EVALUATING THE IMPACT OF VERTICAL ACCESSIBILITY PERFORMANCE TO BANGKOK
MASS TRANSIT STATIONS ON THE TRAVEL BEHAVIOR OF ELDERLY PASSENGERS

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| Thesis Title | EVALUATING THE IMPACT OF VERTICAL ACCESSIBILITY PERFORMANCE TO BANGKOK MASS TRANSIT STATIONS ON THE TRAVEL BEHAVIOR OF ELDERLY PASSENGERS |
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| By | Miss Yoon Ei Kyaw |
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       ระบบขนส่งมวลชนทางรางหรือรถไฟฟ้าบีทีเอสเป็นหนึ่งในรูปแบบการขนส่งสาธารณะหลักของกรุงเทพมหานคร มี
วัตถุประสงค์เพื่อบรรเทาความแออัดของการจราจรบนถนนและช่วยส่งเสริมประสิทธิภาพในการเดินทางในเมือง ตามรายงานของ
ธนาคารโลกปี 2559 ภายในปี 2583 ประชากรไทยมากว่าหนึ่งในสี่จะมีอายุ 65 ปีขึ้นไป หากผู้สูงอายุสามารถเคลื่อนย้ายไปมาใน
เมืองได้อย่างคล่องตัว พวกเขาสามารถทำกิจกรรมในชีวิตประจำวันและมีส่วนร่วมในสังคมมากขึ้น รวมถึงสามารถเข้าถึงบริการ
สุขภาพได้อย่างทั่วถึงอย่างไรก็ตาม ข่าวและรายงานต่าง ๆ แสดงให้เห็นว่ารถไฟฟ้าบีทีเอสมีข้อจำกัดในการเข้าถึงสำหรับผู้ที่
เคลื่อนไหวไม่สะดวก ในการใช้บริการรถไฟฟ้า ลิฟต์และบันไดเลื่อนถือเป็นทางเลือกหลักแทนบันไดสำหรับการเข้าถึงในแนวตั้งใน
สถานี การศึกษานี้มีวัตถุประสงค์เพื่อประเมินประสิทธิภาพของระบบขนส่งมวลชนด้วยการประเมินสถานีรถไฟฟ้าบีทีเอสในด้าน
ระดับการเข้าถึงสำหรับโดยสารสูงอายุ โดยประเมินผลกระทบของประสิทธิภาพของสิ่งอำนวยความสะดวกในสถานีต่อพฤติกรรมการ
เดินทางของผู้สูงอายุ การวิเคราะห์ใช้วิธีการเชิงปริมาณ โดยแบ่งสถานีออกเป็น 3 ประเภทตามสิ่งอำนวยความสะดวกในการเข้าถึง
ชานชาลาภายในสถานี จากการประเมิน พบว่า เกือบครึ่งหนึ่งของสถานีสามารถเข้าถึงได้อย่างจำกัด  ผู้สูงอายุมักใช้รถไฟฟ้าบีทีเอส
เพื่อวัตถุประสงค์ในการเยี่ยมเยือน การซื้อของ การพักผ่อนหย่อนใจ และกิจกรรมเกี่ยวกับสุขภาพ และส่วนใหญ่จะนั่งรถไฟฟ้าบีที
เอสในเวลาไม่เร่งรีบ นอกจากนี้ ระยะทางจากอยู่อาศัยมีผลต่อการตัดสินใจเลือกสถานี ผู้โดยสารสูงอายุส่วนหนึ่งเดินทางด้วย
รถไฟฟ้าบีทีเอสเพียงลำพัง และมักใช้บันไดเลื่อนในการเข้าถึงสถานีในทุกระดับ  ในขณะที่ใช้บันไดเพื่อออกจากสถานีบางแห่ง แม้ว่า
การทดสอบไคสแควร์แสดงให้เห็นว่าระดับการเข้าถึงชานชาลาสถานีด้วยบันไดเลื่อนและลิฟต์ไม่มีผลกระทบอย่างมีนัยสำคัญต่อ
พฤติกรรมการเดินทางและความพึงพอใจของผู้ใช้บริการขนส่งผู้สูงอายุ แต่ผู้สูงอายุที่ไม่มีรถยนต์ส่วนตัวมีแนวโน้มที่จะใช้รถไฟฟ้าบีที
เอส หากทุกสถานีมีสิ่งอำนวยความสะดวกในการเข้าถึงชานชาลาครบถ้วน อย่างไรก็ตาม ผลการวิจัยจึงเสนอแนะว่าการให้บริการ
ของระบบขนส่งมวลชนควรมีนโยบายที่เป็นมิตรต่อคนทุกวัย โดยคำนึงถึงคุณภาพชีวิตที่ดี ความสะดวกและความปลอดภัยในการ
เดินทางของผู้สูงอายุตามแนวทางการออกแบบตามหลักสากล (Universal design)

จุฬาลงกรณ์มหาวิทยาลัย
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| สาขาวิชา | ยุทธศาสตร์เมือง | ลายมือชื่อนิสิต ................................................ |
| ปีการศึกษา | 2564 | ลายมือชื่อ อ.ที่ปรึกษาหลัก ............................ |

# # 6378008625 : MAJOR URBAN STRATEGIES

Yoon Ei Kyaw :  EVALUATING THE IMPACT OF VERTICAL ACCESSIBILITY PERFORMANCE TO BANGKOK MASS TRANSIT STATIONS ON THE TRAVEL BEHAVIOR OF ELDERLY PASSENGERS.  Advisor:  Dr. PEAMSOOK SANIT, Ph.D.

The Bangkok Mass Transit System (BTS) sky-train is one of Bangkok's primary public transit modes to alleviate traffic congestion among many daily users. Regarding urban mobility, inclusivity is crucial. According to a 2016 World Bank report, by 2040, more than a quarter of the Thai population will be 65 or older. If the elderly could move around the city with greater ease, they would be able to participate more in society and have access to health care regardless of their age. However, news and reports demonstrated the BTS sky train's limited accessibility for persons with limited mobility. In this study, lifts and escalators are regarded as the primary alternatives to stairs for vertical circulation in stations. In terms of vertical egress and access to each station level, the performance of BTS stations in elderly passengers' accessibility was measured. The impact of station facilities' performance on the travel behaviour of the elderly was analysed using a quantitative approach. Three types of stations are categorised according to the dependability and functionality of their equipped facilities. The assessment revealed that nearly half of the stations are conditionally or limitedly accessible. They often use BTS for visits, shopping, recreation, and healthcare-related activities and mostly ride the BTS at non-rush hours. In addition, their choice of station is influenced by its closeness to their residence or its more accessible. Many older passengers who ride BTS alone stated that the seniors independently use the transit. Escalators are the most common means of accessing the station on all levels, while stairs are used to exit the stations. Although the chi-square test reveals that the ease of access to station platforms via escalators and elevators has no significant effect on the travel behaviour and satisfaction of elderly transit users, older people who do not own a private vehicle are more likely to use BTS if all stations have completed facilities. Despite this, findings indicate that age-friendly transit services and policies should consider seniors' well-being, travel convenience, and safety using a holistic design approach.

| | | |
|---|---|---|
| Field of Study: | Urban Strategies | Student's Signature ............................. |
| Academic Year: | 2021 | Advisor's Signature ............................. |

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# CHAPTER 1: INTRODUCTION

1.1 Background

Jan Gehl, the Danish architect, has stated, "Stairs and steps, no thanks" in his well-known book, Cities for People. As he discussed, people dislike taking the stairs because they require more effort and muscle power, making us tired while walking. The pedestrian bridges or the sky train stations in our cities usually have a challenge with the ease of access of the pedestrians, including the physically disabled and elderly. The sky train stations are elevated from the street level due to limited location options in some cities. Therefore, the lifts and escalators are equipped for vertical circulation for people who cannot use the stairs. In terms of urban mobility, inclusivity is important. Whether they live or commute, regardless of their age, everyone in the town must have the same opportunities in public transportation. Thailand is one of the most rapidly ageing societies globally, and it is predicted that by 2040, 17 million Thais will be 65 years or older – more than a quarter of the population (World Bank Thailand Economic Monitor Report, June 2016). Bangkok, the most populous city in Thailand, also has a considerable elderly population. The present study evaluated how the BTS Skytrain, one of the busiest public transportation facilities in Bangkok, and its facilities, particularly the stairs and escalators, make it easier for the elderly to board the train. If there are no lifts or escalators in the mass transit stations, senior citizens may have limited access to such modes of transportation. What if the city has a sizable ageing population and public transportation is not up to the task? Therefore, the impact of facilities to get to the elevated transit line will be reviewed in this study, focusing on the active ageing commuters' perceptions in the case of the Bangkok Transit System.

Bangkok, like other megacities, has its public transportation system to provide urban mobility, which can help turn a car-oriented metropolis into a traffic calm and

efficient public-service-oriented city. The Bangkok Transit System (BTS), Bangkok Mass Rapid Transit System (MRT), and BMRT buses are now the city's primary public transit modes to alleviate traffic congestion. The BTS network began with the mainline (Sukhumvit Line) in December 1999, and by 2021, it had expanded to two more lines, the Silom Line and the Golden Line, with 63 service stations. Ridership gradually increases yearly, whereas the number of stations expands (BTS E-Library). With so many daily users, the BTS is one of Bangkok's most important modes of transportation. However, every station has not fully installed lifts or escalators. According to the BTS website and mobile App, every station has lifts, but it is unclear if the lifts are at every exit or on both sides of the street.

Around 2015, disability activists and wheelchair users complained to the Bangkok government that each station lacked sufficient elevators (Zhang, 2015). After a debate regarding the BTS accessibility between disabled activists and Bangkok authorities in 2017, Khaosod English media illustrated a station's map defining the accessibility by lifts in January 2018. According to Khaosod's study map, only Siam and Asok stations have lifts on both sides of the streets, while Na Na and Saphan Taksin stations lack lifts from the street level. Aside from these four stations, others were only probably partly accessible at the street level or required assistance from staff to operate the elevators. After three years of disabled activists suing the BTS for inaccessibility, the demand continues because not all stations have elevators installed, and some are not operational. Lifts are a crucial component of public transportation for people with disabilities. Some elderly passengers who are still active may be able to use escalators if no lifts are available, but some stations lack escalators on one side of the road, leaving the passengers with no choice but to take the stairs.

BTS gives seniors special rates to encourage them to use public transportation more frequently. Nevertheless, their mobility options may be limited if the station's

facilities are inconvenient. Although BTS accessibility has been discussed and mentioned from the perspective of the disabled community, a few case studies highlight the station's vertical accessibility for Bangkok's senior citizens. In addition, the extended sections of the Sukhumvit line can be accessed with minimal information beyond the main section regarding vertical accessibility from previous studies. As the likelihood of an ageing Thai society in the coming years increase, the current state of urban mobility should be evaluated to determine if it is suitable for our senior citizens.

## 1.2 Research Questions

This study's main contribution is to present the transit station's facilities for active ageing. Based on the information offered and research gaps in the urban mobility literature, a research question has developed as follows:

**"How does the vertical accessibility performance of BTS stations affect the travel behaviour of elderly transit users?"**

The other integrated components will investigate to assist the study because this work aims to gain a sense of the stations' infrastructure for an active ageing society. The following **Main hypothesi**s has also been generated to answer the main research question: **The ease of access to the station platforms through escalators and elevators affects the travel behaviour and satisfaction of elderly transit users.**

## 1.3 Purposes of the Study

1. To measure the accessibility performance of BTS stations for elderly passengers in terms of vertical egress and access to the platform.

2. To assess the impact of vertical accessibility performance on the travel behaviour of elderly passengers on the Bangkok mass transit system

## 1.4 Scope of the study and case study area

The BTS Sukhumvit Line, Silom Line, and Gold Line will be evaluated in this study. The stations' accessibility will be analysed using the infrastructure or facilities for vertical access (from the ground level to the BTS station platform). Although almost all BTS stations have escalators, some do not have lifts on both sides of the station or street. This article categorises existing stations according to the vertical conveying facilities, such as Station A, Station B, and Station C. The facilities and relevant data will be considered to meet the requirements of BTS commuters who are senior citizens, as this topic mainly focuses on the elderly. The age of the study's focus group will be the same as that of the Thai elderly act and the BTS special fare offer eligibility, which is 60 years and up. The elderly passengers' access to the first mile and egress to the last mile and the distance from their homes to the station and feeder modes are not considered. Moreover, this article discusses the primary data collection of the present BTS stations' situations to evaluate senior passengers' satisfaction with vertical access.

## CHAPTER 2: LITERATURE REVIEW

### 2.1 Elderly and the Urban Transportation

According to the Cambridge dictionary, "accessibility" means the capability of being easily reached or obtained. The ability to move around cities is essential to the development of most human activities, making it a fundamental requirement for their growth. Improving accessibility is essential for all modes of urban transportation and urban mobility. Transportation is a crucial factor influencing healthy and active ageing. Social and civic participation and access to community and health services depend on the ability to move around the city (WHO, 2007). Multiple modes of transportation (walking, cycling, and public transportation) must connect to critical destinations (Richard et al., 2015). Even though public transportation cannot provide door-to-door service, active seniors may be able to use it as a cost-effective or dependable option when venturing out. Depending on the riders' intent, the modes of public transportation access may vary.

Nevertheless, accessibility also encompasses the design of the stations or stops, which facilitates boarding the vehicles. Furthermore, senior citizens must be able to leave their homes to use neighbourhood amenities and engage in meaningful social, cultural, and physical activities (WHO, Age-friendly strategy transportation and Rantanen, 2012). According to the Centers for Disease Control and Prevention, regular mobility and physical activity can prevent the age-related loss of strength and stamina. In addition, mobility impacts the number and frequency of trips made by senior citizens (Sideris & Wachs, 2018). Consequently, the city's infrastructure and public facilities could be viewed as contributing to the well-being of its users, particularly in terms of urban mobility.

Previous research indicates that older people are a stakeholder in urban mobility. When studying transportation for the elderly, researchers consider their travel behaviours and characteristics, including their physical characteristics, health conditions, and socio-economic factors, when public transportation is assumed to be reliable for elderly passengers. Our bodies undergo numerous changes as we age. There are external physical changes, but there are also many internal changes. Their mobility may be affected by the conditions of their bones, muscles, joints, and eyes, which are the most significant and crucial. (WHO, 2007) Therefore, evaluating transit station accessibility could consider the infrastructure design and senior facilities.

According to WHO guidelines, the following are typically considered essential for age-friendly buildings:

1. elevators
2. escalators
3. ramps
4. wide doorways and passages
5. stairs with railings
6. non-slip flooring
7. rest areas with comfortable seating
8. adequate signage
9. public toilets with handicap access.

In addition, bus stops and train stations must be equipped with ramps, escalators, elevators, the proper platforms, public restrooms, and well-placed, legible signs.

### 2.1.1 Key Determinant of Elderly Passenger's Travel Behaviors

Personal characteristics, living situations, technology adoption, perception of travel opinions, and the surrounding environment influence travel behaviour. (Jamal &

Newbold, 2020). Transportation barriers for seniors, such as services, facilities, and accessibility, impact an individual's travel preferences. Multiple challenges limit older people's commute, including physical, psychological, and economic barriers. (B.P, Shrestha, et al., 2017). In addition to those factors, demographics, Health, socioeconomics, the built environment, automobile access, and housing type influence the travel behaviour of seniors. (Haustein & Siren, 2015, Yang & Cui 2020). Socio-economic, housing, accessibility, and health conditions are critical determinants of elderly passengers' travel behaviours, even though these factors may differ from their locations and personal preferences.

## 2.2 Age Classification and Thailand's Elderly

Globalisation, technological changes (such as transportation and communication), urbanisation, migration, and shifting gender norms are the factors that directly and indirectly impact the lives of the elderly. (World Health Organization, Newsroom, Fact Sheets, 2021). Not all seniors have health issues or are a financial burden on their families. Active Aging: A Policy Framework, published by the World Health Organization, introduced the concept of active ageing. In 2002, the WHO's policy for global ageing defined "active ageing" as "optimizing opportunities for health, participation, and security to enhance the quality of life as people age." This concept of increased activity, a later retirement age, and age-appropriate work practices comes to mind. Regardless of their age, it also considers the elderly's social participation in society as an opportunity for them to pursue their passions. Due to the country's demographic shift, the city might face both challenges and opportunities.

This study's target population consists of elderly BTS passengers in Bangkok. Thailand has the second largest population over 65 years old in Southeast Asia, accounting for 13.0 per cent of the country's total population. According to 2016

estimates by the World Bank, Thailand will be one of the nations with an ageing population by 2050. United Nations and some countries define the elderly as 65 and older. In Thailand, however, senior citizens are defined by Article 3 of the Elderly Act of 2003 as those aged 60 or older. (The Situation of Thai Senior Citizens, 2014) In public health reports, the ageing population is divided into three categories. The Health at a Glance report classifies a country as an "ageing society" when the proportion of people aged 65 or older is between 7 and 14 per cent of the total population, an "aged society" when this proportion is between 15 and 20 per cent, and a "super-aged society" when this proportion is 21 per cent or higher. (OECD/WHO, 2020). In Thailand, however, according to the division of public Health and environmental strategy, more than 10 per cent of the population aged 60 and older is in an ageing society, more than 20 per cent is in a completely aged society, and more than 28 per cent is in a super-aged society (Bangkok elder situation as of September 2020-office of strategy and evaluation). There are 13,912 senior citizens in the BMA area (Public Health and Environmental Division's Dashboard, 2020). Although the age qualification for the elderly varies by region, the elderly BTS users in this study are defined as those aged 60 and older, consistent with the BTS and Thai elderly act.

## 2.3 Related Literature Study

The related literature study is based on three Thailand-based studies on public transportation and the elderly and a UK study on the access of individuals with limited mobility to train stations. The present empirical study outlines the purpose and methods for examining the relationship between transit accessibility and the travel behaviours of the elderly, along with their key findings.

