility, vision, or hearing	*Modification:* Change from "Proportion" to 5-point Likert scale rating (1 = strongly disagree, 5 = strongly agree). The same applies to all self-reporting questions.	The original indicator only allows for "yes/no" or "agree/ disagree", which is over-simplistic when the threshold is not clear and explicit.

Figure 4 Priority seat (left) , wheelchair position (middle), Low-floor vehicle (right), (Kowloon Motor Bus Company, 2016)

2.4.3 Accessibility of Public Transport Stops

While "2.4.2 accessibility of public transport vehicles" is reflecting the quality of public transport services, "accessibility of public transport stops" is reflecting coverage of public transport and how easy it is for older adults to gain access to public transport services in a spatial sense. This indicator describes the density or connectivity of public transport services, and the partly reflects the quality of walking environment (to public transport) rather than the age-friendly amenities at public transport stops.

After modification, the objective indicator included accessibility from home as well as accessibility to destinations, which should capture more completely how older adults' activity networks are supported by public transport. Moreover, connectivity (from origin and to destination) is correlated to walking distance. Although walking distance can be objectively measured, perceptions on walking varies according to the physical ability of older adults. Thus, the original term of "accessible" is being decomposed into three specific items: distance, safety, comfort, to delineate aspects of the perceived walking environment to and from public transport stops.

Table 2 Indicators for Accessibility of Public Transport Stops

Suggested definition in World Health Organization (2015)	**Modification & additional indicators**	**Justification**
Objective Indicator		
Proportion of housing within walking distance (500 m) to a public transportation stop.	*Modification:* (no change) *Addition:* Percentage of community centers that are within 500m of a public transport stop Percentage of healthcare facilities (hospitals and clinics) that are within 500m of a public transport stop Percentage of grocery stores and indoor markets that are within 500m of a public transport stop	Apart from accessibility from housing (origin), accessibility at common destinations (community centres, healthcare facilities, and grocery stores and indoor markets) are also studied
Self-reporting data:		
Proportion of older people who report that public transportation stops are accessible.	*Modification:* The walking distance from my home to public transport stops is acceptable. The route(s) from my home to public transport stop(s) is/ are safe. It is easy and comfortable to walk from my home to public transport stop(s).	"Accessible" could not be readily understood, and it has been made more specific in terms of walking distance, safety of walking path, comfort of walking

2.4.4 Accessibility of Public Spaces and Buildings

Considering a trip chain (home → transport stop → vehicle → transport stop → destination building → specific room in the building), a person could not arrive at the destination and conduct the desired activity if part of this travel chain is broken. The accessibility of the leg from home to transport stop and from transport stop to destination building has been covered in "2.4.3 accessibility of public transport stops", and the middle part of the travel chain has been covered in "2.4.2 accessibility of public transport vehicles", thus the remaining part is whether or not older adults can enter the destination buildings freely. In the objective indicator, public spaces and buildings have been disaggregated into specific types as they are managed by different public authorities or private entities, the disaggregation would provide information for more accurate response. Yet, there was no disaggregation in the self-reporting question to keep the question set simple.

In the field data collection for accessibility of public spaces (which include parks, sitting-out areas, and other open spaces for public use), the areas of each of these public spaces are also obtained. It appeared as if "area of open space" does not fit under "accessibility of public spaces and buildings", in fact despite an open space fulfils the barrier-free criteria according to the local standard, if it is too small, it is not considered as a place for relaxation by older people (Gong, Gallacher, Palmer, & Fone, 2014). If there is no decent open space in the neighbourhood (where "area" is a simple indicator), older people need to walk a long distance or take public transport to reach the larger open spaces or parks for relaxation or recreational activities, otherwise, they just stay at home. Figure 4 shows an example of low-quality but accessible open space identified in the field study, its size is merely 105m^2 (around one-fourth of a standard basketball court), irregular in shape, surrounded by busy traffic streets, with minimal greening, no other amenities except benches with shelters.

Table 3 Indicators for Accessibility of Public Buildings and Spaces

Suggested definition in (World Health Organization, 2015)	**Modification & additional indicators**	**Justification**
Objective indicator		
Proportion of new and existing public spaces and buildings that are fully accessible by wheelchair	*Modification:* Percentage of _____that are fully accessible by wheelchair: - Department store & shopping complex - Indoor market and supermarket - Cinema, theatre, concert hall, stadium, museum, theme part - School, college, university, public library - Sports complex, public swimming pool complex - Hospital - Transport station, interchange, passenger terminal - Open space	"Public spaces and buildings" are disaggregated to allow for more specific discussion. The categories used here made reference to the local guidelines on barrier-free access (Buildings Department, 2008).

	Addition: Average area of each public open space/ park per population	To reflect opportunities for relaxation activities.
Self-reporting data		
Proportion of older people who report that public spaces and buildings in their community are accessible for all people, including those who have limitations in mobility, vision, or hearing.	(no change)	

Figure 5 Arran street sitting-out area: example of low quality but accessible open space (Source: Google Map)

2.4.5 Neighbourhood Walkability

As reviewed in sections 1.3 and 1.4, walking environment is crucial to mobility of older adults, maybe even more important than public transport as most older adults' daily activities are within their own neighbourhood. Walking environment should be safe, provide barrier-free access to places, with high connectivity (short walking distance to various destinations). Connectivity to destinations have already been measured in "2.4.3 Accessibility of public transport stops", it is not repeated here. "Neighbourhood walkability" here focuses on the quality of walking environment, which was assessed according to the local accessibility standard in Buildings Department (2008).

Table 4 Indicators for Neighborhood Walkability

Suggested definition in (World Health Organization, 2015)	**Modification & additional indicators**	**Justification**
Objective indicator		
Proportion of streets in the neighbourhood that have pedestrian paths which meet locally accepted standards	*Modification:* Percentage of walking path to _____ that is accessible.	Local standard here refers to the guidelines set out in Buildings Department

	- Indoor market/ supermarket/ shopping location - Healthcare facility - Leisure/ social activity location - Public transportation station/ stop	(2008) which has specific criteria about the width, gradient, ramps…etc Studying all streets in the neighbourhood is not feasible. A 400m access path (according to Buildings Department (2008) to the most popular location in each category is examined
Self-reporting data		
Proportion of older people who report that their neighbourhood is suitable for walking, including for those who use wheelchairs and other mobility aids	(No change)	

3 Results

According to the definitions of the core indicators listed in Table 1 through Table 4, data have been collected in 12 tertiary planning units (TPUs) in Yau Tsim Mong district, and the data have been aggregated in the following results table. Note the data presented below consist of both objective data and subjective ratings (shaded boxes), so as to provide a balanced view on age-friendliness of physical environment.

Table 5 Survey results

Domain	Indicator	Source of Data	Results		
			Bus	Mini-bus	Metro
Accessibility of Public Transport Vehicles	Percentage vehicles that has designated places for older persons	Public Transport Operator (bus, metro), Field Survey (minibus)	100%	< 10%	100%
	Percentage vehicles that has designated places for people with disability		100%	0%	100%
	Percentage of low-floor vehicles		100%	0%	100%
	The public transport vehicles are accessible for all people, including those who have limitations in mobility, vision, or hearing	Questionnaire (1 = strongly disagree, 5 = strongly agree)	3.67	2.70	3.59
Accessibility of Public Transport Stops	Percentage of housing that are within 500m of a public transport stop	Desktop study	100%		
	Percentage of community centers that are within 500m of a public transport stop		100%		
	Percentage of healthcare facilities that are within 500m of a public transport stop		100%		

Domain	Indicator	Source of Data	Results
	Percentage of grocery stores and indoor markets that are within 500m of a public transport stop		100%
	The walking distance from my home to public transport stops is acceptable.	Questionnaire (1 = strongly disagree, 5 = strongly agree)	3.93
	The route(s) from my home to public transport stop(s) is/ are safe.		3.97
	It is easy and comfortable to walk from my home to public transport stop(s).		3.77
Accessibility of Public Buildings and Open spaces	Percentage of department store & shopping complex that are fully accessible by wheelchair	Field Survey	48%
	Percentage of indoor market and supermarket that are fully accessible by wheelchair		56%
	Percentage of cinema, theatre, concert hall, stadium, museum, theme park that are fully accessible by wheelchair		94%
	Percentage of school, college, university, and public library that are fully accessible by wheelchair		83%
	Percentage of sports complex and public swimming pool complex that are fully accessible by wheelchair		92%
	Percentage of hospital that are fully accessible by wheelchair		100%
	Percentage of transport station, interchange, passenger terminal that are fully accessible by wheelchair		89%
	Percentage of open spaces that are fully accessible by wheelchair		89%
	Average area of open space per population	Field Survey, Government Data	71%
	The public spaces and buildings in this district are accessible for all people, including those who have limitations in mobility, vision, and hearing.	Questionnaire (1 = strongly disagree, 5 = strongly agree)	3.64
Neighbourhood Walkability	Percentage of walking path to indoor market/ supermarket/ shopping location that is accessible.	Field Survey	58%
	Percentage of walking path to healthcare facility that is accessible.		58%
	Percentage of walking path to leisure/ social activity location that is accessible.		67%
	Percentage of walking path to public transport station/ stop that is accessible.		67%
	The area I am living in is suitable for walking, including for those who use wheelchairs and other mobility aids.	Questionnaire	3.55

Domain	Indicator	Source of Data	Results
		(1 = strongly disagree, 5 = strongly agree)	

3.1 Overall agreement between objective measurement and subjective rating

As contented in sections 2.1 and 2.4, evaluation of age-friendliness using both objective and subjective data sources provide a more holistic understanding of the issue. Moreover, it allows for checking of consistency between the objective and subjective evaluation. As noted by Garon et al. (2016), the objective components in evaluation framework constitutes the "classical model" which is readily used by decision makers so make wise decision on public spending and ensure the efforts result in desirable outcomes. If these objective outcome indicators do not relate to the subjective experience or perceptions of older people at all, these are merely meaningless metrics.

In Table 5, the objective assessments are expressed in terms of percentage compliance or achievement, and views of local older people are expressed in Likert scale scores in 1 to 5, with higher scores means it is perceived as more age-friendly. A scatter plot of "compliance" (objective age-friendliness) and "score" (subjective rating) is shown in Figure 5. The two variables have displayed medium relationship, $r = 0.483$ (Pearson correlation coefficient), $p < 0.001$. A medium (instead of strong) relationship is expected because subjective evaluation should be affected by many other factors. Regression analysis was used to test if "compliance" significantly predicted subject rating ("score"). The results of regression indicated the "compliance" explained for 23.3% of the variance in "score" ($R^2 = 0.233, F(1,384) = 116.735, p < 0.001$). It was found that compliance significantly predicted rating ($\beta = 0.622, p < 0.001$)). More detailed analysis in each domain will be discussed in the subsequent sections.