*Table 1 Related literature review*

| 1 | Topic | Study Design | Key Findings | Authors |
|---|---|---|---|---|
| 1. | Ageing Society in Bangkok and the factors affecting the mobility of the elderly in urban public spaces and transportation facilities | Quantitative analysis with a survey in 3 selected districts Sample N = 26,411 Target group = 60 years < Statistical data analysis used SPSS (Crosstab and dummy techniques, Correlation, Binary logistics regression) | 31.7% of the respondent elderly used public transit The busses are the most common transport and Rapid transit was not often used by the elderly Three types of factors influence the elderly mobility to the public spaces (1. individual's independent, 2. distribution of public spaces, 3. urban systems) | Sariya Srichuae, Vilas Nitivattananon and Ranjith Perera (2015) |
| 2. | Elderly User's Satisfaction with Public Transportation in Thailand Using Different Importance | Importance Performance Analysis Gap Analysis IPA with Gap 2 Analysis | Despite reduced fares for the elderly, other services and facilities have been limited. | Methawadee Chaisomboon, Sajjakaj Jomnonkwao and Vatanavongs Ratanavaraha |

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|---|---|---|---|---|
| | Performance Analysis Approaches | face-to-face interview Sample N = 450 (using public transport) Target group = 18-59 and 60 years< Comparing elderly and non-elderly | | (2020) |
| 3. | Analysing transport mode choice for ageing society in Thailand | Thailand (except Bangkok) Literature review close-ended survey questionnaires (elderly-focused) Multinomial Logistic Regression analysis Four modes of transportation as variables | Travel frequency is less than once a week, travel time is in the morning, and most activities are shopping are common characteristics of ageing mobility. | Thanapong Champahom, Sajjakaj Jomnonkwao, et al. (2020) |

| 4. | Step-free railway station access in the UK: the value of inclusive design | Qualitative analysis Semi-structured interviews analysis of Senior/Disabled Persons Railcard data from 17 railway stations in Buckinghamshire | The advantages of step-free access extend beyond the individual typically associated with PRMs, demonstrating the potential to impact society positively. There is a positive relationship between a railway station's level of step-free accessibility and the percentage of PRMs who use it. | Swift, Cheng, P. Y. Loo, Cao & Witlox (2021) |
|---|---|---|---|---|
| 5. | Understanding mobility characteristics and needs of older persons in urban Pakistan with respect to use of public transport and self-driving | Descriptive and comparative analyses chi-square test Three sessions questionnaires 1. Socio-demographic and trip characteristics | The elderly's trip frequency is associated with public transport and self-driving A Pakistan case study Trip frequency of the older people surveyed decreased with age, both for public transport and self-driving | Ahmad, Z, Batool, Z, Starkey, P (2019) |

| | | 2. Mobility characteristics with aspect to the use of public transport<br>3. Mobility characteristics concerning the use of personal vehicles | Two-thirds of respondents admitted to negative feelings<br>The preferred modes of travel are car, motorcycle and walking | |
|---|---|---|---|---|

Srichuae et al. (2015) analysed Bangkok regarding the factors affecting the mobility of the elderly in urban public spaces and transportation facilities. It combined quantitative and qualitative approaches. The study employed a survey of 60 years old and above residents in three selected Bangkok districts. The data was collected using a questionnaire-based survey. The significant factors affecting the mobility of the elderly were determined by using logistic regression for the research. The finding reveals that 31.7% of the respondent's elderly used public transit, the bus was the most common transport, and the correspondents did not often use rapid transit. In addition, the ability to travel independently, the distribution of public spaces with accessible transportation services, urban density, and urban development patterns were found to influence the mobility of seniors through this study.

The elderly user's satisfaction with public transportation in Thailand was done by Chaisomboon et al. (2020) using different importance-performance analysis approaches. The study assumes that even though there is a policy that lowers fares for elderly passengers, the limited services and facilities for the elderly, such as stairs,

elevators, handrails, restrooms, and wheelchairs, are not enough to get the elderly to use the service. The study focused on the elderly over 60-plus years old from four different regions of Thailand, and the data was collected from a face-to-face interview. In addition, non-elderly 18-59 years old were also conducted in the Bangkok area, where transportation services differ from other regions. The survey consisted of two parts: Part 1 consisted of social-demographic characteristics and travel behaviour, such as gender, income, marital status, travel purpose, travel duration, and the number of travellers who travelled with participants; Part 2 consisted of 10 dimensions or 39 service quality attributes. The level of service satisfaction was measured using a 5-point Likert scale (1, the lowest satisfaction level; 5, the highest satisfaction level). The service quality variables are defined by ten factors: vehicle characteristics, access, safety, reliability, waiting time, convenience, staff, information, station/STOP, and affordability.

Champahom et al. (2020) studied the selection of transport modes by the ageing population of Thailand. This study considers four modes of transportation for mode selection: bicycle or motorcycle, automobile, and public transportation. A close-ended survey questionnaire was used to collect the data directly from the elderly. The analysis method was multinomial logistic regression, with a nominal scale as the independent variable and a car as the base model for interpreting the change in transportation mode among the elderly. The study concluded that the typical characteristics of ageing mobility are a travel frequency of less than once per week, morning travel, and shopping as the principal activity. The study stated that private automobile transportation should be enhanced for convenience. Moreover, the authors suggest that public transportation should be improved to accommodate the elderly's travel activities, such as hospital visits and shopping trips. Although the Bangkok region was not included in this study, the knowledge related to the Thai

elderly's behaviour and travel characteristics can be applied to studying the transportation of the elderly.

More recently, Swift et al. (2021) discussed that the government and interested stakeholders should commit to increasing the number and coverage of step-free stations across the UK. Moreover, the findings describe that the advantages of step-free access extend beyond the individual typically associated with PRMs, indicating that they have the potential to impact society positively. It is a qualitative and quantitative mixed methods study along with the semi-structured interviews and interviews analysis of Senior/Disabled Persons Railcard data from 17 railway stations in Buckinghamshire. According to the respondents from this study, there is no single, universal definition of step-free access, including step-free street-to-platform or street-to-train access. In any case, the lifts and escalators for vertical access to the station are the facilities referred to as step-free access in this study. The evaluation also reveals a correlation between the number of PRMs using a train station, its step-free accessibility, and the importance of universal design.

2.3.1 Summary of the related literature

*Table 2 Captured variables from the literature*

| Variables | Sources |
|---|---|
| Elderly passengers' travel behaviour<br><br>- Trip Frequency (per week)<br><br>- Travel Time<br><br>- Trip purposes | Srichuae et al. (2015), Ahmad, Z et al. (2015), Chaisomboon et al. (2020), Champahom et al. (2020), Ahmad, Z et al. (2015) |

| The elderly satisfaction with public transportation<br><br>- Five levels of satisfaction with facilities and services | Chaisomboon et al. (2020) |
|---|---|
| The station facilities' performance<br><br>- Step-free facilities<br>(Lifts and Escalators) | Swift et al. (2021) |
| Mode choice of the ageing society<br><br>- Ability to use the private car<br>- Accessible to the transitz | Champahom et al. (2020), Ahmad, Z et al (2015) |
| The health conditions of elderly<br><br>- Physical health condition<br>- Vision Condition<br>- Using a walking aid for mobility | Swift et al. (2021), (World Health Organization, Newsroom, Fact Sheets, 2021) |
| The characteristics of elderly<br><br>- Social demographic (Age, Gender) | Srichuae et al. (2015), Ahmad, Z et al (2015), |

According to the critical findings of prior research, senior citizens are one of the stakeholders in public transportation. When determining the dependability of public transportation for elderly passengers, studies consider their travel behaviours and characteristics, including their physical characteristics, health conditions, and socio-economic factors. According to the local case studies, safety and facilities are more important than other policies for the elderly.

## 2.4 Literature Review Conclusion
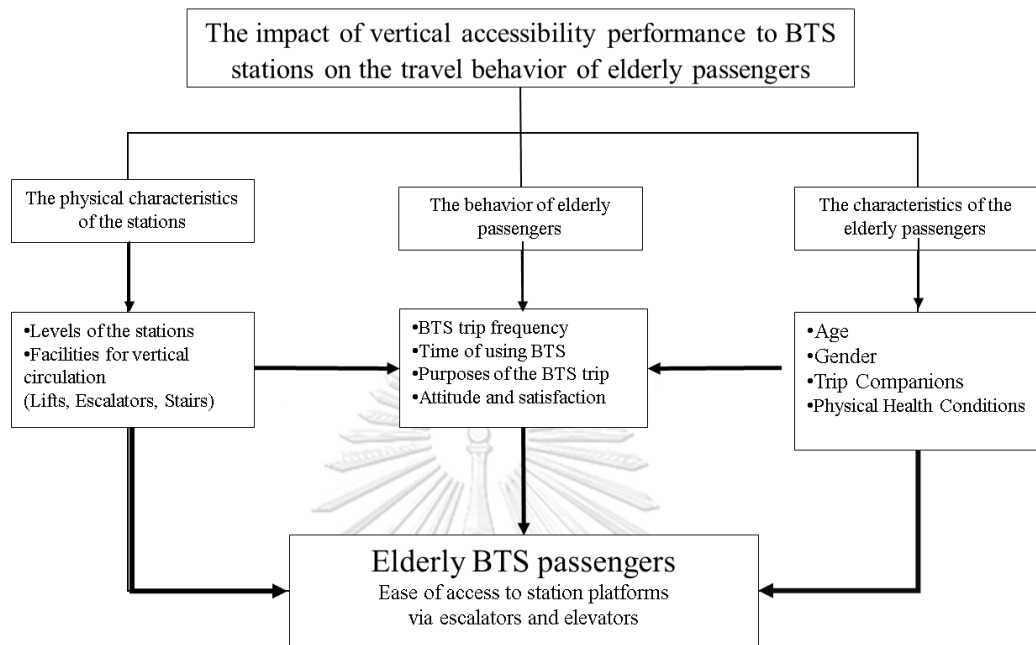


*Figure 1 Conceptual framework of the study*

The age definition of elderly may vary in the region, but 60 years old and above can be considered senior citizens. Global Age-friendly Cities: A Guide already suggests that older people comprise the vulnerable group and their active and inclusive participation in our society should be encouraged in public services. Public transportation is one of the many infrastructures which are accessible to older people. The fare reduction and prioritised seats are not all the services provided in public transportation for older people. The accessible stations may welcome more senior passengers Swift et al. (2021)

Since the outgoing and commute pattern of the elderly are different from other adults, travel behaviour is studied along with transportation studies. The user characteristics and socio-economic are also involved in the previous transportation

research to understand the factors influencing their public transportation trips. Moreover, facilities performance, such as the senior-friendly infrastructure, is interested in examining the impact of mobility. Chaisomboon et al. (2020) found that although they are prioritised in the public area, the facilities and infrastructure are sometimes not suitable for them and cause an impact on their outdoor activities.

Moreover, Swift et al. (2021) assumed the advantages of step-free access in stations impact society, especially for those with limited mobility. Their analysis also described a correlation between the degree of step-free accessibility at a train station and the proportion of PRMs who use it. Chaisomboon et al. (2020) also suggested that the facilities are more important to attract elderly passengers in public transportation. Hence, the satisfaction is analyzed to understand whether those are functional or useable by the elderly.

All in all, Travel behaviour and user characteristics are the main components in the previous transportation studies. However, the travel behaviour of the elderly may differ by each type of transportation. Therefore, this study emphasises only the senior BTS passengers' travel behaviour. Furthermore, although the study target group is 60 years old and above, the previous studies have no divided group for the elderly by age. In the present study, the age has been divided into two groups among the elderly. Moreover, the physical characteristics of the elderly passengers are used to examine the impact on their station accessibility by vertical circulation.

## CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

### 3.1 Research Method

This chapter describes the research methodology used to determine the impact of Bangkok's vertical accessibility performance on senior citizens' travel behaviour. Initially, it illustrates the research questions, objectives, and study area. Then, the target population, research design, materials, data collection techniques, and analysis methods were explained.

The study consists of two parts: measuring the accessibility performance of BTS stations for elderly passengers in terms of vertical egress and access to the platform and examining the difficulties elderly passengers face in reaching BTS stations. The study used a quantitative approach with a physical survey checklist and questionaries based on and developed from previous studies (Srichuae et al., 2015, Chaisomboon et al., 2020, Champahom et al.,2020) and a physical survey checklist.
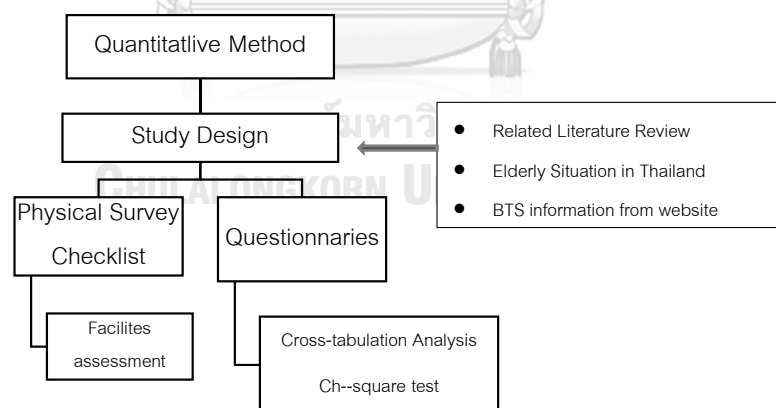


*Figure 2 Methodological framework for the study*

Descriptive statistics provide simple summaries of the sample and measures. The study can be divided into sections on supply and demand. On the supply side, a field survey was conducted using a physical checklist to evaluate the existing

infrastructure and senior-friendly facilities at transit stations. On the other hand, to understand the satisfaction of the elderly passengers from the demand side, questionnaires are used to collect information on their travel behaviours and user characteristics as the study's conceptual framework. (See Fig 2)

## 3.2 Procedure of the research method

The research was applied under the following procedures. First, the situation of the Thai elderly and the local definition of age classification was studied to determine the target group's age, which will then be applied to the study of mobility behaviour, user characteristics, and station facilities using Health and annual statistical reports. In the meantime, the BTS website was scoured for information on BTS station facilities to determine what kind of data was available to the public.

Next, the relevant literature was reviewed to explore the relationship between public transportation and elderly passengers, particularly those using mass transit. Then, the methodologies, study design, and the variables used in the previous literature are applied in this study.

The BTS lines and stations in the Bangkok Metropolitan Administration Area were designated as research areas to conduct field research and collect primary data using physical survey checklists and questionnaires. About forty elderly passengers volunteered to participate in the survey, and all stations were inspected for the checklist's existing conditions evaluation. The participants were approached at the stations, on the train, and via social media using simple random sampling.

Finally, descriptive statistics were applied to the physical inception checklist. The collected data were processed for cross-tabulation analysis to determine the

effect of vertical accessibility performance to Bangkok's mass transit stations on the travel behaviour of senior citizens.

## 3.3 Data Collection and Data Collection Guide

### 3.3.1 Case Study Location

Bangkok's public transportation system is the most developed of all Thai provinces. This study only evaluates the BTS Sukhumvit, Silom, and Gold lines for vertical accessibility at mass transit stations. The location of the study is therefore considered to be within the Metropolitan Administrative Area of Bangkok. The data collection was conducted in the metropolitan area of Bangkok, particularly in the neighbourhood of the BTS lines.

### 3.3.2 Study Respondents

The primary contribution of this study is the presentation of the transit station's facilities for the active ageing of elderly passengers. Due to the study's focus on the elderly, the sample for this study consists of Bangkok residents who are at least 60 years old, and over thirty seniors participated in the survey. In addition, most of this survey's respondents have used or are currently using the BTS sky train. Previous studies of public transportation in Bangkok (Champahom et al., 2020; Chaisomboon et al., 2020) indicate that the number of elderly passengers is comparable to or less than that of other passengers, mainly in transit. Therefore, the sampling was initially defined as a minimum of 30 senior passengers for collecting primary data. However, the number of participants increased to nearly forty when collected in the stations and on the trains within May 2022.

### 3.3.3 Data Collection Methods

This study aims to evaluate the stations' vertical accessibility. A physical inception checklist was used to examine the station infrastructure and senior welfare facilities to comprehend the supply. On the other hand, a printed survey form or google form was used to assess passenger behaviour, characteristics, and level of satisfaction as the demand part. A simple random sampling method was used.

*Physical Inception Checklist*

The current situation of vertical accessibility in BTS stations and senior welfare facilities was assessed by using an inspection checklist to record the current state of the stations' facilities. From March to April of 2022, the author of this study examines both sections using the checklist. In some stations, the station staff shared information about their station frailties for seniors, such as broken elevators for how long. Through the checklist, the present conditions of the BTS stations are reviewed as the primary source of data collection for the supply side.

*Survey Form*

A survey form of 20 close-end questions was developed to determine the perceptions of elderly passengers regarding station accessibility and facilities using the literature review and conceptual framework. The format of the questionnaires was bilingual. The transit riders represent the study population in the case study area. Respondents who use or have used the BTS and are at least 60 years old were selected randomly to determine their perspective on the physical characteristics and accessibility of BTS stations. The survey was conducted on weekdays and weekends from the last week of April to May 2022 in the station area and on the trains. When completing the survey in stations or on trains, respondents were commuting. In order to save the respondents' time, a pamphlet-like sheet containing the survey's

description and a QR code for the Google form was provided so that they could complete it when they had the opportunity. A printed survey form was used when elderly passengers were unfamiliar with Google forms. In addition, to increase participation and include the perspective of infrequent passengers, a Google Forms survey was distributed via social media and locals to reach more individuals. Before the actual survey, a pre-survey was conducted in the last week of March 2022 to determine whether or not respondents could comprehend the questions and revise them accordingly. The questionnaires can see in (Appendix 1).

3.3.4 Data Collection Guide

Concerning the study design, there are two main components. Part 1 is the physical inception checklist, which will assist in evaluating the vertical accessibility performance of the BTS stations. Part 2 explored the travel habits, characteristics, and satisfactions of the elderly. In addition, using questionnaires, the elderly passengers' difficulties accessing the stations were investigated in Part 2.

*Table 3 The data collecting guide*

| Part | Description | Objectives | Methods |
|------|-------------|------------|---------|
| Part 1 | The physical characteristic and present condition of the stations | To measure the accessibility performance of BTS stations for elderly passengers in terms of vertical egress and access to the platform | Physical survey checklist |

| Part 2 | - Travel behaviour<br><br>- User characteristics<br><br>-Satisfaction &<br>Attitude | To assess the impact of vertical accessibility performance on the travel behaviour of elderly passengers on the Bangkok mass transit system | Questionnaires |
|---|---|---|---|

### 3.3.5 Developing the physical inception checklist

The checklist consists of station infrastructure design and elderly care facilities. The vertically accessible infrastructure is primarily evaluated as the station facilities that allow passengers to reach the platform level. In the design of station infrastructure, there are escalators, elevators, and stairs to get on and off the stations. First, the BTS website and App were used to determine the information available to passengers online and offline. Then, the checklist was done by using the station facilities provided by the BTS in the excel sheet, including simple criteria such as whether the facilities are good or broken and accessible or not for every level of each station.