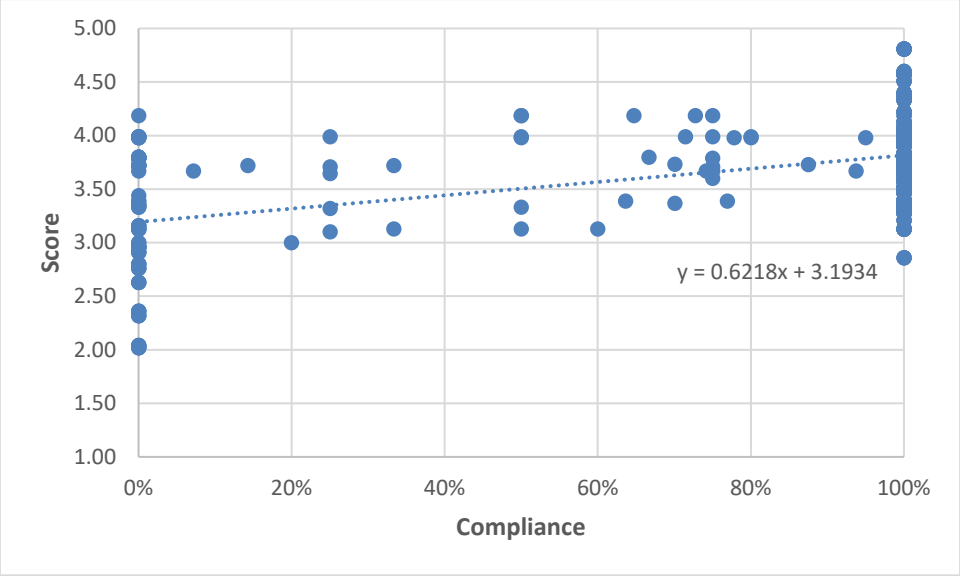

Figure 6 Scatter plot of overall objective compliance and subjective rating scores on age-friendliness

3.2 Accessibility of Public Transport Vehicles

There are three land-based public transport modes in the study area: buses, minibuses, and metro (MTR). Both buses and minibuses are franchised, fixed-route services. All franchised buses in Hong Kong are accessible (low-floor, designated wheelchair position). Minibus vehicles are smaller (16 to 19 seats), single-deck, offering feeder services in local districts (Transport and Housing Bureau, 2017). The government is encouraging the minibus trade to improve the accessibility of minibus vehicles, more will be discussed in section 4.1.

From the aggregated results from all studied TPUs in Table 5, it is apparent that as minibus vehicles are less accessible, elderlies also view minibuses as the least accessible with average scored of 2.7 (1 = strongly disagree, 5 = fully agree). Meaningful regression analysis between objective compliance and subjective rating on age-friendliness could not be performed due to the lack of variability in the explanatory variables: for buses and MTR their achievement in "percentage of vehicles that has designated places for older persons", "percentage of vehicles that has designated places for people with disability", and "percentage of low-floor vehicles" are all 100% in all studied TPUs, while it is 0% for minibuses in most of the TPUs.

A point to note is that although there is no mean to investigate the level of agreement of subjective rating and objective measurement in the aspect of accessibility of public transport vehicles, this set of indicators should be kept, and the objective data collection can be simplified to monitor the accessibility improvement of minibus vehicles.

3.3 Accessibility of Public Transport stops

Owing to the very high density urban environment (49,065 person per km^2) and high density of public transport services, one can always find public transport stops within 500m from one's home or popular destinations (such as community centers, healthcare facilities (clinics and hospitals, grocery stores and indoor markets), as indicated by the 100% compliance in the second section in Table 5. This finding points to the fact that high density urban environment is favourable as it offers high connectivity, but one has to be cautious that a very high density may also imply overcrowding, less pleasant environment, and less parks and open spaces.

In the study methodology proposed in World Health Organization (2015), an air distance of 500m is suggested. In a high-density environment like Hong Kong, it is questionable whether 500m is appropriate. During the questionnaire survey with local elderlies, they implied they are not willing to walk that long (500m) and would take public transport instead. Koohsari et al. (2013) also advocated for the need to determine a threshold walking distance which varies according to local context.

Due to the lack of variability in explanatory variable, the agreement between objective measurement and subjective rating could not be examined in this specific aspect.

3.4 Accessibility of public buildings and spaces

Table 6 shows the proportion of public buildings and space that are accessible in each TPU and the corresponding average rating on the accessibility of public buildings and spaces in the self-reporting questions. Unlike the case for public transport vehicles and public transport stops, there is a wide range of accessibility displayed in various types of buildings. The boxes with "n.a." means that kind of building (e.g. hospital) is absent in the TPU concerned, it should be distinguished form 0% which means all the buildings of that type are not accessible.

One point to note from Table 6 is that "Department store and shopping complex" and "Indoor market and supermarket" are the least accessible types of buildings amongst others, these are places primarily owned or operated by private sector.