### 3.3.6 Background of questionnaires in the survey design

Each survey question's purpose and input to the study's research question were explained in this segment. The questionnaire consisted of three sections with a total of forty-one questions, including ten questions that were not variables but were meant to assist respondents in answering the main questions. The survey form, including the questions, can be looked at in Appendix A.

Section 1 contains twelve questions regarding the behaviour of the elderly. Section 1 was to collect the travel behaviour of elderly BTS passengers, including trip frequency per week, trip companion, and trip purpose, along with their payment method. In addition, their behaviour in checking station facilities were also questioned. Besides that, their modes of choice of mobility were also asked about before and after their retirement. Those variables in this section referenced this study's related local case literature review.

In Section 2, fifteen questions assessed station facility satisfaction. The first ten questions asked respondents about their preferred station access and exit facilities to determine satisfaction. First, an illustration of a train station's level was added to clarify the answers because, during the pilot survey, respondents were confused about the levels and their terms. Then, their consideration and satisfaction regarding using those facilities were questioned. This section's questions were developed based on the literature review on the relationship between senior citizens and public transportation and adapted from the physical inception checklist.

Fourteen questions were used to determine the characteristics of the elderly in section 3 as the final part of the survey. Demographics like age, gender, and health conditions of the elderly determine if their perceptions may be related to mobility. In addition, the four questions corresponding to the characteristics of needing assistance while accessing the station were included in the station to support the suggestion of strategies. As in previous sections, the variables in this section were derived from Chapter 2's literature review.

**3.4 Data Entry and Analysis**

The checklist was compiled in an Excel spreadsheet, and the criteria were explained in the data collection. Finally, the survey information was entered into a computer and analysed using a Microsoft Excel Spreadsheet.

The accessibility of the stations will be evaluated using vertical access infrastructure or facilities (from the ground level to the BTS station platform). However, not all BTS stations have elevators on both sides of the station or street. So, this paper categorises existing stations such as Station A (Fully accessible stations), Station B (Partially accessible stations), and Station C (Limited accessible stations). The proportion of the stations by their vertical facilities performance is presented after categorizing.

*Table 4 The analytical methods*

| Description | Data Source | Analysis |
|---|---|---|
| The physical characteristic and present condition of the stations | Physical survey checklist | Assessment |
| - User characteristics -Travel behaviour -Satisfaction & Attitude | Survey section 3 Survey section 1 Survey section 2 | Cross-tabulation |
| Impact of the stations' facilities' performance on the behaviour of elderly passengers | Survey section 1 Survey section 2 | Chi-square test |

The impact of vertical accessibility performance to Bangkok mass transit stations on the travel behaviour of elderly passengers was evaluated using a quantitative method. Cross-tabulation is a simple data table that displays the results of the respondents and is a quantitative technique for analysing the relationship between two or more variables. The cross-tabulation test compares categorical variables in one or more categories to find whether the variables are associated (Ahmad et al., 2019). Therefore, the crosstab is appropriate to present the findings in this small sample study. This study has been used to determine the relationship between the behaviour, characteristics, and satisfaction of the elderly and the station's accessibility. Therefore, compare the elderly's behaviour at each station type and analyse the difference in their behaviour using chi-square.

## 3.5 Limitation of the study

This study only considered the BTS lines among Bangkok's public transportation networks to determine the senior citizens' accessibility to the sky train. Moreover, hence, the other transit lines are ignored in this review. Furthermore, as the study focused on station accessibility via vertical facilities; therefore, it does not consider whether the elderly enter or exit the station at street level for their first or last mile. In addition to the field research survey checklist, the stations' facilities were checked during the visiting time and recorded conditions. Although the conditions of the stairs, elevators, and escalators may change after the study, station staff information was also considered to determine whether the facilities were temporarily broken or under maintenance for an extended period. Consequently, the information regarding the condition of the station's facilities may not influence the results.

As this study was scoped at 30 to 40 elderly passengers who used or had used the BTS during the study time, the gender balance and age range may not represent the whole elderly in Bangkok. Moreover, the random sampling method to survey the

characteristics and behaviour of elderly passengers may be limited. When the survey was distributed through social media, the sample may have bias upon the age concern and some detailed answering when the older people were unfamiliar with the technology. In that case, their family members could help answer the questions, or a printed form was used when they were accessible offline.

In the case of testing the significance of crosstab results using Chi-square, the small sample size may not be sufficient to establish the significance of the elderly passengers. Although it may not be statistically significant for the entire population, nearly forty samples are larger than the minimum required for Chi-square analysis. Therefore, the study is expected to contribute to vertical accessibility and knowledge of seniors' perceptions of the sky train's accessibility. However, the findings may not be significant for all seniors in Bangkok who use the BTS.
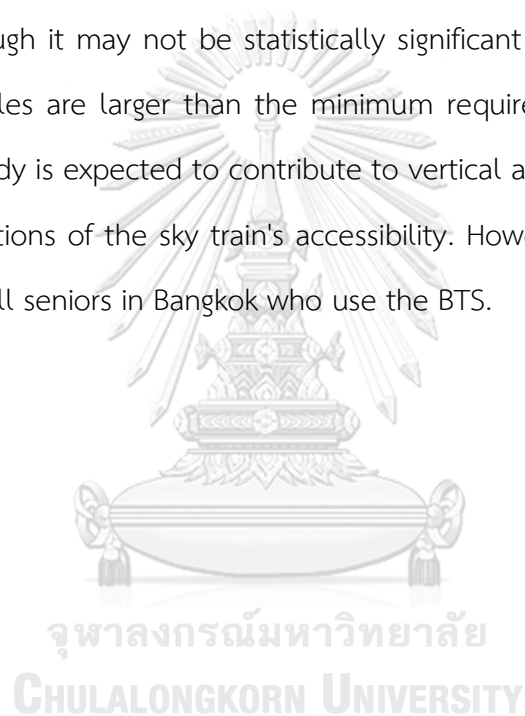
## CHAPTER 4: ANALYZING

This chapter examines the data collected from the physical survey checklist, questionnaires, and previous study variables. The impact of escalators and elevators on the accessibility of station platforms on the travel behaviour and satisfaction of elderly passengers was evaluated to answer the research question. The study and analysis were completed in two parts. Initially, the accessibility performance of the stations is reviewed via a physical survey checklist. Then, collected survey data are used to examine the behaviour, characteristics, and satisfaction of the elderly passengers. Lastly, the impact on elderly passengers and their access station types were tested to confirm the hypothesis. To confirm the study hypothesis, the analysis results will be described as the findings in the following chapter.

### 4.1 The accessibility performance of BTS stations

The physical survey checklist was used for access **to measure the accessibility performance of BTS stations for elderly passengers in terms of vertical egress and access to the platform**. So, the physical characteristics of the stations and the present condition of the stations are explained first. Then, the stations are categorised into their facilities and conditions for vertical circulation to determine their accessibility relating to the characteristics and behaviours of the elderly.

4.1.1 The physical characteristics of the stations

There are 63 stations total on three BTS lines. The three levels of a typical BTS station are street level, concourse level, and platform level. Each station, according to its designs, has at least four exits. As the sky train is above the street level, access needs from both sides of the street to the stations. (See Fig 3). Therefore, all exits have

vertical circulation facilities to get on the sky train. Those unable to use the stairs at a typical station can choose between a lift and an escalator for vertical circulation. Due to the fact that the exits are on opposite sides of the street, a typical station may have at least two escalators and two lifts.

In addition, the concourse level of each station provides a map detailing exit information and facilities, as well as facilities for vertical circulation and the waiting area with seating at the platform level. Because the station has three levels, the condition of these three facilities should be evaluated based on their level.
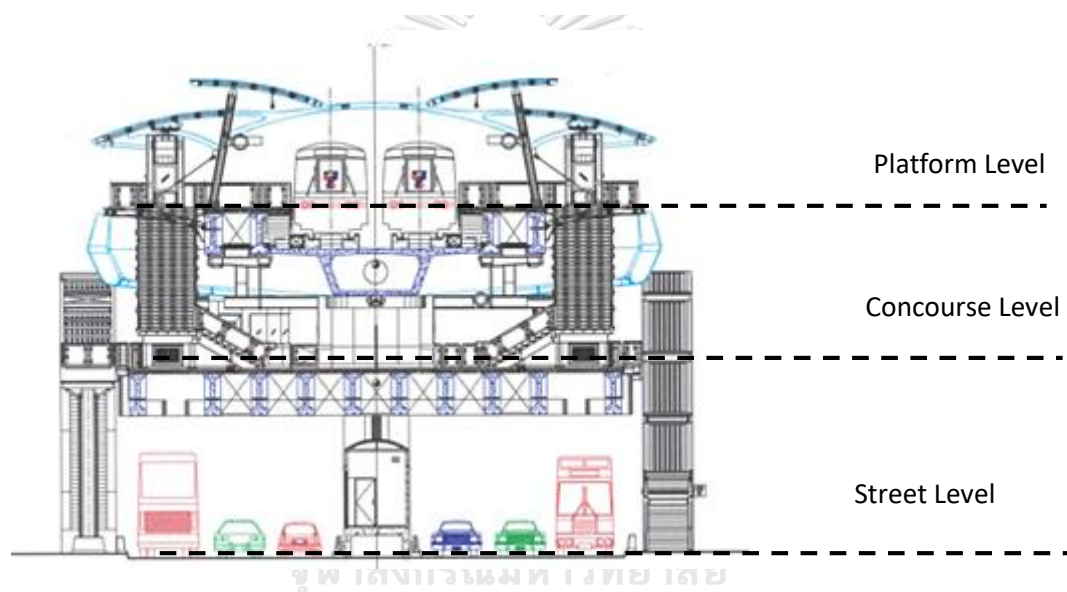


*Figure 3 The levels of a typical station (Source: www.bts.co.th)*

4.1.2 The accessibility performance of BTS stations

From March to April 2022, the primary data collection consists of a review of the current state of the BTS stations. A physical survey checklist determined the types of stations based on their vertical access facilities. The information and location of stairs, escalators, and lifts can be found on the BTS website, App, and area map; however, the data is not always updated, and some lifts are not operational outside. In addition, most of the stations' exits are directly accessible from the street

level. However, some are also connected with the buildings beside them, like shopping centres and offices. Therefore, this study only considers vertical access from the street to the station.

The following results are derived from the physical survey checklist.

*Street Level to concourse accessibility*

On the street level of the stations, stairs are the main accessible facilities for every exit. They are on both sides of the street, but lifts or escalators do not feature on both sides or at every exit. Figure 4 presents the different facilities and their locations at street level. 5% of the stations have no lifts at street level. Lifts and escalators on only one side of the stations are 22% and 27% respectively, while the rest have different facilities on both sides of the streets. However, 9% of the stations have at least one lift that does not operate when collecting the data.
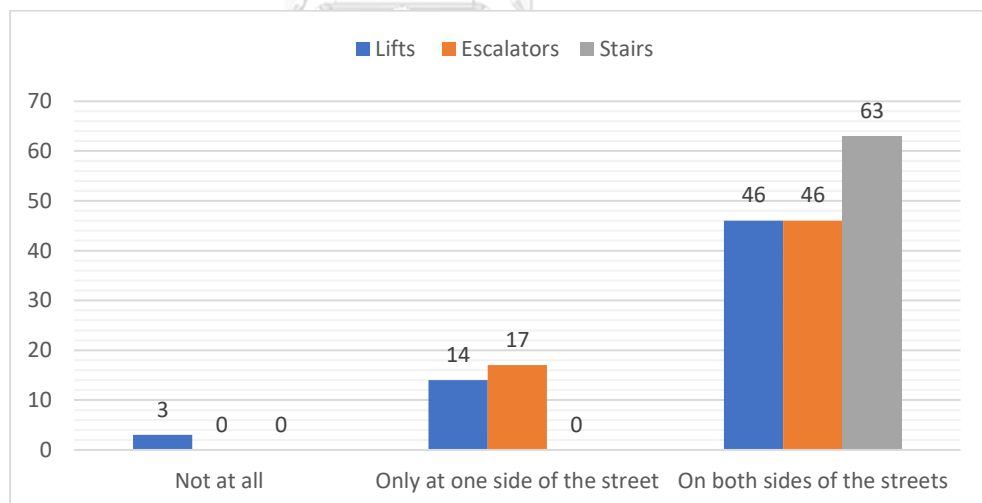


*Figure 4 Station numbers that have different vertical facilities at street level*
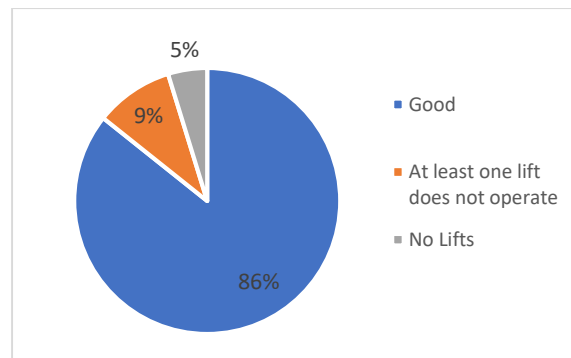
*Figure 5 The percentage of stations based on the condition of their street-level lifts*

Meanwhile, there was no lousy condition street-level escalator in all 63 stations. Most escalators from the street level to the concourse are only for ascending, except for one escalator at Mo Chit station's exit 3. So, most of the stations' escalators only support access to the stations. Therefore, the stairs are the primary facilities for the stations' vertical circulation after the escalators.

*Concourse to platform level accessibility*

The stairs at every station's concourse are the main facilities access to the platform level. Except for the Saphan Taksin station, the last 62 stations have concourse-level escalators and lifts for getting to both sides of the platform. (See Figure 4). In a large station like Siam, the escalators at the concourse level are both up and down accessible. As another exception, although all the stations have concourse level lifts, a lift at Mochit station does not operate for over three years. At all stations, waiting areas with seating are only located on the platform level.
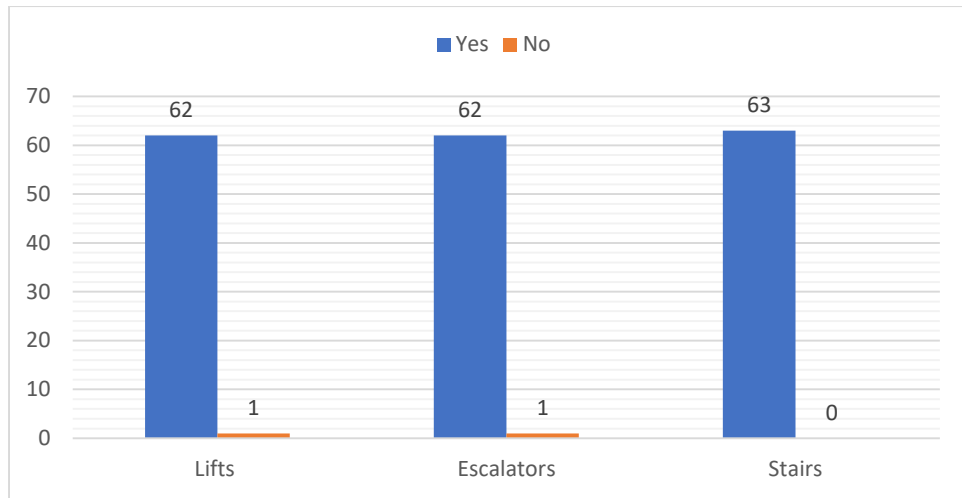
*Figure 6 Station numbers that have different vertical facilities at concourse to platform level*
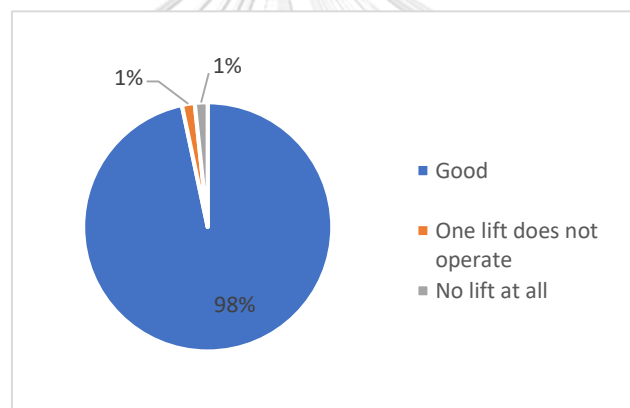


*Figure 7 The percentage of stations based on the condition of their platform-level lifts*

### 4.1.3 Types of the station according to accessibility level

As a result, the facilities for vertical accessibility to the platform level of the stations are better equipped than the street levels. When inspecting the state of the stations, all stairways are standard and fitted with railings at each stop. Based on the findings, the accessibility of vertical circulation of the stations is considered for people who cannot use the stairs—following their functionality and accountability when accessing the BTS. The stations are into three types in Table 5. Then, the assessment

through the checklist for the vertical accessibility level of each station can be seen in detail in figure 10.

Table 5 Descriptions of the station criteria by their vertical accessibility

| Types of Station | Descriptions |
|---|---|
| Station A | **Fully accessible Stations:** functional street-level lifts and escalators are on both sides of the street, and the platform level has functional lifts and escalators |
| Station B | **Conditionally or partially accessible stations**: street-level lifts and escalators are only on one side of the streets or do not operate, or the different vertical facilities are only one and at the opposite of the street or platform level has an unfunctional lift or escalator |
| Station C | **Limited accessible stations**: there are no street-level lifts or escalators on both sides of the street or only one facility does not operate, or no vertical facilities access to the platform level |

According to the criteria in table 5, the three station types are explained with the example stations.