Table 6 Proportion of public spaces and buildings that are accessible

	Proportion of public spaces and buildings that are accessible								Self-reporting question (see *Note*)
TPU	Department store & shopping complex	Cinema, theatre, concert hall, stadium, museum, theme park	School, college, university, and public library	Sports complex and public swimming pool complex	Indoor market and supermarket	Hospital	Transport station, interchange, passenger terminal	Open Spaces	
2.1.1	64.7%	75.0%	72.7%	100.0%	50.0%	n.a.	100.0%	50.00%	4.19
2.2.0	45.5%	n.a.	100.0%	0.0%	n.a.	100.0%	n.a.	0.00%	3.99
2.2.1 East	71.4%	n.a.	80.0%	100.0%	50.0%	n.a.	100.0%	100.00%	3.73
2.2.1 West	100.0%	100.0%	100.0%	100.0%	100.0%	n.a.	100.0%	87.50%	3.67
2.2.2	50.0%	100.0%	60.0%	100.0%	33.3%	n.a.	100.0%	100.00%	3.13
2.2.5 South	100.0%	n.a.	0.0%	n.a.	14.3%	n.a.	33.3%	100.00%	3.72
2.2.5 North	n.a.	100.0%	100.0%	n.a.	0.0%	n.a.	100.0%	75.00%	3.79
2.2.7	0.0%	100.0%	100.0%	100.0%	25.0%	n.a.	75.0%	100.00%	3.99
2.2.8	n.a.	0.0%	100.0%	n.a.	66.7%	n.a.	0.0%	100.00%	3.80
2.2.9	50.0%	100.0%	100.0%	n.a.	100.0%	n.a.	100.0%	100.00%	3.33
2.5.1	100.0%	100.0%	n.a.	n.a.	100.0%	n.a.	100.0%	100.00%	3.13
2.5.3	100.0%	100.0%	100.0%	n.a.	63.6%	n.a.	76.9%	100.00%	3.39
2.5.4	100.0%	n.a.	77.8%	n.a.	50.0%	n.a.	95.0%	80.00%	3.98
Overall	47.9%	93.8%	82.8%	91.7%	56.3%	100.0%	89.1%	88.52%	3.64

Note: the self-reporting question was "The public spaces and buildings in this district are accessible for all people, including those who have limitations in mobility, vision, and hearing.", in 5-point Likert scale.

Figure 6 is a scatter plot of accessibility of each type of building and spaces (by different colours) and the rating in the self-reporting question. Percentage of building and spaces being accessible and subject rating showed almost no relationship, ($r = -0.08$, $p = 0.417$).

Regression analysis was performed to see whether objective accessibility of buildings and spaces can significantly predict the subjective ratings. The model was in fact very poor, $R^2 = 0.006, F(1,102) = 0.665, p = 0.417$, and objective accessibility is not able to explain subjective rating ($\beta = -0.061, p = 0.417$).

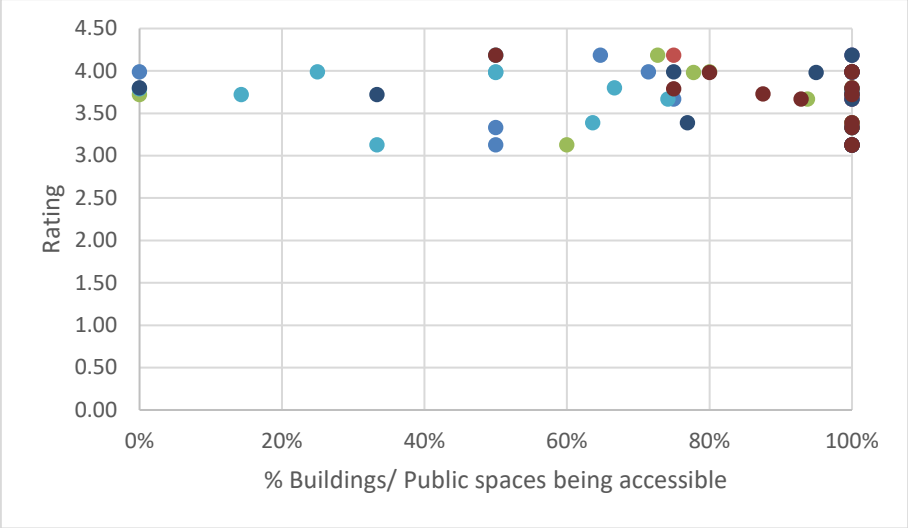

Figure 7 Scatter plot of objective compliance and subjective rating scores on age-friendliness regarding "accessible buildings and spaces"

There is a lack of agreement between objective age-friendliness (fulfil local statutory standard) and subjective views. One possible reason is the accessibility criteria set in the statutory standard dictates the minimum provision such that people with disability (mainly regarding people in wheelchair) have "a mean of access". Consider a large shopping complex with multiple entrances, even if there is only one wheelchair accessible entrance at a remote location, this shopping complex is counted as "accessible" under the statutory standard. Apparently, in the subjective evaluation, quality of access, such as convenience or user-friendliness is also valued, especially if the questionnaire respondent is not wheelchair-bound. The disparity between "able to access" and "easy and comfortable to access" mainly speaks for the lack of agreement between objective accessibility to buildings and spaces and the subjective rating.

3.5 Neighbourhood Walkability

In the walkability survey, a 400-m access route to one of each type of facilities has been examined (indoor market/ supermarket, healthcare facility, leisure/ social activity location, and public transport station/ stop). Access route to only one destination of each type is sampled for manpower reason, a survey on all walkways in an area is not feasible if the method is to be used for wide adoption. The assessment was based on the local standard in Buildings Department (2008), with criteria on walkways and ramps, and the data is collected from field survey. The results are summarized in Table 7. An access route is "completely accessible" only if all the requirements are satisfied along the entire 400m stretch of the route.