### Station A: Fully accessible stations

The stations would be fully accessible if installed with lifts and escalators on both sides of the street to the concourse level. In addition, at least two functional disabled lifts and

escalators access the platform. (e.g., Siam Station, Wongwai Yai Station). This type of station can be considered an ideal sky train station for elderly passengers or anyone unable to use the stairs.
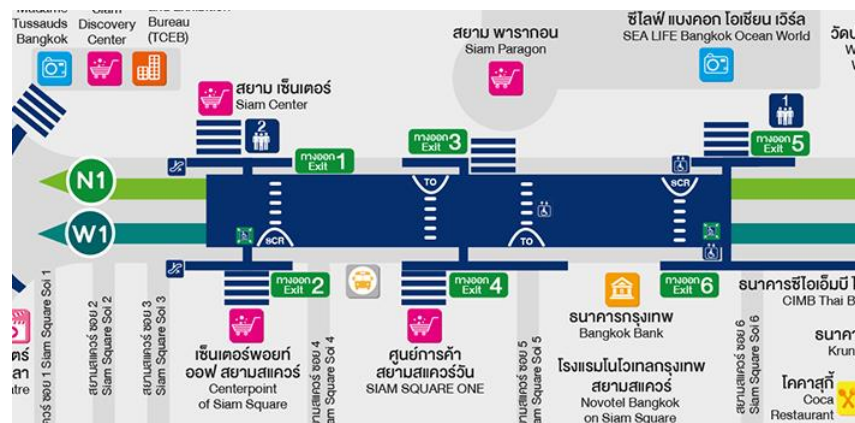


*Figure 8 Siam Station: Station type A* (Source: Cropped BTS station area map)
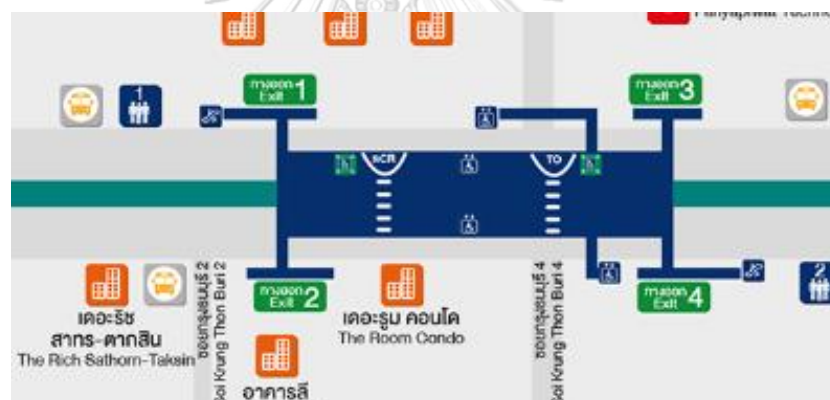


*Figure 9 Wongwian Yai station: Station type A* (Source: Cropped BTS station area map

### *Station B: Conditionally or partially accessible stations*

The stations are conditionally accessible and equipped with lifts and escalators on both sides of the street to the concourse level. However, only one side of the lift works well, or only one side has lifts or escalators. Perhaps the street-level lift and escalators are only on one side, and passengers must cross the street to use the lift or escalators. For example, in Figure 1, the Saphan Kwai station is conditionally accessible.

Some stations are only partially accessible because a lift and an escalator at street level are on the opposite side of the street, for example, Phra Khanong station. Furthermore, except for

Mo Chit station, all type B stations have at least two functional lifts and escalators accessing the platform. Even though Mo Chit station has full facilities on the street level, only half of the station is accessible because the lift on the platform level does not work.
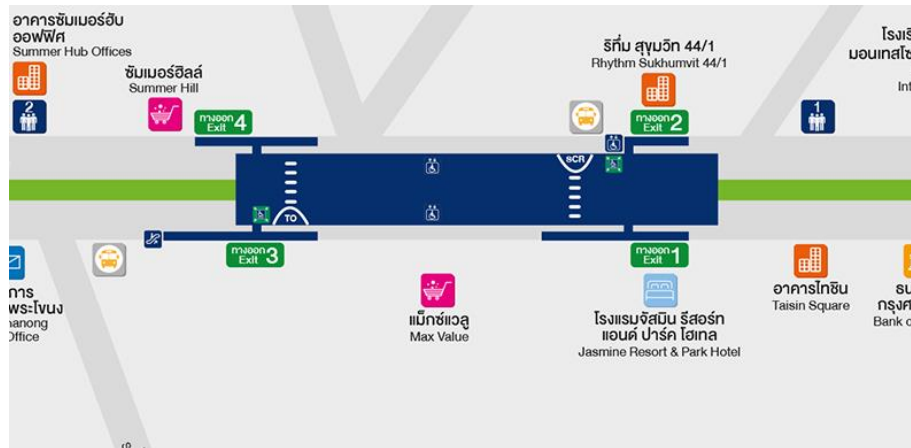


*Figure 10 Phra Khanong station: Station type B* (Source: Cropped BTS station area map)



*Figure 11 Saphan Khwai station: Station type B* (Source: Cropped BTS station area map)

***Station C: Limited accessible stations***



*Figure 12Saphan Taksin station: Station type C (Source: Cropped BTS station area map)*
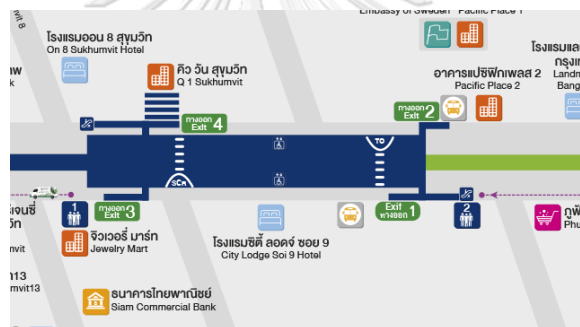


*Figure 13 Na Na station: Station type C (Source: Cropped BTS station area map)*

When there are no facilities for vertical circulation, the station is inaccessible to those unable to use the stairs. For example, some BTS stations have only one lift or escalator on one side of the street, but that lift is broken, or there is no lift from the street level to the concourse. Furthermore, there are no accessible facilities on the platform, such as the Saphan Taksin station. Therefore, these stations are classified as limited-access stations for elderly passengers.

*Figure 14 Stations assessment through physical survey checklist*

| | Name of the station | Escalators (Street to Concourse) Location of the Escalators | Condition | Lifts (Street to Concourse) Location of the Lifts | Condition | Other Facilities or Remark | Types of Station |
|---|---|---|---|---|---|---|---|
| Sukhumvit Line | Siam | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | N/A | Station A |
| | Ratchathewi | Only at one side of the street | Normal | Only at one side of the street | Good | The lift and escalator locate at the opposite sides | Station B |
| | Phaya Thai | Only at one side of the street | Normal | Only at one side of the street | Good | The lift and escalator locate at the opposite sides | Station B |
| | Victory Monument | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | N/A | Station A |
| | Sanam Pao | Only at one side of the street | Normal | Only at one side of the street | Good | The lift and escalator locate at the opposite sides | Station B |
| | Ari | Yes, on both sides of the street | Normal | Only at one side of the street | Good | The lift and escalator locate at the opposite sides | Station B |
| | Saphan Khwai | Only at one side of the street | Normal | Only at one side of the street | Good | Lift and escalator locate at the same side. The other side has only stairs | Station C |
| | Mo Chit | Yes, on both sides of the street | Normal | Yes, on both sides of the street | The disabled lift is broken | Total4 lifts (but one is broken), the street-level escalator at exit 3 is for descending | Station C |
| | Ha Yaek Lat Phrao | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | Skybridge connection has disabled lift | Station A |
| | Phahon Yothin 24 | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | N/A | Station A |
| | Ratchayothin | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | N/A | Station A |
| | Sena Nikhom | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | N/A | Station A |
| | Kasetsart University | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | Total3 lifts (with one disabled lift) | Station A |
| | Royal Forest Department | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | As the exit info, exit 1 should has another lift but can't find | Station A |
| | Bang Bua | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | As the exit info, every exit has lifts (total 4) but only at exit 1 and 4 (total12) | Station A |
| | 11th Infantry Regiment | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | As exit info there should be 4 lifts but only 2 at exit 3 and 4 | Station A |
| | Wat Phra Sri Mahathat | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | All 4 exists has lifts and escalators | Station A |
| | Phahon Yothin 59 | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | N/A | Station A |
| | Sai Yud | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | No exit info for lifts escalators | Station A |
| | Saphan Mai | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | No exit info for lifts and escalators | Station A |
| | Bhumibol Adulyadej Hospi | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | No exit info for lifts and escalators | Station A |
| | Royal Thai Air Force Museu | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | No exit info for lifts and escalators | Station A |
| | Yaek Kor Por Aor | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | No exit info for lifts and escalators | Station A |
| | Khu Khot | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | No exit info for lifts escalators | Station A |
| | Chit Lom | Only at one side of the street | Normal | Only at one side of the street | Good | Wheelchair ramp and all the escalators are connected the skybridge at exit 6 | Station C |
| | Phloen Chit | Only at one side of the street | Normal | Only at one side of the street | Good | The escalators are too far for exit 1,2 and 5 | Station B |
| | Nana | Yes, on both sides of the street | Normal | Not at all | N/A | N/A | Station A |
| | Asok | Only at one side of the street | Normal | Yes, on both sides of the street | Good | Connected to MRT | Station A |
| | Phrom Phong | Only at one side of the street | Normal | Only at one side of the street | One side is broken | The only one lift was broken when conducting the survey in last week of April | Station C |
| | Thong Lo | Yes, on both sides of the street | Normal | Yes, on both sides of the street | One side is broken | The handicap lift wasn't operated when conducting the survey in last week of April | Station B |
| | Ekkamai | Yes, on both sides of the street | Normal | Only at one side of the street | Good | Exit 1 has connected to the other building's lift | Station B |
| | Phra Khanong | Only at one side of the street | Normal | Only at one side of the street | Good | The lift and escalator are opposite sides of the station | Station B |
| | On Nut | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Handicap lift wasn't operate | Total3 lifts but the handicap lift wasn't operated when conducting the survey in last week | Station A |
| | Bang Chak | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | N/A | Station A |
| | Punnawithi | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | N/A | Station A |
| | Udom Suk | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | N/A | Station A |
| | Bang Na | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | Total2 lifts at exit 2 and exit 3,4,5have not lift or escalator | Station A |
| | Bearing | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | N/A | Station A |
| | Samrong | Yes, on both sides of the street | Normal | Yes, on both sides of the street | One side is broken | N/A | Station B |
| | Pu Chao | Only at one side of the street | Normal | Yes, on both sides of the street | One side is broken | N/A | Station B |
| | Chang Erawan | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | N/A | Station A |
| | Royal Thai Naval Academy | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | N/A | Station A |
| | Pak Nam | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | Total3 escalators | Station A |
| | Si Nakharn | Only at one side of the street | Normal | Only at one side of the street | Good | Exit 2 has only stairs | Station B |
| | Phraek Sa | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | N/A | Station A |
| | Sai Luat | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | N/A | Station A |
| | Kheha | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | N/A | Station A |
| Silom Line | National Stadium | Yes, on both sides of the street | Normal | Yes, on both sides of the street | One lift is difficult to find | Stair lift for disabled persons use at the connection with sky walk | Station B |
| | Ratchadamri | Only at one side of the street | Normal | Yes, on both sides of the street | One side is broken | N/A | Station C |
| | Sala Daeng | Yes, on both sides of the street | Normal | Not at all | N/A | Passengers use a lift from MRT walk way to access the concourse | Station C |
| | Chong Nonsi | Only at one side of the street | Normal | Yes, on both sides of the street | Good | But the lifts are in the middle of the road and difficult to access for the disabled | Station C |
| | Saint Louis | Only at one side of the street | Normal | Only at one side of the street | Good | Both of the escalator and lift are at the same side of the street | Station B |
| | Surasak | Only at one side of the street | Normal | Yes, on both sides of the street | Good | Both of the lift and escalator are at the same side of the street | Station B |
| | Saphan Taksin | Only at one side of the street | Normal | Not at all | N/A | The station is connected and sharing the access with MRT station | Station C |
| | Krung Thon Buri | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | Two escalators are at the same side | Station A |
| | Wongwian Yai | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | One lift and elevator are sharing with Gold Line station | Station A |
| | Pho Nimit | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | Exit 2 has no lift nor escalator | Station A |
| | Talat Phlu | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | Exit 2 has no escalator nor lift | Station A |
| | Wutthakat | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | All the 4 exits are one side of the station b/c of the flyover is beside of it | Station A |
| | Bang Wa | Yes, on both sides of the street | Normal | Yes, on both sides of the street | Good | All the exit are on one side of the station b/c of the flyover is beside of it | Station A |
| Gold | Charoen Nako | Only at one side of the street | Normal | Yes, on both sides of the street | Good | The station is connected with Icon Siam Mall | Station B |
| | Khlong San | Only at one side of the street | Normal | Only at one side of the street | Good | The exit at Lat Ya Road has neither lift or escalator | Station B |
| | Krung Thon Buri (Gold) | Yes, on both sides of the street | Normal | Only at one side of the street | Good | One escalator is sharing with Green Line's bridge | Station C |

**4.2 The travel behaviour and characteristics of the elderly**

The literature review described the factors related to public transportation and elderly passengers, such as travel behaviour and user characteristics. In this part, crosstabulation is used to analyse the sociodemographic, physical Health, and elderly passengers' different behaviour. The variables are obtained from the previous station assessment, and the station types for the elderly are obtained from the physical survey checklist.

4.2.1 The characteristics of the BTS user

The variables of elderly passengers' characteristics and collected data from the elderly passengers are described in Table 6.

*Table 6 Characteristics of the elderly passengers who ride BTS (Data: Survey)*

| Variables in detail | Category | Number | Percentage |
|---|---|---|---|
| Gender | Female | 24 | 57% |
| | Male | 18 | 43% |
| Age | 60-65 | 23 | 55% |
| | 66+ | 19 | 45% |
| Physical health conditions which may limit their mobility | Yes | 17 | 40% |
| | No | 25 | 60% |
| Visual conditions which may limit their mobility | Good | 11 | 26% |
| | Bad | 31 | 74% |
| | Visually Impaired | 0 | 0% |
| Need a walking aid, such as a walking stick | Need | 7 | 17% |
| | No Need | 35 | 83% |
| Trip Companions | Alone | 17 | 40% |
| | With friends or family | 25 | 60% |

The survey participants are 60 years of age or older. The age is divided into two sub-groups: those 60–65 years old are still in the working age, and those over 65 and

older are in the retirement age. The following table outlines the different station types used by the elderly as their access station. The class A station, which has completed vertical accessibility, is the most prominent among both age groups. Then, the percentage of users at the partially accessible station B and the limited-access station C are not significantly different. However, station type C has fewer users aged 66 and older than the other two stations. (See Table 7)

*Table 7 Age * Types of the access stations Crosstabulation*

| | | Types of the access stations | | | | | | Total | |
| | | Station A | | Station B | | Station C | | | |
| | | N | % | N | % | N | % | N | % |
|---|---|---|---|---|---|---|---|---|---|
| Age | 60-65 | 14 | 56.0% | 3 | 37.5% | 6 | 66.7% | 23 | 54.8% |
| | 66+ | 11 | 44.0% | 5 | 62.5% | 3 | 33.3% | 19 | 45.2% |
| Total | | 25 | 100.0% | 8 | 100.0% | 9 | 100.0% | 42 | 100.0% |
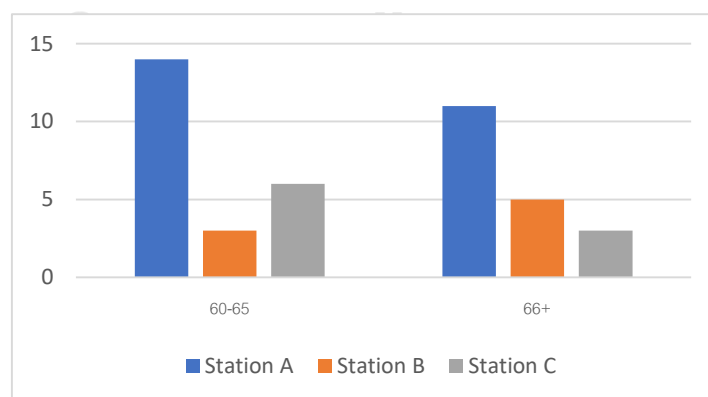


*Figure 15 The access station types and elderly passengers by age*

Table 8 presents the access station types by elderly gender. 24 (57%) out of 42 respondents were female passengers. Although there has no difference between stations A and B, the 66.7% of elderly BTS users who access station C are male passengers.

The elderly who has trip companions and those who ride the BTS alone can be found in Table 9. Except for the station B users, 56% of A station users and 55.6% of C users ride the BTS with their family or friends. The BTS is only used by 62% of those with access to Station B.

*Table 8 Gender * Types of the access stations Crosstabulation*

| | | Types of the access stations | | | | | | Total | |
| | | Station A | | Station B | | Station C | | | |
| | | N | % | N | % | N | % | N | % |
| Gender | Female | 16 | 64.0% | 5 | 62.5% | 3 | 33.3% | 24 | 57.1% |
| | Male | 9 | 36.0% | 3 | 37.5% | 6 | 66.7% | 18 | 42.9% |
| Total | | 25 | 100.0% | 8 | 100.0% | 9 | 100.0% | 42 | 100.0% |
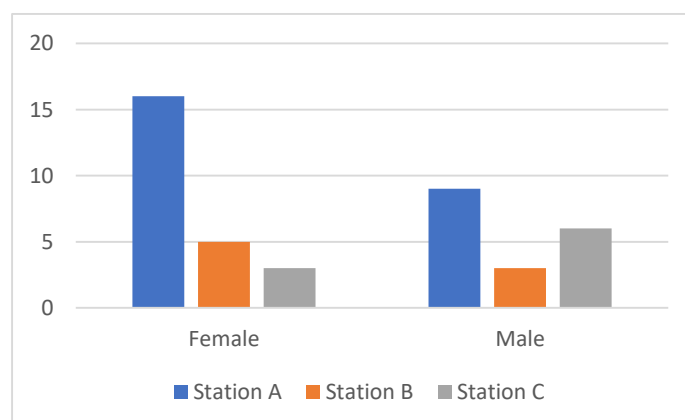


*Figure 16 The access station types and elderly passengers by gender*

*Table 9 Trip Companions * Types of the access stations Crosstabulation*

| | | Types of the access stations | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|
| | | Station A | | Station B | | Station C | | | |
| | | N | % | N | % | N | % | N | % |
| Trip Companions | Alone | 11 | 44.0% | 5 | 62.5% | 4 | 44.4% | 20 | 47.6% |
| | With family or friends | 14 | 56.0% | 3 | 37.5% | 5 | 55.6% | 22 | 52.4% |
| Total | | 25 | 100.0% | 8 | 100.0% | 9 | 100.0% | 42 | 100.0% |
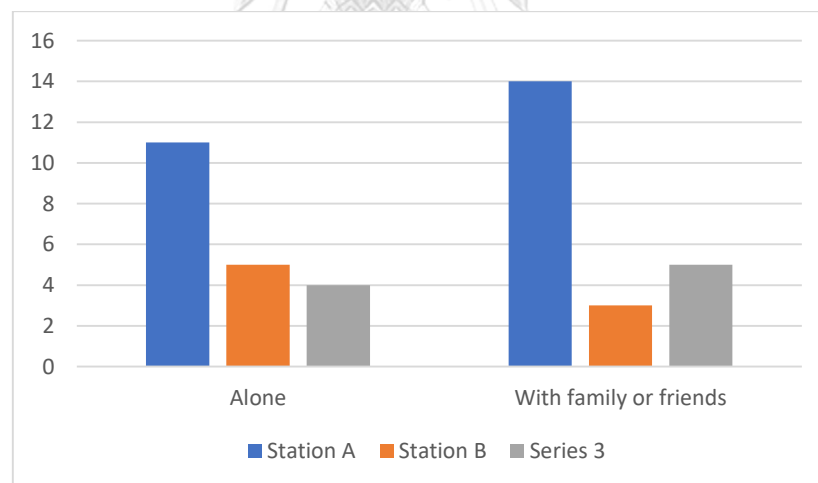


*Figure 17 The access station types and elderly passengers by their trip companions*

When evaluating the station's accessibility, additional characteristics of elderly individuals who may require walking assistance are also taken into account. Eighty-three per cent of survey respondents do not need walking aids. Despite a smaller

proportion, those who use walking aids have accessed the partially and limited accessible stations (B and C), which are 4 out of 7. The result is evident in Table 10.