Table 7 Neighborhood walkability assessment and subjective rating

TPU	Indoor market/ supermarket/ shopping location Completely Accessible?	Healthcare facility Completely Accessible?	Leisure/ Social Activity Location Completely Accessible?	Public Transport Station/ Stop Completely Accessible?	Subjective Rating (see *Note*)
2.1.1	No	No	Yes	No	3.64
2.2.0	No	No	Yes	No	3.71
2.2.1 West	Yes	Yes	Yes	Yes	4.02
2.2.1 East	Yes	Yes	Yes	No	3.6
2.2.2	No	No	No	Yes	3.10
2.2.5 South	No	No	No	Yes	3.32
2.2.7	Yes	Yes	Yes	Yes	3.57
2.2.8	No	No	No	No	3.44
2.2.9	Yes	Yes	No	Yes	3.71
2.5.1	Yes	Yes	Yes	Yes	3.13
2.5.3	Yes	Yes	Yes	Yes	3.4
2.5.4	Yes	Yes	Yes	Yes	3.7

Note: The self-reporting question was "The area I am living in is suitable for walking, including for those who use wheelchairs and other mobility aids".

The reasons for the access paths in Table 7 not fulling accessibility requirement are mainly due to poor surface condition (9 cases), ramps being too steep (5 cases), poor drainage condition (4 cases), followed by insufficient width (3 cases).

If it is assumed that the four 400-m route studied in each TPU is a representation of the walkability in the study area, a scatter plot can be produced to examine the relationship between objective accessibility of walking path and subjective rating on the walkability of the neighbourhood as in Figure 7, where 25% accessible walking path means 1 out of the 4 studied paths being accessible (fully satisfy local standard). Percentage of walking paths being accessible and subjective rating on walkability showed weak correlation, $r = 0.294, p = 0.354$. Regression analysis was performed to determine whether objective percentages of accessible walking paths can significantly explain for the subjective ratings. The overall explanatory power is weak, $R^2 = 0.086, F(1,10) = 0.945, p = 0.354$. Percentage of walking paths being accessible somehow explains for subjective rating, but not significant, $\beta = 0.201, p = 0.354$.

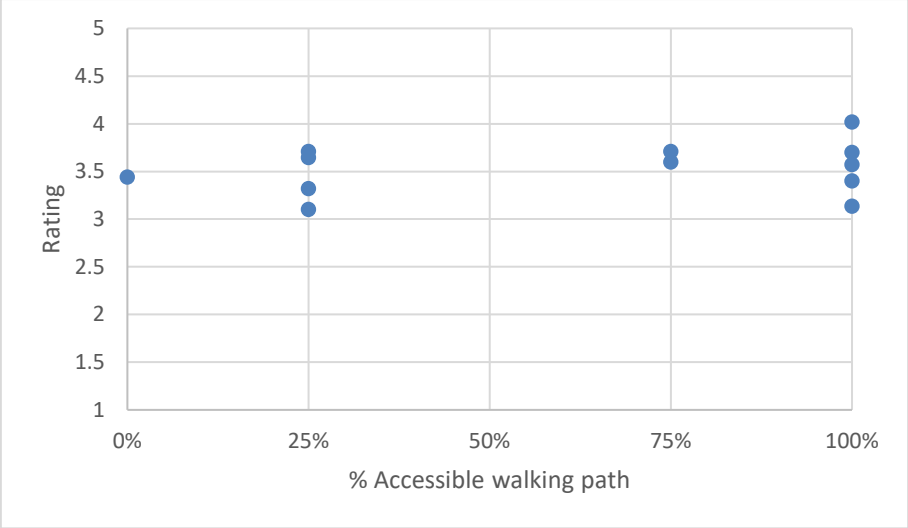

Figure 8 Scatter plot of objective compliance and subjective rating scores on age-friendliness regarding "neighbourhood walkability"

Similar to the discussions made in "2.4.4 Accessibility of public buildings and spaces", accessibility is determined according to the local statutory guideline which only indicates the minimum standard. Yet, the agreement between objective measurement and subjective perception is slightly stronger in this case. It is because the local standard on walkways include some criteria on the quality of walking environment (e.g. surface condition, drainage condition) on top of the those measuring the ability of access (e.g. width).

4 Actions by government, facility, and service providers

Section 3 reported results on the objective and subjective evaluation on age-friendliness in the physical environment aspects (public transportation, buildings and outdoor spaces, which are crucial to mobility of older adults. It was found that the public transportation system is quite age-friendly while accessibility of buildings and outdoor spaces (including walking environment) apparently need to catch up. This section examines the "input resources", including government policy and initiatives, and actions taken by facility and service providers (of publicly-used facility and spaces) that led to the "outcomes" (objective and subjective indicators on age-friendliness) reported in section 3. An analysis on the logic of what is going to work facilitates transfer of experience.

4.1 Accessible public transport

Among the four domains evaluated in Section 3, the two related to public transport ("accessibility of public transport vehicles" and "accessibility of public transport stops") have got the highest subjective and objective ratings. It has to be reiterated that indicators under "accessibility of public transport stops" in section 3.3 reflect the density of public transport stops or how close they are to destinations (land-use density), instead age-friendly or barrier-free amenities at public transport stops. In section 3.2, it was found that buses, metro are fully

accessible while minibuses are not so accessible. These outcomes can be explained by the efforts by the Hong Kong Government and public transport operators (buses, metro, minibuses, and taxis) since 2002.

Hong Kong Government has been advocating the concept of "Transport for All" since 2002 to encourage older people and people with disability to integrate into the community. In Hong Kong, public transport services are provided by the private sector, as such the government has been working in close partnership with operators on initiatives that promote mobility of older people. The elderly-friendly measures implemented so far or initiatives in progress are summarized below (extracted from (Transport and Housing Bureau, 2017)).

4.1.1 Metro (Mass Transit Railway)

Metro system (Mass Transit Railway or MTR) is the backbone of Hong Kong's public transport system which accounts for about 42% of all trips made on public transport each day. The operator of the railway system is a private company with Hong Kong Government being the largest shareholder (after privatization).

In Table 5, all metro vehicles are found to be fully accessible and older adults rated accessibility of metro vehicles as 3.59 out of 5. At present, all MTR vehicles are accessible to wheelchairs and have priority seats. All MTR stations are equipped with at least one barrier-free access, such as passenger lifts, ramps, stair lifts and wheelchair aids. The operator will ensure barrier-free corridor connecting stations concourse and street level (MTR Corporation Limited, 2019). These explained for the high objective and subjective age-friendliness of the metro system reported earlier.

4.1.2 Franchised Buses

In Hong Kong, franchised bus services are offered by private operators under franchise agreement (typically 10 years) without direct government subsidy. Under the franchise agreement, vehicles and facilities such as termini, bus stop signs, shelters, queue railings and so on, are provided by the operator.

In Table 5, all bus vehicles are found to be fully accessible and older adults rated accessibility of bus vehicles as 3.67 out of 5. At present, all buses have priority seats (but not designated seat). As at 2017, over 90% of the buses in Hong Kong are wheelchair-accessible low-floor buses. The government is working with operators in increase the number of wheelchair position from 1 to 2. The government is retrofitting current public transport interchange, bus and minibus termini with barrier-free facilities, and all new public transport facilities will be designed according to the latest accessibility standard. The government is subsidising franchised bus operators to install seats at bus stops for the convenience of passengers, especially the elderly and those in need. Therefore, buses were found to have high objective and subjective age-friendliness in this study as well.

4.1.3 Minibus

Minibuses in Hong Kong also offer fixed route service like franchised buses, but they use smaller vehicles of 16 to 19 seats to serve routes with relatively lower patronage. The minibus routes are operated by numerous small private operators that operates one or a few local lines. It is not a highly profitable business without much economy of scale. Thus, the operators are not very willing, and have limited capability to upgrade their vehicle fleet or station amenities to address the mobility needs of older people or people with disability.

In Table 5, minibus vehicles are found to quite inaccessible and older adults rated accessibility of minibus vehicles 2.70 out of 5. As noted in section 3.2, minibus vehicles are found to be not very accessible, priority seats are found only in very few vehicles, none of the vehicles are low-floor or have wheelchair position.

It is understandable that the progress of improvement in the minibus trade is going to be slow if it is left to the free market, strong government intervention including financial subsidy and even legislation is needed for more effective changes to be made. The government is encouraging the minibus trade to designate priority seats. The government has been encouraging the trade to introduce low-floor minibus, there are currently two low-floor minibus under pilot run in two hospital routes (Figure 8). Passengers may call the operator to make a reservation on such service.

Figure 9 Low-floor minibus under pilot run (Transport Department, 2019)

4.1.4 Taxis

In Hong Kong, taxis are licensed to individuals. Most drivers operate their own taxis for a living. There are some taxi companies who act as the "middleman" to arrange the rental matters: drivers pay the rent for operating the taxi, and they pocket the operating revenue. Although taxis are not covered in the data collection in Section 3, it is covered here for completeness.

Taxi vehicles can carry no more than 5 passengers by the law, and thus the mainstream vehicle type is sedan cars. The government has been encouraging the taxi trade to use wheelchair

accessible models (Figure 9). As at 2017, there are over 80 accessible taxis among the total fleet of 18,163 taxis.

Figure 10 Example of accessible taxi in Hong Kong(Diamond Cab, n.d.)

4.1.5 Fare concession

Affordable public transport has been one of the factor in age-friendly transport in World Health Organization (2007) and has been confirmed in local studies (Szeto et al., 2017; Wong et al., 2018), however but it was not present in the list of outcome indicators in World Health Organization (2015). In the context of Hong Kong, it is probably not crucial to debate whether or not affordable public transport should be added to the indicator set as public transport of older people is already very affordable under the current concession scheme.

In June 2012, the government has launched the Public Transport Fare Concession Scheme in phases, so that eligible people with disability and elderly people aged 65 or above can travel on most scheduled public transport on concessionary fare of HKD$2 (around USD0.26) per trip. The government would reimburse the public transport operators concerned for the fare revenue they have forgone (Legislative Council Panel on Welfare Services, 2012; Transport and Housing Bureau, 2017).

4.2 Accessibility of outdoor spaces and walkways

In contrast to public transport which the operation is rested in the hands of operators, the government can play a more active role in age-friendly outdoor spaces and buildings, as government owns all public buildings, roads, parks, and so on. In the 2016 Policy Address, the government even identified "Building an Age-friendly Environment" as one of the government's strategy (Hong Kong Special Administrative Region Government, 2016). The initiatives and progress more relevant outdoor space and buildings are summarized below.