*Table 10 Need a walking aid, * Types of the access stations Crosstabulation*

| | | Types of the access stations | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|
| | | Station A | | Station B | | Station C | | | |
| | | N | % | N | % | N | % | N | % |
| Do you require a walking aid, such as a walking stick, when you go out? | No Need | 22 | 88.0% | 6 | 75.0% | 7 | 77.8% | 35 | 83.3% |
| | Need | 3 | 12.0% | 2 | 25.0% | 2 | 22.2% | 7 | 16.7% |
| Total | | 25 | 100.0% | 8 | 100.0% | 9 | 100.0% | 42 | 100.0% |
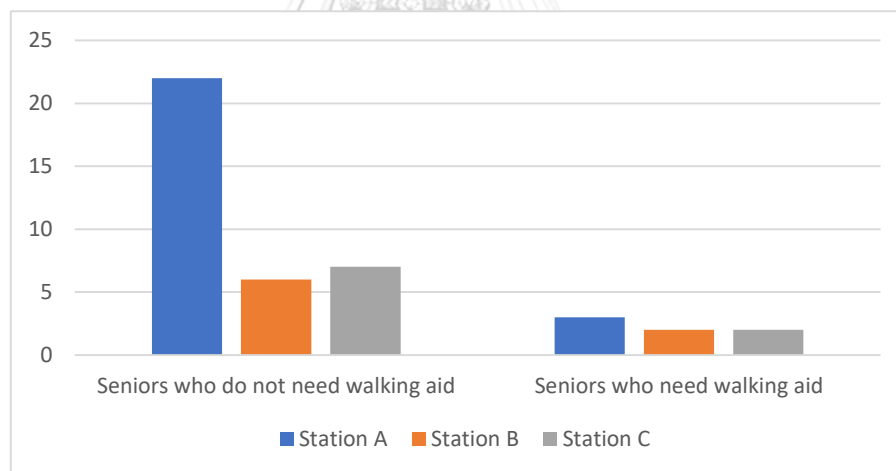


*Figure 18 The seniors who with or without walking aids and their access stations*

No visually impaired or wheelchair users were discovered during data collection. However, because the elderly may be less reliable in vision and physical Health, characteristics related to these conditions were also asked. Along with Table 11, 73 percent of respondents have poor eyesight. According to the crosstab analysis,

elderly passengers with eyesight problems use the limited accessible stations. Nevertheless, nearly sixty percent of participants are in good physical condition. In any case, according to the table, the conditionally accessible stations are used by seniors with physical concerns such as chronic pain (as in Table 12).

*Table 11 Visual conditions * Types of the access stations Crosstabulation*

| | | Types of the access stations | | | | | | Total | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | Station A | | Station B | | Station C | | | |
| | | N | % | N | % | N | % | N | % |
| How are the conditions of your vision? (eg. Visual impairment or blurred vision) | Bad | 21 | 84.0% | 6 | 75.0% | 4 | 44.4% | 31 | 73.8% |
| | Good | 4 | 16.0% | 2 | 25.0% | 5 | 55.6% | 11 | 26.2% |
| Total | | 25 | 100.0% | 8 | 100.0% | 9 | 100.0% | 42 | 100.0% |
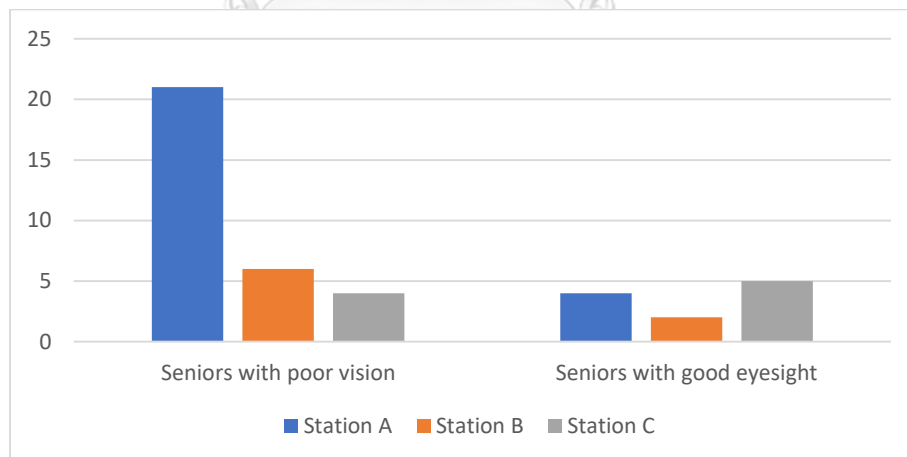


*Figure 19 The seniors with their visual conditions and their access stations*

*Table 12 Physical health conditions * Types of the stations Crosstabulation*

| | | Types of the access stations | | | | | | Total | |
| | | Station A | | Station B | | Station C | | | |
| | | N | % | N | % | N | % | N | % |
|---|---|---|---|---|---|---|---|---|---|
| Do you have any physical health issues, whether severe or minor, that may limit your ability to go out? (Chronic pain, such as back pain, leg ache, or knee pain) | No | 15 | 60.0% | 5 | 62.5% | 5 | 55.6% | 25 | 59.5% |
| | Yes | 10 | 40.0% | 3 | 37.5% | 4 | 44.4% | 17 | 40.5% |
| Total | | 25 | 100.0% | 8 | 100.0% | 9 | 100.0% | 42 | 100.0% |
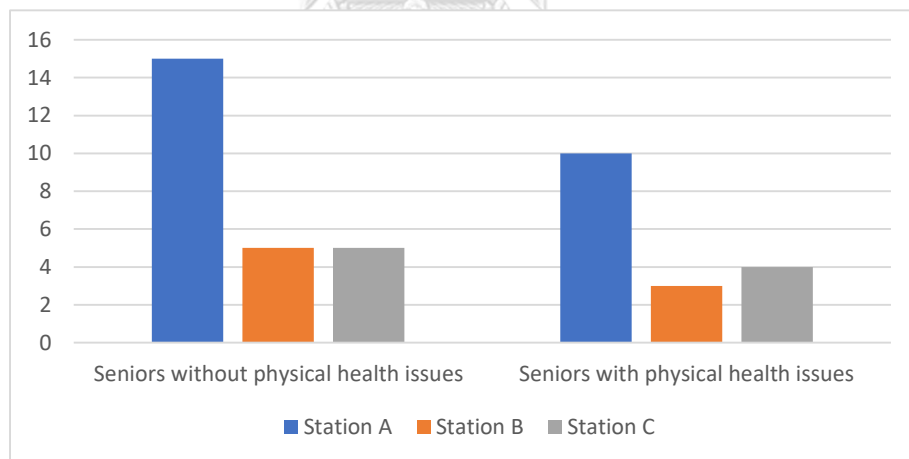


*Figure 20 The seniors with their physical health conditions and their access stations*

### 4.2.2 The travel behaviour of the elderly

The variables of elderly passengers' travel behaviour and the collected data from the elderly passengers are described in Table 13.

*Table 13 Behaviour of the elderly passengers who ride BTS (Data: Survey)*

| Variables in detail | Category | Number | Percentage |
|---|---|---|---|
| *Type of the access station* | *Station A* | *25* | *60%* |
| | *Station B* | *8* | *19%* |
| | *Station C* | *9* | *21%* |
| *BTS Trips per week* | *Seldom* | *14* | *33%* |
| | *1-2 times per week* | *14* | *33%* |
| | *3-4 times per week* | *7* | *17%* |
| | *5-6 times per week* | *4* | *10%* |
| | *Everyday* | *3* | *7%* |
| *Reasons to choose access station selection* | *Near to my home* | *9* | *22%* |
| | *Not nearby home but more accessible* | *8* | *20%* |

The travel behaviour of the elderly passengers was included to understand their BTS trips. Since the elderly rarely commute more than other passengers, the categories for BTS frequency were conducted through weekly trips. Only 7% of those who responded to the survey said they use BTS daily. However, none of the daily passengers is found in station B. Thirty-three per cent of respondents use BTS infrequently. All the frequencies can be seen in the fully accessible stations. However, regardless of the access station types, elderly trip frequency is four times per week or fewer. (See Table 14).

Otherwise, more older people may have access to fully accessible stations because there are more station types A in the mass transit system. However, even station A users take the BTS less than twice a week. The result implies that the elderly may not use the BTS frequently or may have fewer commute trips than others.

*Table 14 Frequency * Types of the stations Crosstabulation*

| | | Types of the access stations | | | | | | Total | |
| | | Station A | | Station B | | Station C | | | |
| | | N | % | N | % | N | % | N | % |
|---|---|---|---|---|---|---|---|---|---|
| Frequency | Seldom | 7 | 28.0% | 3 | 37.5% | 4 | 44.4% | 14 | 33.3% |
| | 1-2 times per week | 10 | 40.0% | 2 | 25.0% | 2 | 22.2% | 14 | 33.3% |
| | 3-4 times per week | 5 | 20.0% | 1 | 12.5% | 1 | 11.1% | 7 | 16.7% |
| | 5-6 times per week | 1 | 4.0% | 2 | 25.0% | 1 | 11.1% | 4 | 9.5% |
| | Everyday | 2 | 8.0% | 0 | 0.0% | 1 | 11.1% | 3 | 7.1% |
| Total | | 25 | 100.0% | 8 | 100.0% | 9 | 100.0% | 42 | 100.0% |
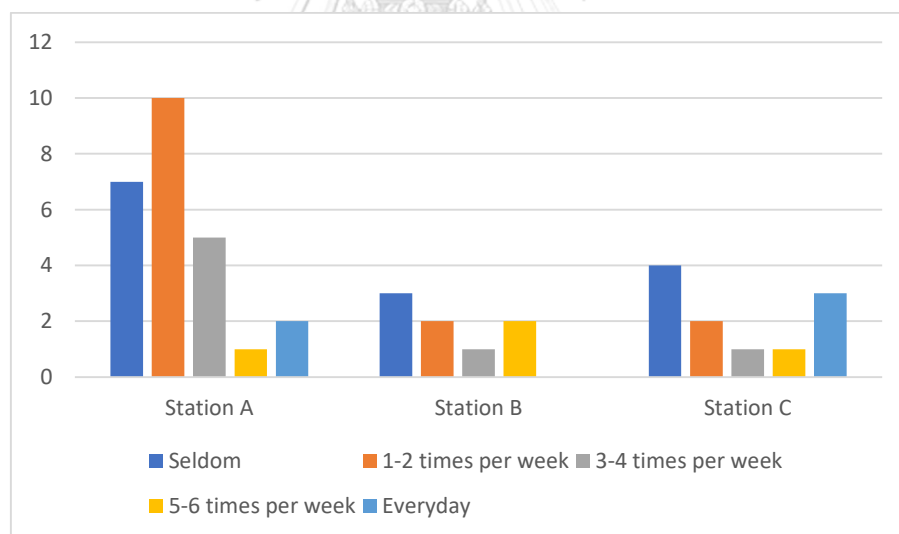


*Figure 21 Elderly passengers' trip frequency per different access station types*

Table 15 shows the various purposes for which elderly BTS passengers travel. 12.5 per cent of station B users and 11.1 per cent of station C users have access to this station to connect to other modes of transportation. Those who access station A use

BTS to visit recreational places and friends or relatives the most, with 24 per cent each. No one goes to the hospital, shops, or downtown from station C. Furthermore, station B users make no trips to recreational areas or send their children to school. Aside from that, the only purposes found in all three station types are visiting friends or relatives and going to work by BTS.

*Table 15 Purpose of the BTS * Types of the stations Crosstabulation*

| | | Types of the access stations | | | | | | Total | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | Station A | | Station B | | Station C | | | |
| | | N | % | N | % | N | % | N | % |
| Purpose of the BTS trips | Connect to MRT/BRT | 0 | 0.0% | 1 | 12.5% | 1 | 11.1% | 2 | 4.8% |
| | Health Care | 4 | 16.0% | 1 | 12.5% | 0 | 0.0% | 5 | 11.9% |
| | Recreation/Fitness | 6 | 24.0% | 0 | 0.0% | 1 | 11.1% | 7 | 16.7% |
| | Sending/ Pick up children | 1 | 4.0% | 0 | 0.0% | 1 | 11.1% | 2 | 4.8% |
| | Shopping | 4 | 16.0% | 2 | 25.0% | 0 | 0.0% | 6 | 14.3% |
| | To go downtown | 1 | 4.0% | 1 | 12.5% | 0 | 0.0% | 2 | 4.8% |
| | Visiting | 6 | 24.0% | 2 | 25.0% | 3 | 33.3% | 11 | 26.2% |
| | Work | 3 | 12.0% | 1 | 12.5% | 3 | 33.3% | 7 | 16.7% |
| Total | | 25 | 100.0% | 8 | 100.0% | 9 | 100.0% | 42 | 100.0% |
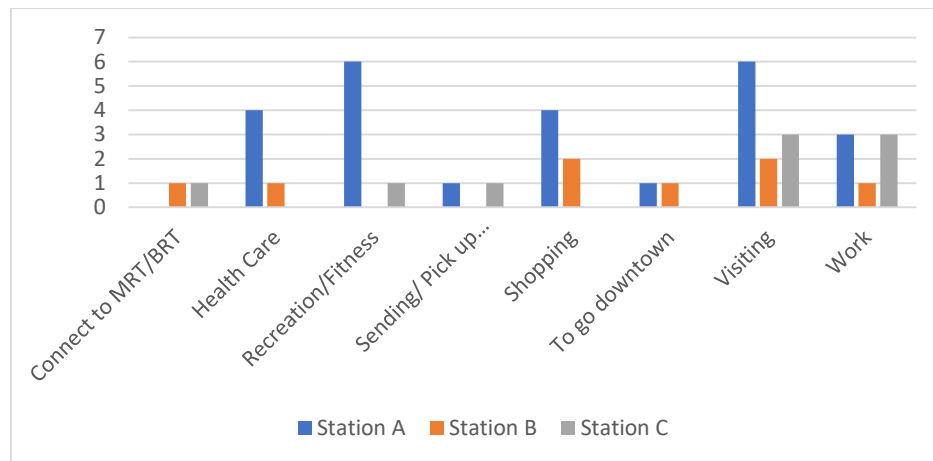
*Figure 22 Elderly passengers' BTS trip purposes*

During the week, 42.9 per cent of passengers use the BTS depending on their trip purpose, while 35.7 per cent of elderly passengers use it primarily between 10:00 and 16:59. According to the crosstab result in Table 16, the 10:00 to 16:59 time slot has the highest number of elderly passengers, except for those who use BTS depending on their trip reason. However, during rush hour, before and after rush hour, especially at stations B and C, fewer or no elderly respondents use the BTS.

*Table 16 Time of using BTS during weekdays * Types of the stations Crosstabulation*

| | | Types of the access stations | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|
| | | Station A | | Station B | | Station C | | | |
| | | N | % | N | % | N | % | N | % |
| Time of using BTS during weekdays | 10:00 - 16:59 | 8 | 32.0% | 3 | 37.5% | 4 | 44.4% | 15 | 35.7% |
| | 17:00 –19:59 | 1 | 4.0% | 0 | 0.0% | 0 | 0.0% | 1 | 2.4% |
| | 20:00 – 23:59 | 0 | 0.0% | 1 | 12.5% | 0 | 0.0% | 1 | 2.4% |
| | 6:00 -7:29 | 3 | 12.0% | 0 | 0.0% | 0 | 0.0% | 3 | 7.1% |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 7:30-9:59 | 2 | 8.0% | 0 | 0.0% | 2 | 22.2% | 4 | 9.5% |
| | Depending on the purpose of the trip | 11 | 44.0% | 4 | 50.0% | 3 | 33.3% | 18 | 42.9% |
| Total | | 25 | 100.0% | 8 | 100.0% | 9 | 100.0% | 42 | 100.0% |
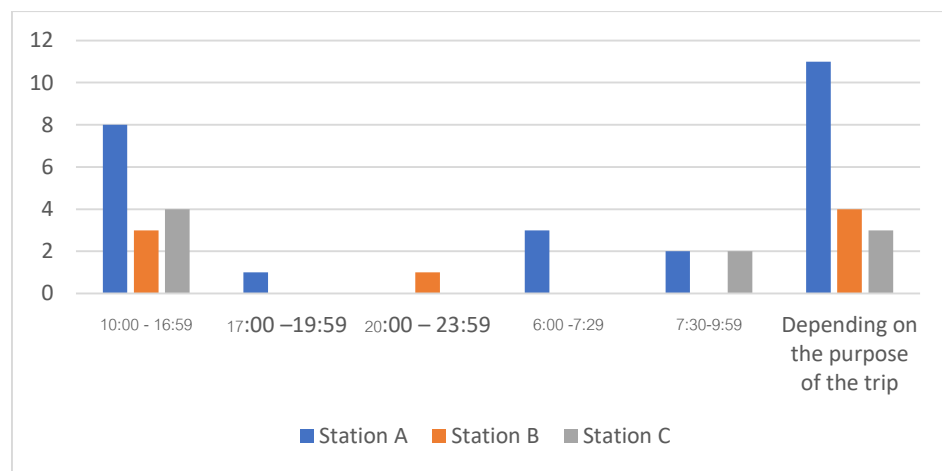


*Figure 23 Elderly passengers' BTS trip purposes*

### Attitude

Although station C has limited access, the number of elderly passengers is slightly higher than at station B, which has partial access. Despite the fact that they may have chosen those stations for various reasons, 69% of seniors said it is the closest station to their home. In comparison, 31% said it is not near but is more accessible from their home. Other noteworthy reasons they provided include the station's proximity to or accessibility to different modes of public transportation, such as BRT/MRT or bus stations. Not only the fully vertically accessible station A but also the limited vertically accessible station C has been used, even though they are not near their home.

*Table 17 Reason for choosing the station * Types of the stations Crosstabulation*

| | | Types of the access stations | | | | | | Total | |
| | | Station A | | Station B | | Station C | | | |
| | | N | % | N | % | N | % | N | % |
| Why do you access this station? | Not near to home but more accessible | 9 | 36.0% | 0 | 0.0% | 4 | 44.4% | 13 | 31.0% |
| | The station is near to my home | 16 | 64.0% | 8 | 100.0% | 5 | 55.6% | 29 | 69.0% |
| Total | | 25 | 100.0% | 8 | 100.0% | 9 | 100.0% | 42 | 100.0% |
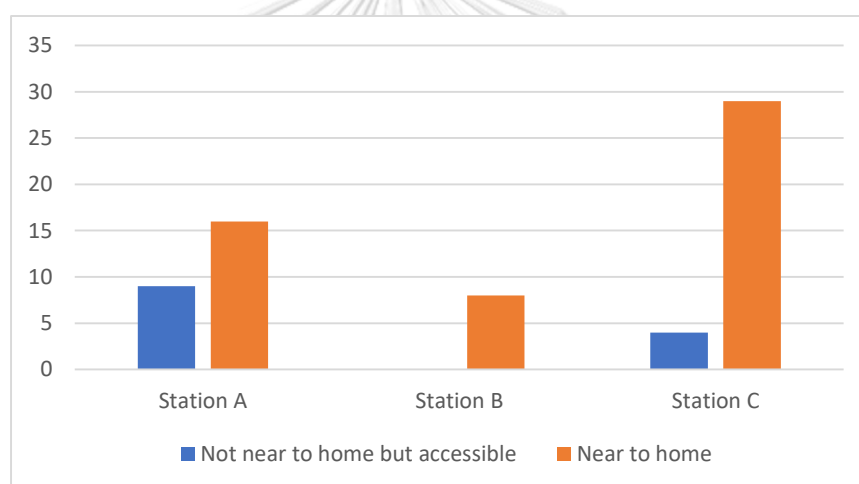


*Figure 24 Reasons for elderly passengers' choice of stations*

### Satisfaction with the vertical facilities

Before examining the satisfaction with the station facilities, the habit of elderly passengers using facilities to access the stations has also been checked. The different facilities used by the elderly when accessing or departing the station are shown in figure 19. The escalators are frequent for entering the station at any level, and the stairs are more commonly used to exit the stations from any level. Although the

escalators at big stations have both up and down, none of the respondents selected the escalators in the survey. Lifts are often selected when exiting from the platform level, but stairs are used to exit from the concourse.
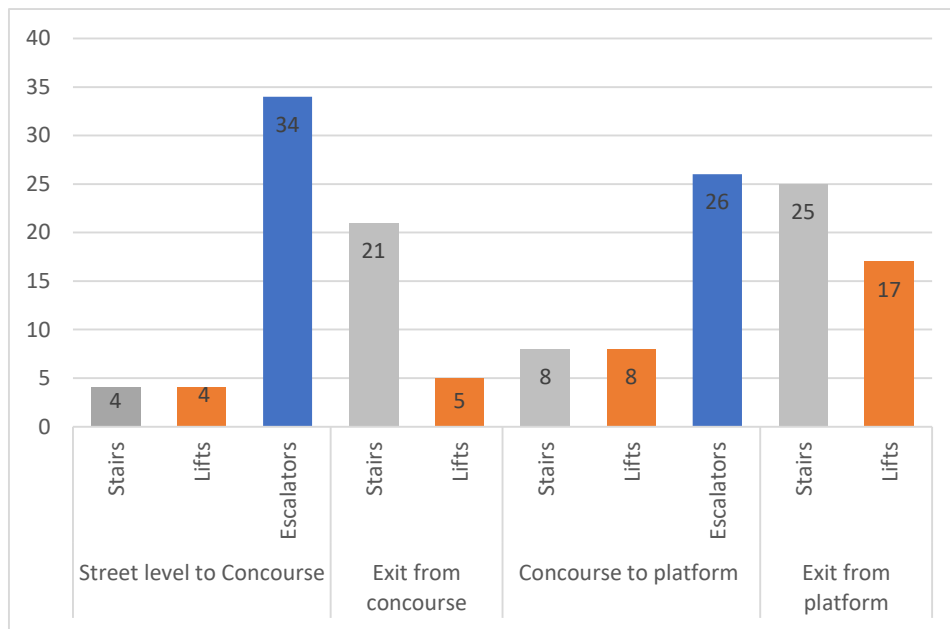


*Figure 25 The different facilities used by the elderly when accessing or exiting the station*

Tables 18 to 20 are the cross-tabulation findings regarding the user satisfaction with stairs, lifts, and escalators by their access station types.

*Table 18 Different access station users' satisfaction with lifts*

|  |  | Users by different access stations |  |  |  |  |  | Total |  |
|---|---|---|---|---|---|---|---|---|---|
|  |  | Station A users |  | Station B users |  | Station C users |  |  |  |
|  |  | N | % | N | % | N | % | N | % |
| Satisfaction on Stairs | Dissatisfied | 5 | 20.0% | 3 | 37.5% | 2 | 22.2% | 10 | 23.8% |
|  | Not at all satisfied | 1 | 4.0% | 0 | 0.0% | 0 | 0.0% | 1 | 2.4% |
|  | Satisfied | 9 | 36.0% | 0 | 0.0% | 3 | 33.3% | 12 | 28.6% |
|  | Somewhat Satisfied | 10 | 40.0% | 5 | 62.5% | 4 | 44.4% | 19 | 45.2% |
| Total |  | 25 | 100.0% | 8 | 100.0% | 9 | 100.0% | 42 | 100.0% |

55.6% of the station C users are somewhat satisfied with the lift even though that station has limited access. However, 50% of the station B users are dissatisfied with the lifts, which is more significant than the other station users. There is only one station C user who is unsatisfied with the elevators. The satisfaction on escalators is highest in stations A and B, as the table 14. The selected station A users were somewhat satisfied or satisfied with 40% each, and 50% of the station B users were slightly happy with the escalators.

On the other hand, 33.3% of station C users are dissatisfied with the escalators. In contrast, none of the station A or B users is disappointed. (See Table 19, 20)

*Table 19 The different access station users' satisfaction with lifts*

| | | Users by different access stations | | | | | | Total | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | Station A users | | Station B users | | Station C users | | | |
| | | N | % | N | % | N | % | N | % |
| Satisfaction on Lifts | Dissatisfied | 5 | 20.0% | 4 | 50.0% | 2 | 22.2% | 11 | 26.2% |
| | Extremely Satisfied | 2 | 8.0% | 1 | 12.5% | 0 | 0.0% | 3 | 7.1% |
| | Not at all satisfied | 0 | 0.0% | 0 | 0.0% | 1 | 11.1% | 1 | 2.4% |
| | Satisfied | 8 | 32.0% | 2 | 25.0% | 1 | 11.1% | 11 | 26.2% |
| | Somewhat Satisfied | 10 | 40.0% | 1 | 12.5% | 5 | 55.6% | 16 | 38.1% |
| Total | | 25 | 100.0% | 8 | 100.0% | 9 | 100.0% | 42 | 100.0% |

*Table 20 The different access station users' satisfaction with escalators*

| | | Users by different access stations | | | | | | Total | |
| | | Station A users | | Station B users | | Station C users | | | |
| | | N | % | N | % | N | % | N | % |
|---|---|---|---|---|---|---|---|---|---|
| Satisfaction on Escalators | Dissatisfied | 0 | 0.0% | 0 | 0.0% | 3 | 33.3% | 3 | 7.1% |
| | Extremely Satisfied | 5 | 20.0% | 2 | 25.0% | 2 | 22.2% | 9 | 21.4% |
| | Satisfied | 10 | 40.0% | 2 | 25.0% | 2 | 22.2% | 14 | 33.3% |
| | Somewhat Satisfied | 10 | 40.0% | 4 | 50.0% | 2 | 22.2% | 16 | 38.1% |
| Total | | 25 | 100.0% | 8 | 100.0% | 9 | 100.0% | 42 | 100.0% |

## 4.3 The impact of vertical accessibility performance on the travel behaviour of elderly passengers in the Bangkok mass transit system

The passenger behaviours of the elderly and their access station types are used to evaluate any possible correlation between them. The chi-square test was used to determine the influence of facilities on travel frequency and satisfaction. The outcome may assist in comprehending the BTS trips of the elderly as well as their perception of the current vertical accessibility of the stations.

### 4.3.1 The impact of vertical accessibility performance on the frequency of using the BTS

In order to compare the impact of vertical accessibility performance on the frequency of using BTS, a Chi-square test was used.

Ha0. The access station type does not impact the frequency of using the BTS by elderly passenger

Ha1. The access station type impacts the frequency of using the BTS by elderly passenger

*Table 21 Frequency and type of the access stations crosstab*

| | | | Type of the access stations | | | Total |
|---|---|---|---|---|---|---|
| | | | Station A | Station B | Station C | |
| Frequency | 1-2 times per week | Count | 10 | 2 | 2 | 14 |
| | | Expected Count | 8.3 | 2.7 | 3.0 | 14.0 |
| | 3-4 times per week | Count | 5 | 1 | 1 | 7 |
| | | Expected Count | 4.2 | 1.3 | 1.5 | 7.0 |
| | 5-6 times per week | Count | 1 | 2 | 1 | 4 |
| | | Expected Count | 2.4 | .8 | .9 | 4.0 |
| | Everyday | Count | 2 | 0 | 1 | 3 |
| | | Expected Count | 1.8 | .6 | .6 | 3.0 |
| | Seldom | Count | 7 | 3 | 4 | 14 |
| | | Expected Count | 8.3 | 2.7 | 3.0 | 14.0 |
| Total | | Count | 25 | 8 | 9 | 42 |
| | | Expected Count | 25.0 | 8.0 | 9.0 | 42.0 |

| *Chi-Square Tests * Frequency and type of the access station* | | | |
|---|---|---|---|
| | Value | df | Asymptotic Significance (2-sided) |
| Pearson Chi-Square | 5.471[a] | 8 | .706 |
| Likelihood Ratio | 5.649 | 8 | s.687 |
| N of Valid Cases | 42 | | |
| a. 13 cells (86.7%) have an expected count of less than 5. The minimum expected count is .57. | | | |

A p-value less than 0.05 will indicate statistical significance. Since the p-value is greater than the chosen significance level (a=0.05), the null hypothesis is not rejected. So, there is not enough evidence to suggest an association between the access station types and BTS trip frequency. ($X^2$ = 5.471; df = 8; p =0.706)

The variables are derived from the cross-tabulation, and the chi-square test in the table showed that **the access station type does not impact the frequency of using the BTS by the elderly passenger.** According to the previous study, the elderly may not have many weekly trips because their activities are fewer, or they do not need to go out.

4.3.2 The impact of vertical accessibility performance on the satisfaction

The relationship between vertical accessibility performance and senior satisfaction with facilities and services has been investigated using the Chi-square test. It is used to determine how satisfaction, attitude, and station facilities affect senior citizens in the following ways: The results evaluate the potential impact of access station type on old satisfaction. In addition, the ability of elderly passengers to use a private vehicle may influence their BTS choice, which is also considered in the

calculation. Finally, this section also addresses whether there is a correlation between the performance of the station's facilities and the reason for selecting the station.

### *Satisfaction*

A chi-square test was used to compare the impact of vertical accessibility performance on the aeffect of user satisfaction.

Hb0. The station performance does not associate with the overall stratification of the station facilities and services for elderly

Hb1. The station performance is associated with the overall stratification of the station facilities and services for elderly

A p-value less than 0.05 will indicate statistical significance. Since the calculated p-value is more remarkable than the chosen significance level (a=0.05), the null hypothesis is not rejected. So, there is not enough evidence to suggest an association between the access station types and satisfaction with facilities and overall services for the elderly.

$(X^2 = 6.062; df=6; p =0.416)$

*Table 22 Satisfaction with overall services and facilities for elderly \* Types of the access stations Crosstabulation*

| | | | Types of the access stations | | | Total |
|---|---|---|---|---|---|---|
| | | | Station A | Station B | Station C | |
| Satisfaction with the station facilities | Dissatisfied | Count | 6 | 1 | 2 | 9 |
| | | Expected Count | 5.4 | 1.7 | 1.9 | 9.0 |
| | | Count | 0 | 1 | 0 | 1 |

| and | Extremely | Expected | .6 | .2 | .2 | 1.0 |
| services | Satisfied | Count | | | | |
| for | | | | | | |
| elderly | Satisfied | Count | 8 | 1 | 2 | 11 |
| | | Expected Count | 6.5 | 2.1 | 2.4 | 11.0 |
| | Somewhat Satisfied | Count | 11 | 5 | 5 | 21 |
| | | Expected Count | 12.5 | 4.0 | 4.5 | 21.0 |
| Total | | Count | 25 | 8 | 9 | 42 |
| | | Expected Count | 25.0 | 8.0 | 9.0 | 42.0 |

| *Chi-Square Tests* | | | |
|---|---|---|---|
| | Value | df | Asymptotic Significance (2-sided) |
| Pearson Chi-Square | 6.062[a] | 6 | .416 |
| Likelihood Ratio | 5.285 | 6 | .508 |
| N of Valid Cases | 42 | | |
| a. 9 cells (75.0%) have an expected count of less than 5. Therefore, the minimum expected count is .19. | | | |

The variables are derived from the cross-tabulation. The chi-square test in the table showed that **the station performance does not associate with the overall stratification of the station facilities and services for the elderly.** The level of satisfaction was defined as five stages in the survey to choose from, but no one

selected was not at all satisfied with the overall services and facilities. The result shows that the elderly have a positive or natural attitude towards the station facilities since the other finding of the physical health conditions has no issue.

### *Attitude (Reasons to choose the station and ability to use the private car)*

In order to compare the impact of vertical accessibility performance on user satisfaction, the attitude toward choosing the station and the ability to use the private car is examined using a Chi-square test.

Hc0. There is no relationship between the station facilities' performance and the reason for choosing the station

Hc1. There is a relationship between the station facilities' performance and the reason for choosing the station.

A p-value less than 0.05 will indicate statistical significance. Since the calculated p-value is greater than the chosen significance level (a=0.05), the null hypothesis is not rejected. So, there is not enough evidence to suggest an association between the access station types and the reason for choosing the station.

$(X^2 = 4.651; df=2; p =0.98)$

*Table 23 Reasons for choosing the station * Types of the stations Crosstabulation*

| | | | Types of the stations | | | Total |
|---|---|---|---|---|---|---|
| | | | Station A | Statio n B | Statio n C | |
| Why do you access | Not near to home but more accessible | Count | 9 | 0 | 4 | 13 |
| | | Expected Count | 7.7 | 2.5 | 2.8 | 13.0 |

| this station? | The station is near to my home | Count | 16 | 8 | 5 | 29 |
|---|---|---|---|---|---|---|
| | | Expected Count | 17.3 | 5.5 | 6.2 | 29.0 |
| Total | | Count | 25 | 8 | 9 | 42 |
| | | Expected Count | 25.0 | 8.0 | 9.0 | 42.0 |

| *Chi-Square Tests* | | | |
|---|---|---|---|
| | Value | df | Asymptotic Significance (2-sided) |
| Pearson Chi-Square | 4.651[a] | 2 | .098 |
| Likelihood Ratio | 6.936 | 2 | .031 |
| N of Valid Cases | 42 | | |
| a. 2 cells (33.3%) have an expected count of less than 5. Therefore, the minimum expected count is 2.48. | | | |

The variables are derived from the cross-tabulation, and the chi-square test in the table showed no relationship between the station facilities' performance and the reason for **choosing the station.** Nevertheless, the likelihood ratio of the Chi-square test indicates the possibility of a significant association between the elderly access station facilities and their reason for choosing the station.

They are likely to choose the station located close, but the crosstab shows fewer passengers' access from the partially accessible stations. Therefore, the elderly living close to BTS stations may use the system more commonly than others.

### *Ability to use the car and their attitude toward using BTS*

Hd0. There is no significant association between the performance of station facilities and the elderly who will use BTS.

Hd1. There is a significant association between the performance of station facilities and the elderly who will use BTS.

A p-value less than 0.05 will indicate statistical significance. Since the calculated p-value is greater than chosen significance level (a=0.05), the null hypothesis is not rejected. So, there is not enough evidence to suggest an association between the access station types and the reason for choosing the station. (X2 = 1.375; df=1; p =0.241)

*Table 24 Ability to use private car\* willingness to use BTS with full facilities Crosstabulation*

| | | | Will you use the BTS more often if the stations have escalators & lifts on both sides of the street? | | Total |
|---|---|---|---|---|---|
| | | | Not Sure | Yes | |
| Do you have private vehicles? | Yes | Count | 8 | 14 | 22 |
| | | Expected Count | 6.3 | 15.7 | 22.0 |
| | No | Count | 4 | 16 | 20 |
| | | Expected Count | 5.7 | 14.3 | 20.0 |
| Total | | Count | 12 | 30 | 42 |
| | | Expected Count | 12.0 | 30.0 | 42.0 |

*Chi-Square Tests*

| | Value | df | Asymptotic Significance (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
|---|---|---|---|---|---|
| Pearson Chi-Square | 1.375[a] | 1 | .241 | | |
| Continuity Correction | .690 | 1 | .406 | | |
| Likelihood Ratio | 1.397 | 1 | .237 | | |
| Fisher's Exact Test | | | | .315 | .204 |
| N of Valid Cases | 42 | | | | |
| a. 0 cells (0.0%) have an expected count of less than 5. The minimum expected count is 5.71. | | | | | |
| b. Computed only for a 2x2 table | | | | | |

The variables are derived from the cross-tabulation, and the chi-square test in the table showed **no significant association between the performance of station facilities and the elderly who will use BTS.** The possibility of seniors using the BTS could indicate that they do not own a vehicle or do not wish to drive. Therefore, if every sky train stations have a good infrastructure for vertical circulation, they will have access to alternative modes of transportation. On the other hand, because they make fewer trips than the other adult age group, they may not be sure to use the BTS even though they are fully accessible.