4.2.1 Walkways

Slopes and staircases are common in Hong Kong due to the hilly topography. In 2012, the government has introduced the "Universal Accessibility Programme" to install or improve barrier-free access facilities at public footbridges, elevated walkways and subways, such as providing vertical lifts and covers (Highways Department, 2019). The programme has recently been extended to include walkways in which public has access, i.e. not limited to those owned by the government. Elevated walkway systems have also been built to provide convenient access.

In Table 5, older people rated 3.55 out of 5 in the question about whether the neighbourhood is suitable for walking, while only 58% to 67% of walking paths were found to fully meet the local statutory accessibility criteria. The projects commissioned under the "Universal Accessibility Programme" are targeting barriers in overcoming differences in elevations, problems leading to inaccessible walkways or streets reported in section 3.5, such as poor surface conditions, ramps being too steep, or poor drainage conditions, are not included. Comparing the efforts in public transport that started in 2002, government efforts in universal accessibility started a decade, it partly explains for the lower in "achievements" in accessible transport and walkability.

Figure 11 Example of works under the Universal Accessibility Programme (Highways Department, 2019)

4.2.2 Signal Crossing

The "Universal Accessibility Programme" in the preceding paragraph mainly concerns footbridges, elevated walkways and subways, most pedestrians (both older people and younger people) prefer at-grade crossings for convenience. Recently there has been initiatives to make signal crossings more age-friendly. In the first quarter of 2018, smart pedestrian traffic signal was piloted at 9 locations. Elderly persons or persons with disabilities can activate a smart device with their smart travel card (special cards issued to people aged 65 or above, or people with disability) to extend the green time for crossing (Transport Department, 2018).

Figure 12 Smart Pedestrian Crossing(Transport Department, 2018)

4.2.3 Buildings

Table 5, the percentage of buildings that fulfils local accessibility criteria are higher in the public buildings (such as "school, college, university, and public library" – 83%, "sports complex and public swimming pools" – 92%, "hospitals" – 100%, "open spaces" – 89%) than private buildings ("department stores and shopping centers" – 48%, "indoor market and supermarket" – 56%). There is an on-going effort to provide additional chairs or priority seats for the elderly in existing public facilities such as markets, swimming pools and sports centres, and incorporate more age-friendly design when planning and constructing new public space and facilities.

The statutory guideline "*Design manual: Barrier Free Access 2008*" (Buildings Department, 2008) only applies to new buildings or alterations after year 2008. In the study area, many of buildings which public have access are old buildings that are exempted from this requirement unless they undergo major alteration works. Many private buildings, including ground-floor shops, were found to be inaccessible. One commonly seen problem was many ground level shops have one small step at entrance (Figure 12), making it not accessible to wheelchair and inconvenient to older people who have difficulties in lifting his/ her legs.

Figure 13 Example of steps in front of shops

For new buildings, even if they satisfied the statutory guideline at first, they may later on become not accessible due to illegal alteration or poor maintenance. Formally, the government

authority would be able to identify such situations through inspection, owners of the buildings are obliged to rectify the situation. Practically, the rate of inspection is very low, not to mention enforcement. Therefore, the compliance to accessibility standard is high among government buildings and spaces, but low for privately-owned buildings – these buildings may be so old that they are exempted of the accessibility requirement, or they violated the law, but the enforcement was weak. As commented by a local architect: "*Property developers want to maximise their profits, so barrier-free access is not a priority for them. When architects go farther than the minimum requirements stipulate, they see it as a waste of gross floor area.*" (Cheung, 2018), it explains for the low compliance in privately-owned buildings.

5 Conclusion

Age-friendly city is a complex and broad concept, this paper focuses on aspects of physical environment that are crucial to mobility of older adults. A set of good indicators is necessary to understand current problems, setup performance standards, and support deliberation among stakeholders. The set of indicators should be concise, objective (but can appropriately explain subjective views), easy to understand, easy to implement (data collection and analysis). To being with, this study modified and slightly expanded the set of indicators on accessible physical environment proposed by WHO (World Health Organization, 2015) and adapted it to local conditions. Actual data collection has been conducted in an old urban area in Hong Kong in 2018 that evaluated the age-friendliness of physical environment encompassing both objective data and subjective ratings. The actions taken by (or ongoing actions) by the government, facility and service providers to support mobility of older adults in the community have also been reviewed, in light of uncovering the relationship between input resources and measured outcomes to the sake of transfer of experience.

5.1 Age-friendly Physical Environment Indicators

The set of indicators on accessible physical environment proposed by WHO (World Health Organization, 2015) was modified and slightly expanded, and the criteria used referred to local design standards in Hong Kong. One major objective of this study is to examine the use of core indicators proposed in World Health Organization (2015). It is found that the set of indicators is concise, easy to understand, and easy to implement.

5.1.1 Data collection effort

In the data collection for the objective indicators, data on accessibility of public transportation vehicles and stops can be obtained easily through internet search (map data, government data, operator data), while those concerning accessibility of public buildings and spaces, and neighbourhood walkability required field survey. The data collection for the objective indicators was straight forward, students were being able to handle the tasks accurately according to simple written instructions. The subjective ratings on age-friendliness were obtained through face-to-face questionnaire survey consisting only 12 questions (including two questions on demographic information for screening), which only took 5 minutes or less

to complete for a literate older adult. In this study, 12 out of 19 tertiary planning units were covered, with 1209 questionnaire surveys being conducted. It can be concluded that the data collection effort is not tedious, it should be feasible for local organizations to conduct such survey regularly.