# CHAPTER 5: FINDINGS & CONCLUSION

The results and key findings from the previous chapter's crosstab analysis and chi-square test are presented in this chapter. The main focus of this chapter is the relationship between vertical circulation in sky train stations and elderly passengers. The current study's findings on the travel behaviour of the elderly can be added to the literature on urban planning and mobility for the Thai ageing society. The current study's findings were then linked to the previous study to better understand the attitudes and behaviours of elderly transit passengers. In addition, the conclusions include recommendations for strategies that could be implemented or used as a starting point for additional research.

## 5.1 Research findings

The findings accomplished all three of the study's objectives. The accessibility performance of the BTS stations was initially assessed using a physical survey checklist. The measurement identifies the three types of stations based on their vertical accessibility and the stations' current situation based on the equipped facilities. Following that, the impact of vertical accessibility performance on the travel of elderly passengers was evaluated using station types and station user characteristics. Furthermore, the significant association between station performance and travel behaviour supports the satisfaction and attitude toward using the BTS according to their access station types, which were previously defined. As a result, the evidence and findings are used to develop a station design strategy that will make them easier to use by encouraging mobility and active ageing.

5.1.1 The accessibility performance of BTS stations

The stairs are the primary vertical circulation options in every BTS station because every station does not equip enough lifts or escalators. The escalators are primarily for ascending to the upper BTS floors. Only major BTS stations have escalators for descending from the stations. The passengers with limited mobility are encouraged to use the lifts. However, in some stations, the lifts are only on one street side.

As per the criteria from **Table 2**, all the BTS stations are categorised as three different stations. The detail of the accessibility and condition can be found in figure 10. **Figure 8** shows the proportion of the station types with vertical accessibility. Accordingly, 60% of the BTS stations are fully accessible, and 26% of the station is partially or conditionally accessible for a person who does not want to use the stairs. The last 14% of the stations have limited accessibility for vertical circulation at the station from street to platform level, such as Na Na station.
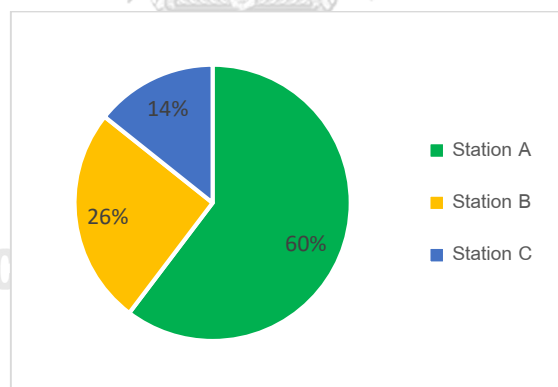


*Figure 26, The pie chart shows the percentage of the stations in three different categories*
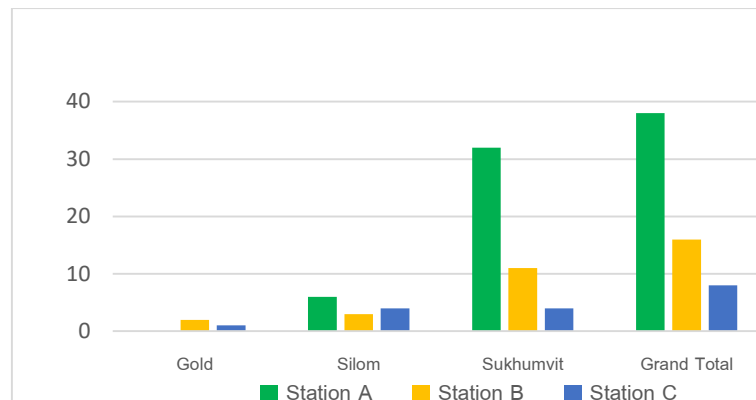
*Figure 27 The bar chart shows the numbers of the stations in 3 BTS lines by the different categories*

When the station types are looked at per different BTS lines, 7 out of 13 Silom line stations have partial or limited access. (See figure 9). There are no fully accessible stations in the Gold line. In contrast, 32 out of 47 stations of the Sukhumvit line are fully accessible. As a result, the accessibility performance of the BTS station at Sukhumvit stations is better than the others

5.1.2 The characteristics and travel behaviour of the elderly

*The characteristics of the elderly*

Sixty per cent of respondents in the present study use Station A as their access station, compared to 19 per cent and 21 per cent, who use Stations B and C. Therefore, elderly passengers are more likely to access the fully accessible stations than the partially and limitedly accessible stations.

The characteristics of the elderly passengers have been described by their age, gender and health conditions. According to the numbers, 60 to 65 years old passengers participated more than 66 years and above. Regardless of age, almost 60 % of the respondents' access stations are station type A, which has fully vertical facilities.

Consequently, the present study has more female than male seniors. Although every type of station has senior female users, station A has the most access to others. Because the elderly may be less dependable regarding vision and physical health, characteristics related to these conditions were also investigated. In any case, conditionally accessible stations, according to the table, are used by 16.6% of the seniors who have physical issues such as chronic pain.

Additional characteristics of older people who may require walking help and support are considered when evaluating the station's accessibility. During the survey, none of the wheelchair users is discovered. So, in this case, 16.7 % of older people who use walking support answered that they used walking canes or umbrellas when they walked. Eighty-three per cent of those surveyed do not require assistance. Despite a lower proportion, those using walking aids have visited four out of seven partially and limited accessible stations (B and C). During data collection, not visually impaired or wheelchair users were also discovered. In addition to Table 4 crosstab result, 73% of respondents have poor vision. However, elderly passengers with vision issues have used station types B and C.

Half of the elderly ride the BTS with family or friends, and 47.6 per cent ride alone. The elderly passengers who commute alone have access to stations that are partially or limitedly accessible.

### *The travel behaviours of the elderly*

Only 7% of those who responded to the survey said they use the BTS daily. On the other hand, though, none of the daily passengers in station B. BTS is used infrequently by 33% of respondents. All frequencies are visible in fully accessible stations. Regardless of access station type, elderly trips are made four times per week or less. Except for those who use BTS depending on their trip reason, the 10:00 to 16:59 time slot has the highest number of elderly passengers in every station type.

Fewer or no elderly respondents use the BTS during rush hour, before and after rush hour, particularly at stations B and C.

The primary purpose of BTS trips for the elderly who have access to station A is to visit and go to recreational places. Second, in station A, access for the elderly is shopping and going to health care facilities. Users of Station C do not take the BTS to hospitals or clinics.

*Satisfaction and Attitude*

The elderly passengers choose their access station because it is close to their homes or more accessible but not close to their homes. Even though they are not close to home, both the fully vertically accessible station A and the limited vertically accessible station C have been used. They chose the station to connect to other modes of transportation if it is not close to their home.

Elderly passengers take the escalators to access all station levels while they use the steps to exit the concourse and platform. The majority of lift activity occurs when leaving the platform. Regarding facility satisfaction, older travellers' attitudes regarding stairs are predominantly neutral. Despite the station's limited accessibility, half of station C's users are somewhat satisfied with the lift.

In contrast, half of station B's passengers are dissatisfied with the elevators. Furthermore, 33.3 per cent of station C users are dissatisfied with the escalators, whereas neither station A nor station B users are displeased. Older people who do not own cars are more likely to use the BTS if every station is fully accessible with vertical facilities.

5.1.3 The impact of vertical accessibility performance to Bangkok mass transit stations on the travel behaviour of elderly passengers

The crosstabulation analysis reveals a relationship between the behaviour and characteristics of the elderly and their access station types. The chi-square test results presented in Chapter 4 demonstrate the relation between vertical accessibility performance and the travel behaviour, satisfaction and attitude of elderly passengers.

The impact of the station's vertical accessibility performance on the BTS trip frequency of the elderly suggests no significant relationship exists between them. Nevertheless, crosstab results indicate that even fully accessible station users ride the BTS less than twice per week. In addition, most respondents are somewhat satisfied with the station facilities and services for elderly passengers, regardless of their access station types. The Chi-square test reveals, however, that the satisfaction of elderly passengers with the services and facilities for them is not strongly correlated with the kind of access station they use.

There is no significant association between the performance of the station's facilities and the reason for choosing the station. In addition, the Chi-square test evaluates the attitudes of the elderly towards using the BTS if the stations have facilities for vertical access based on their ability to use the private car. Although the findings reveal that station facilities' performance has no significant relationship with the elderly using BTS, the desire to take BTS can be seen in crosstab results. Hence, the elderly who do not have a car prefer to use the BTS more than those who do if every station has adequate lifts and escalators.

It is assumed that **vertical accessibility performance at Bangkok's mass transit stations has no significant impact on the travel behaviour of elderly passengers** based on the results of the crosstabulation analysis and chi-square test.

However, if the sample size were changed, the chi-square test results would be different because it depends on the number of respondents.

## 5.2 Conclusions

5.2.1 Summarizing the key findings

The facilities for vertical circulation of the sky train stations participate in the elderly accessibility to the BTS system. In the case of BTS stations' facilities, 60 per cent of the stations' vertical circulation is fully accessible, and the partially and limitedly accessible stations are 26 per cent and 14 per cent, respectively. Thus, the BTS stations' vertical accessibility performance shows that the present condition has an opportunity for the elderly to access the transit. Moreover, the proportion of survey participants indicates that elderly passengers are more likely to access the fully accessible stations than the partially and limitedly accessible stations. On the other hand, as the fully accessible stations are more than the partially accessible and limited accessible stations, the elderly may access or egress the stations more than expected. However, some stations with inadequate facilities would distract older people from using the BTS.

Station type A, which has full vertical access, is the most common among age groups. Alternatively, the station with limited vertical facilities has fewer users aged 66 and older than the other stations. Although the elderly rides the BTS alone or with someone, both fully accessible and limited accessible station users ride with someone. Elderly BTS passengers use the BTS less than twice a week, regardless of access station type. During peak hours, the majority of them do not use BTS. Although the elderly rarely use the BTS, they take it for various reasons. The elderly's most common BTS trips are visiting, shopping, and visiting health care facilities. Hence, the seniors actively

participate in society by taking the sky train. Nonetheless, the different station users demonstrate that their choice of access station is influenced not only by proximity to their homes but also by whether the access station is accessible via other modes of transportation, even if it is not close to their homes.

Furthermore, the physical characteristics or health conditions of the elderly passengers indicate that, with the exception of their visual conditions, older people with better physical conditions may use BTS more than others. Even though 73.8 per cent of respondents have a vision problem, the visually impaired elderly passengers were not observed during the survey. The elderly wheelchair users were not also discovered during the study period.

Regarding user characteristics, age and gender are not influenced by their choice of stations. However, their physical health and vision depend on the facilities they use to enter and exit the stations. For example, **escalator users are more likely than stairs and lift users to access the stations regardless of age and gender**. It pointed out that escalators are the most practical facilities for vertical access. However, they are only used for ascending every level of the stations. In the meantime, there are **more stair users than lift users when egressing the station**. As the escalators are not available to go down from the platform or concourse, they are assumed to use the stairs, whether they are reliable or lifts are unavailable. Since there are no wheelchair users or visually impaired people involved in the survey, their aspects of the station facilities may differ from the present user characteristics findings.

Likewise, satisfaction with the facilities reveals that elderly passengers are assumed to have positive attitudes toward the station's facilities and services. The findings also indicate that adequate station facilities for vertical circulation would encourage them to use BTS more frequently, particularly those without private vehicle.

However, there is no significant relationship between the access station types, the reasons for selecting the station, or the frequency of BTS trips. Accordingly, **the ease of access to station platforms via escalators and elevators could not affect the travel behaviour and satisfaction of elderly transit riders.**

### 5.2.2 Discussion of the previous studies

There are more female participants than males in the present study, which contrasts with the survey in Pakistan by Ahmad Z et al. (2015). In the behaviour of the elderly, the seniors' BTS trips less than two times per week is not much different from the study of Thai elderly from other provinces in 2020 by Champahom et al. Trip frequency of the older adults surveyed decreased with age; both for public transport and self-driving in the case study in Pakistan. Therefore, the elderly may not frequently use public transportation or may only go out on rare occasions. The seniors' BTS passengers' BTS using time, on the other hand, is not the same as in Champahom's study because their study found the elderly from other provinces use public transportation in the morning while most of the BTS using time is in the afternoon.

The present study is not consistent with Srichuae et al. (2015). They stated that rapid transit was not often used by the elderly to go to public places in Bangkok as the respondents used BTS to go to recreation places and markets. However, the purpose of elderly trips is similar to that of Champahom (2020)'s study that found public transportation was taken when shopping and health activities were done in the elderly. The safety-enhancing equipment for public transportation service users is an essential factor that must be improved for all elderly passengers in Thailand. Despite the fare being reduced for the elderly, other services and facilities have been limited for them Chaisomboon et al. (2020).

Besides that, there is a positive relationship between a railway station's level of step-free accessibility and the percentage of PRMs who use it. Swift et al. (2021). The satisfaction and attitude findings of the elderly in the present study also confirmed that. Two-thirds of respondents admitted negative feelings about using public transportation in the study by Ahmad Z et al. (2015). However, the assessment of the BTS elderly passengers reveals that they are either neutral or satisfied with the BTS facilities and services. For seniors who do not have a car or cannot drive, reliable and safe, affordable transportation modes are also suggested in Srichuae et al. (2015) and Ahmad Z et al. (2015). The present evaluation of the BTS facilities and elderly passengers also follows their statement because the respondents who do not own a private vehicle are more likely to use the BTS if all the stations have completed facilities. The previous studies do not include the trip companions of elderly passengers when using public transportation. The present study considers having a trip companion in their BTS trip an independent variable. Almost half of the elderly passengers from this study ride the BTS alone. Furthermore, hence, the elderly passengers independently commute by taking BTS.

According to the case studies in WHO's Age-friendly City, the elderly in Nairobi fear elevators and must be escorted. In contrast, the elderly in Tripoli fear becoming stuck if they use elevators because of the frequent power shortage. The findings of this study also indicate that the elderly prefer to use stairs and escalators over elevators. Hence, even while facilities such as elevators ease their access, some elderly may be unfamiliar with using them.

The facilities referred to as step-free access in this study are the lifts and escalators for vertical access to the station Swift et al. (2021). Their assessment also revealed a link between the number of people with reduced mobility (PRMs), stations' step-free accessibility, and the significance of universal design in the UK. The present

study finds no significant relationship between station selection and facility performance. On the other hand, the elderly with physical or visual impairments has less access to stations with limited or no facilities, implying that the elderly prefer to take BTS from fully accessible stations. Since visually impaired or elderly wheelchair users were not observed at the stations during the study period, the effects of the BTS stations' vertical accessibility on those with limited mobility are not indicated by the study results. The findings suggest that older individuals without or with fewer physical conditions will use the BTS more frequently than those with conditions.

Nevertheless, the satisfaction of the whole trip may not be the same as the satisfaction with the ease of access to vertical facilities. Aside from facilities and accessibility, demographics, health, socioeconomics, built environment, car access, and housing type all influence senior travel (Yang & Cui, 2020; Haustein & Siren, 2015). Various factors are associated with the mobility behaviour of the elderly, and it has been stated that the determinants of the elderly's travel behaviour directly or indirectly impact the elderly attitude towards transit trips. According to the findings, public transportation is vital for those who cannot drive or afford a private vehicle.

As previously stated, the present study did not include the entire elderly population of Bangkok, and the impact of vertical facilities on the travel behaviour of the elderly cannot be inferred from the statistical findings. However, seniors' use of public transportation is influenced not only by the facilities but also by their socioeconomic status, where they reside, the accessibility of their destination, and their health.

**5.3 Strategies Recommendation**

Although the test result cannot conclude a significant relationship between the ease of access to the station via facilities and the elderly, it indicates the potential for elderly transit use. Furthermore, the elderly's BTS trips and attitude toward the station's facilities suggest that passengers are slightly satisfied with the present situation. Besides, the measurement results of current station facilities and their performance reveal how to improve Bangkok's transit facilities for an ageing population. Finally, these findings led to the strategy recommendations for active ageing in society and vulnerable groups to participate in the city due to the ease of commuting in our city.

The limitations and findings of the study regarding the factors influencing the travel behaviour of the elderly may inspire another analysis to expand the aspect of accessibility for the elderly or individuals with limited mobility. The three-perspective future study was also concluded at the end of the study.

5.3.1 Age-friendly transportation

The study suggests urban mobility strategies be inclusive the older people. As the ageing society is growing in Thailand, public transportation should emphasize its service to seniors. Transportation overcomes social isolation and promotes active engagement and community integration. (Novek & Menec, 2014). The WHO guidelines for age-friendly transportation **also include safe and accessible shelters and stations as vital aspects**. In addition, the present study's findings highlight the accountable factors of station accessibility via vertical infrastructure. Present and future elderly residents could indeed contribute to the community's well-being. BTS rides are essential to their commute, as BTS is the backbone of Bangkok's public transportation

system. Not only is encouraging the elderly to use public transportation affordable, but it also promotes social cohesion. Although the ease of access to the station platform by vertical circulation does not impact the travel behaviour of the elderly passengers, the facilities and services of transit might consider for the seniors.

Barrier-free buildings and streets improve the mobility and independence of disabled individuals of all ages. In some cities, physical access barriers are mentioned, which can discourage elderly individuals from leaving their homes. Nevertheless, some elderly individuals do not always find the features for the elderly to be comfortable. Older people might drive less frequently or not at all. They might not have access to a personal vehicle and therefore need to rely on family, caregivers, or public transportation. Age-related physical challenges, such as vision and mobility issues, may limit an older person's ability to drive or use public transportation. A lack of transportation may impact their daily activities, access to healthcare, and health. Transportation may not be a barrier to active ageing. (EMTA, 2007)

The investigation into the BTS trips' intended uses also revealed how crucial it is for seniors to be able to move about the city and engage with the community. Therefore, promoting and preparing public transportation that is more comfortable, accessible, affordable, and secure is beneficial for active ageing in urban areas. Therefore, **age-friendly stations** could be the primary strategy for this study. The present study's findings paved the way for two initiatives that could improve the accessibility of BTS stations for the elderly, which are as follows.