5.1.2 Agreement between objective indicators and subjective views

It was found that there is a general agreement between the level of achievement in each objective indicator and the subjective ratings on the age-friendliness. As one takes a closer look in each of the sub-domains:

- *Accessibility of public transport vehicles*: there seems to be an agreement, but degree of association between objective level of achievement and subjective rating could not be analyzed due to lack of variability in data. The objective accessibilities of public transport vehicles were either 100% (bus and metro) or 0% (minibus).
- *Accessibility of public transport stops*: due to very high-density urban environment and high density of public transport network, the objective accessibilities of public transport stops were 100%. Although the subjecting ratings were also high, it was not possible to study the degree of association due to lack of variability in data.
- *Accessibility of public buildings and spaces*: The objective accessibility and subjective ratings showed almost no statistical relationship. One possible reason is the disparity between "able to access" (in the statutory design standard) and "easy and comfortable to access" (in subjective perception).
- *Neighbourhood walkability*: Similar to the above, objective indicator of walkability showed weak but not statistically significant relationship with the subjective ratings. The explanation is similar, it speaks for the gap between statutory design standard and the desire for quality. Yet, in case of walkways, the design standard includes some criteria related to the quality of walkways, so a weak instead of no relationship can be seen.

5.1.3 Suggestions on indicators

Evaluation of age-friendliness using both objective and subjective data sources provides a more holistic understanding of the issue. If the objective indicators show no association with the subjective experience or perceptions of the stakeholders at all, the metrics lost their actual meanings. Based on the findings discussed in the above, there are a few suggestions to the objective indicators so as to more accurately gauge objective physical environment variables to the subjective views on age-friendliness.

Review acceptable walking distance

In the assessment of "accessibility of public transport stops" and "neighbourhood walkability", assumed acceptable walking distance of 500m and 400m respectively were used in the measurements. As noted in literature, acceptable walking distance is a local variable. From the comments received in the face-to-face interviews with local older adults, it seems the actual acceptable walking distance is shorter than the values used in this study. Therefore, there is a need to conduct a side study to investigate the acceptable walking distance in a high-density environment like Hong Kong.

Include "quality variables" in objective indicators of accessibility of public buildings and spaces

Study results showed some weak, general agreement between objective and subjective evaluation on age-friendliness, which is expected considering the presence of other factors and individual variations. However, the objective and subjective evaluation showed almost no association in "accessibility of public buildings and spaces", probably because the accessibility criteria only considered the bare minimum of "being able to access" while "quality of access" is also viewed as an important part of "accessibility. It is suggested that the objective evaluation criteria should include some quality variables.

Include financial affordability of public transport

In the discussion of accessible public transport, physical accessibility of public transport vehicles and stops have been examined, but the proposed indicators in World Health Organization (2015) omitted affordability of public transport. Public transport fare is a determinant of mobility as well. It is suggested that, "*percentage income spent on transport*" could be used as an objective indicator. This information shall be readily available from census data or household expenditure surveys. The corresponding self-reporting question should be "I find the public transportation is affordable".

5.2 Age-friendly Physical Environment

From the assessment results, the study area is doing very well in public transport. The vehicles and stations of buses and metro are highly accessible, older people and people with disability can access public transport easily. Except for minibuses, since its services are mainly provided by small operators, it is harder to motivate the operators invest in upgrading the vehicle fleet, strong government intervention is necessary. The public transport network is comprehensive and dense, one can access to the public transport system from home and from popular destinations such as shopping places, community centers, healthcare facilities in short walking distance. The subjective rating on age-friendliness related to public transport vehicles and stops are high too.

Age-friendliness of public buildings and outdoor spaces, including walking environment are less encouraging. Although the objective criteria being used is merely the local design standard which describes the minimum provision in "able to access", the compliance rate was low for privately-owned or -managed premises, only around half of these premises satisfied the minimum standard. The situation was much better in government venues. Similar occurred to accessibility of walkways, although only the minimum standard has been used, the compliance was only around 60%. Owing to the gap between the objective standard which merely refers to "able to access" but subjective evaluation concerns a lot on "quality of access", the level of agreement between the two is not strong.

5.3 Actions by Government, Facility and Service providers

Hong Kong, like other developed regions of the world, is facing rapid population ageing. The government is well-aware of the challenges and needs to prepare in advance. The concept

"Transport for All" has been advocated since 2002. Under the long-term collaboration between the government and public transport operators, the vehicles and stops for buses and metro are currently highly accessible. The progress has been slow with the minibus trade as the operators are small, they are thus less willing and less capable of making investments in improving accessibility. Apart from physical accessibility of public transportation and stops, the government has launched a concession scheme so that people aged 65 or above can travel at a flat fare of HKD$2 (around USD$0.26) per trip, operators are reimbursed for the difference in fare revenue.

The government showed her commitment in age-friendly city by announcing "Building an Age-Friendly Environment" as one of the government strategies in the 2016 Policy Address. Government-built or -managed buildings and spaces are following closely the accessibility design standard, and efforts have been made to upgrade existing public infrastructures and facilities. When it comes to privately-owned or -managed buildings, the only mean is through the local building design standard, which old buildings are exempted from it, and the enforcement has been criticized to be weak. Provision of barrier-free access and incorporation of age-friendly designs are perceived to be against the commercial principals amongst majority of private developers and operators, not too many see "grey hair market" as an opportunity. To improve the accessibility among the privately-owned or -managed buildings, stronger incentive and stronger enforcement by the government is needed.

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