*Initiative 1: Concentrating on the effectiveness and safety of existing facilities for older passenger*

The BTS stations encourage the elderly and passengers who have difficulty walking upstairs to use the lifts from the street level. "Use Elevator" posters are on the

stations' street level. However, the lifts at some stations are either not operational or are undergoing maintenance. Aside from that, the study found that elderly passengers prefer to use escalators and stairs rather than lifts. In addition, as in the previous studies, the elderly may be afraid or unfamiliar with using lifts.

Twenty-five out of the sixty-three stations does not have full vertical circulation facilities. Especially, Silom line and gold line users may face challenges in accessing the stations when they cannot use the stairs. Therefore, those partially accessible stations should be upgraded with enough facilities. For example, as the elderly are satisfied with the escalators, a station should have at least one escalator on each side of the street when the lifts are not possible to install. Furthermore, the majority of the elderly have poor eyesight. In contrast, according to the study, only a few elderly passengers require walking aids. Beyond the vertical facilities, station information maps, wayfinding, and reliability signage may all contribute to the stations' facilities and services.

Before upgrading the stations to achieve complete vertical accessibility, the existing facilities must be reliable and functional. Accordingly, escalators and stairs are more prominent in vertical circulation for elderly users. Since the existing escalators only ascend, the stairs should be equally dependable to exit the station. Additionally, the speed of escalators could be modified so that the elderly can easily ride them, for example, by decreasing the speed. Although the stairs are not technically a vertical circulation facility, they are the primary means of accessing the platform. Likewise, ensure that the stairs are not slick and that the handrails are in good condition.

Existing vertical facilities should initially prioritise the safety and efficiency of older passengers, despite their satisfaction with the current state. Consequently, the platform may necessitate upper-level access, and the facilities may present some

limitations for some seniors. However, the variety of station access options may encourage the elderly to travel throughout the city.

*Initiative 2: Go about easily for the active ageing of Thai seniors*

The study indicates that the BTS sky train has a role in the mobility of seniors, despite their reduced trip frequency, based on their various BTS travel purposes, such as going to markets and healthcare facilities. Aside from that, some passengers use BTS to connect to other means of transportation, or they choose the station since it is more accessible from their homes. However, the elderly may have a lesser income and less ability to drive than young adults. In addition, the majority of them do not have health insurance, which may cover the accident.

The study findings reveal that the elderly mostly use the BTS during non-rush hours. That highlight that their travel characteristics are different from the adults. They are also weaker in technological knowledge to access transport-related information, too. (EMTA, 2007 & WHO, 2007). Hence not only the facilities but also the services and information should be considered to access by the elderly passengers for their commute trips.

This study aims to analyse station accessibility via vertical circulation. According to one of the findings, the elderly take the BTS from such stations even though they are far from their homes since they are more accessible. So the findings uncover some older passengers' BTS user behaviours. The travel behaviour of the elderly is influenced by some factors, with accessibility being one of the essential aspects that may alter their opinion of public transit. Especially in urban areas, access to reliable public transportation may support active ageing in Thailand's future ageing society. Access to rapid transit can inspire senior citizens to engage more in various urban activities without stressing traffic congestion or travel costs.

Reliable services and age-friendly planning are crucial factors for an ageing population. Mobility is a component of promoting active ageing in urban areas. In addition, raising awareness and disseminating information through multiple platforms could facilitate their mobility. (NORC,2019 & WHO, 2007) Therefore, the facilities and services of the vehicle stops and stations must be economical and accessible to older Thai citizens. We cannot compel others to perform what we would like, but we may provide for their necessities and well-being. Therefore, making them more accessible through improved transit and adequate facilities might bring Bangkok residents of all ages together. Ultimately, age-friendly transit services and policies should consider elders' well-being, travel convenience, and safety using a holistic design approach.

## 5.4 Future study recommendations

The findings of this study may contribute additional knowledge to the transit facilities for the elderly, which may support the active ageing of the population. However, the study has limitations, such as time and sample size, that prevent it from examining seniors' attitudes. In addition, the vertical accessibility of the station was evaluated solely from the street. Therefore, other factors, such as station location and connectivity, may impact the accessibility of the BTS system.

Due to the study's scope and limitations, the BTS accessibility-related research or station design performance research can continue. For example, as all downtown stations are located in TOD areas, certain station exits are directly connected to buildings. Therefore, in the case of partially accessible stations, the interconnectedness between the station's buildings, entrances, and exits may also be thoroughly investigated. In addition, the survey could be conducted with a small sample of elderly passengers, and detailed research on their awareness of services and facilities could be conducted with many passengers over 60. Moreover, qualitative research

techniques have been applied in the past when analyzing the travel characteristics of the elderly. Thus, a qualitative study or a mixed-methods approach should be employed to investigate the accessibility of older transit riders further.

Lastly, the well-being of the elderly, their ability to actively participate in urban society regardless of their age, and the accessibility of Bangkok's mass transit adopting vertical circulation also play a part in urban cohesion. As a result, the public transportation study may continue not just for the ageing population but also to enhance transit facilities as part of the city's mobility.

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การประเมินผลกระทบ การเข้าถึงแนวตั้งของสถานีระบบขนส่งมวลชนในกรุงเทพมหานครต่อพฤติกรรมการเดินทางของผู้โดยสารสูงอายุ

**(Evaluating the impact of vertical accessibility at Bangkok mass transit stations on the travel behaviour of elderly passengers)**

Ms Yoon Ei, a student of MSc. Urban Strategies (Chulalongkorn University) collected this survey for her graduation thesis requirement. The survey questions concern the elderly passengers' experiences using Bangkok's BTS stations. Therefore, this survey is open to all BTS passengers aged 60 and up. However, the responses and organised data will only be used for academic purposes. Thus, in this survey, respondents are not required to provide personal information such as their name or contact information.

It is estimated that answering the questions will take 10-15 minutes.

ดิฉัน น.ส. ยูน อี นักเรียนศึกษาระดับปริญญาโท วิชาการศึกษาในเมือง มหาวิทยาลัยจุฬาลงกรณ์ ขอความช่วยเหลือจากคุณในการตอบแบบสอบถามอันนี้สำหรับ การทำวิทยานิพนธ์ของฉัน

แบบสอบถามอันนี้มีคำถามเกี่ยวกับประสบการณ์ของผู้สูงอายุในการใช้สถานีรถไฟฟ้า BTS ในกทม. ดังนั้นแบบสอบถามอันนี้จึงเปิดให้ผู้ใช้บริการ BTS ที่มีอายุสูงกว่า 60 ปีขึ้นไปในการตอบแบบสอบถามนี้

ข้อมูลที่รวบรวมจากการตอบแบบสอบถามอันนี้จะถูกเอาไปใช้เฉพาะงานวิจัยทางวิชาการ แบบสอบถามนี้จะไม่มีการเก็บข้อมูลส่วนตัวของผู้ตอบ

การตอบแบบสอบถามจะใช้เวลา 10-15 นาที

## Section 1: Travel behaviour of the elderly - พฤติกรรมการเดินทางของผู้สูงอายุ

| | Questions | Answers (Variables) |
|---|---|---|
| 1. | What type of ticket do you usually use?<br><br>โดยปกติคุณใช้ตั๋วเดินทางชนิดไหน | *Please select one option*<br><br>กรุณาเลือกหนึ่งทางเลือก<br><br>Rabbit Card for Senior - บัตรแรบบิท สำหรับผู้สูงอายุ<br><br>Normal Rabbit Card - บัตรแรบบิท<br><br>Single Journey Card - บัตรโดยสารเที่ยวเดียว<br><br>One Day Pass - บัตรโดยสารประเภทหนึ่งวัน |

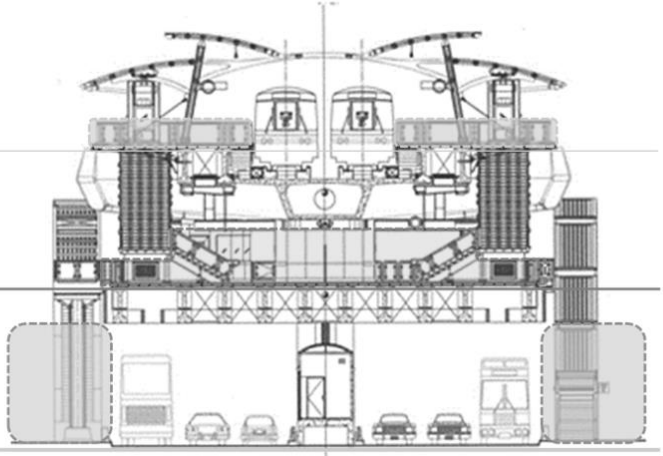| 2. | How often do you take the BTS in a month?<br><br>คุณใช้ BTS กี่ครั้งต่อเดือน | *Please select one option*<br>กรุณาเลือกหนึ่งทางเลือก<br><br>Everyday<br><br>1-2 times per week<br><br>3-4 times per week<br><br>5-6 times per week<br><br>Seldom |
|---|---|---|
| 3. | When do you usually ride the BTS during the week?<br><br>โดยปกติจันทร์ถึงศุกร์คุณนั่ง BTS เวลาใดมากที่สุด | *Please select up to 3 options*<br>กรุณาเลือกไม่เกิน3ทางเลือก<br><br>○ 6:00 -7:00 am<br>7:30-9:30 am<br><br>10:00 am- 4:30 pm<br><br>5:00 – 7:30 pm<br><br>8:00 – 11:30 pm<br><br>Depending on the purpose of the trip - แล้วแต่เหตุผลการเดินทาง |
| 4. | When do you typically ride BTS on the weekends?<br><br>โดยปกติวันหยุดคุณนั่ง BTS เวลาใดมากที่สุด | Please select up to 3 options<br>กรุณาเลือกไม่เกิน3ทางเลือก<br><br>6:00 -7:00 am<br><br>7:30-9:30 am<br><br>10:00 am- 4:30 pm<br><br>5:00 – 7:30 pm<br><br>8:00 – 11:30 pm<br><br>Depending on the purpose of the trip - แล้วแต่เหตุผลการเดินทาง |

| 5. | คุณนั่ง BTS ไปทำกิจกรรมอะไรบ้าง<br><br>What are your BTS trip purposes? | กรุณาเลือกไม่เกิน3ทางเลือก<br><br>Please select up to 3 purposes<br><br><br>Health Care (Hospitals, Clinics, etc.) ไปตรวจสุขภาพหรือพบกับหมอ ที่โรงพยาบาลหรือคลินิก<br><br>Shopping (Market, Malls, etc.) ไปซื้อของ (ตลาด, ห้างสรรพสินค้า)<br><br>Recreation (parks, museums, elderly centres, etc.) ไปเที่ยว (สวนสาธารณะ, พิพิธภัณฑ์, ศูนย์สร้างสุขผู้สูงอายุ ๆ)<br><br>Religious (Temples, Wats, etc.) ไปวัดหรือศาสนสถานอื่นๆ<br><br>Visiting (to relatives, families, etc.) ไปเยี่ยมญาติหรือเพื่อน<br><br>Working (office, school, markets, etc.) ไปทำงาน (ออฟฟิศ, โรงเรียน, ตลาด)<br><br>Others ... |
| --- | --- | --- |
| 6. | Do you have private vehicles?<br><br>คุณมีรถส่วนตัวไหม | มี Yes<br><br>ไม่มี No |
| 7. | Do you use BTS App or check the website for train information?<br><br>คุณใช้แอพ BTS หรือดูเว็บไซท์ BTS เพื่อหาข้อมูลเกี่ยวกับบริการของ BTS ไหม | ใช้ Yes<br><br>ไม่ใช้ No |
| 8 | Before leaving home, do you usually check the first station's facilities, such as escalators and lifts?<br><br>ก่อนคุณออกจากบ้าน คุณตรวจสิ่งอำนวยความสะดวกของสถานี BTS แรกที่คุณต้องการใช้ เช่นบันไดเลื่อน กับลิฟต์ ไหม | ตรวจ Yes<br><br>ไม่ตรวจ No |

| | | |
|---|---|---|
| 9 | Before leaving home, do you usually check the exit station's facilities, such as escalators and lifts?<br><br>ก่อนคุณออกจากบ้าน คุณตรวจสิ่งอำนวยความสะดวกของสถานี BTS สุดท้ายที่คุณต้องการใช้ เช่นบันไดเลื่อน กับลิฟต์ ไหม | ตรวจ Yes<br><br>ไม่ตรวจ No |
| 10 | Do you know that there is the station map and facility information on the concourse level?<br><br>คุณทราบไหมว่าชั้นจำหน่ายตั๋ว มีแผนที่ของสถานีและข้อมูลเกี่ยวกับสิ่งอำนวยความสะดวกของสถานี | ทราบ Yes<br><br>ไม่ทราบ No |
| 11 | Do you know the BTS website and App have information about station facilities?<br><br>คุณทราบไหมว่าแอพ BTS กับเว็บไซท์ BTS มีแผนที่และข้อมูลเกี่ยวกับสิ่งอำนวยความสะดวกของทุกสถานี | ทราบ Yes<br><br>ไม่ทราบ No |

Section 2: Satisfaction with the station facilities - ความพึงพอใจกับสิ่งอำนวยความสะดวกของสถานี BTS

| | Questions | Answers (Variables) |
|---|---|---|
| 1 | Which BTS station do you usually choose when you go out from home? | Please write down the name of the BTS station where you typically go |

| | ตอนคุณออกจากบ้าน คุณไปใช้สถานี BTS ไหนบ่อยที่สุด | ....<br><br>กรุณาเขียนชื่อสถานีที่คุณไปใช้บ่อยที่สุดเมื่อคุณออกจากบ้าน |
|---|---|---|
| 2 | Why do you select this station when you go out?<br><br>ทำไมคุณถึงเลือกสถานีนี้ | The station is near to my home  - สถานีนี้ใกล้บ้านฉัน<br><br>The station is not near to my home but more accessible to the platform - สถานีไม่ได้อยู่ใกล้บ้านฉันแต่มันมีสิ่งอำนวยความสะดวก<br><br>Others ......เหตุอื่นๆ |



ชั้นชานชาลา Platform level

ชั้นจำหน่ายตั๋ว Concourse level

ชั้นพื้นถนน Street level

Figure showing the levels of a BTS station

| | Access To Concourse Level  (street level to the ticket floor)<br><br>การเข้าถึงชั้นจำหน่ายตั๋ว | |
|---|---|---|
| 3 | When you go from the BTS station's street level to the concourse level (ticket booth floor), which vertical access do you usually use?<br><br>เวลาคุณจะขึ้นไปบนสถานี คุณใช้สิ่งอำนวยความสะดวกใด | ลิฟต์ Lift/Elevator<br><br>บันไดเลื่อน Escalator<br><br>บันได Stairs |

| 4 | When you exit the BTS station's Concourse (ticket booth floor) to the street, which is the vertical access you usually use?<br><br>เวลาคุณลงจากชั้นจำหน่ายตั๋วจนถึงชั้นพื้นถนน คุณลงด้วยวิธีใด | ลิฟต์ Lift/Elevator<br><br>บันได Stairs |
|---|---|---|
| 6 | Have you ever had trouble getting to the concourse level of the station?<br><br>คุณเคยมีปัญหาในการจะขึ้นไปที่ชั้นจำหน่ายตั๋วไหม | เคย Yes<br><br>ไม่เลย Not at all<br><br>บางครั้ง Sometimes |
| | **Access To Platform Level (concourse level to the platform)**<br><br>**การเข้าถึงชั้นชานชาลา** | |
| 7 | Which vertical access do you usually use when you go to the platform level?<br><br>เวลาคุณจะขึ้นไปที่ชั้นชานชาลา คุณใช้สิ่งอำนวยความสะดวกใด | ลิฟต์ Lift/Elevator<br><br>บันไดเลื่อน Escalator<br><br>บันได Stairs |
| 8 | Which vertical access do you usually use when going down from the platform to the concourse level (ticket floor)?<br><br>เวลาคุณลงจากชั้นชานชาลาจนถึงชั้นจำหน่ายตั๋ว คุณลงด้วยวิธีใด | ลิฟต์ Lift/Elevator<br><br>บันได Stairs |
| 9 | Have you ever had trouble getting off the platform of the station?<br><br>คุณเคยมีปัญหาในการลงจากชั้นชานชาลาไหม | มี Yes<br><br>ไม่เคยมี Not at all<br><br>เคยมีบางครั้ง Sometimes |

| 10 | Do you have any difficulties using the stairs in the stations?<br><br>ฉนมีปัญหาในการใช้บันไดที่สถานี BTS ไหมคุ | มี Yes<br><br>ไม่มี Not at all<br><br>บางครั้ง Sometimes |
|---|---|---|

14. How truly satisfied are you with the facilities such as lifts and escalators provided by the station to which you have access? (Please select one in each row)

กรุณาเลือกระดับความพอใจของสิ่งอำนวยความสะดวกของสถานี BTS

| Facilities<br><br>สิ่งอำนวยความสะดวกของสถานี BTS | Not at all satisfied<br><br>ไม่พึงพอใจเลย | Dissatisfied<br><br>ไม่พอใจ | Somewhat Satisfied<br><br>พอใจ | Satisfied<br><br>พอใจมาก | Extremely Satisfied<br><br>พอใจมากที่สุด |
|---|---|---|---|---|---|
| Stairs<br>บันได | | | | | |
| Lifts/ Elevators<br>ลิฟต์ | | | | | |
| Escalators<br>บันไดเลื่อน | | | | | |
| Reliable of the information and signs<br>ความน่าเชื่อถือของป้ายแล้วข้อมูลต่างๆที่สถานี BTS | | | | | |
| Helpfulness of the staff | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| ความช่วยเหลือจากเจ้าหน้าที่ที่สถานี | | | | | |
| Sense of safety<br><br>ความรู้สึกปลอดภัย | | | | | |
| Waiting Area<br><br>พื้นที่รอ | | | | | |
| WHEELCHAIR Accessibility<br><br>การเข้าถึงสำหรับผู้ใช้รถเข็น | | | | | |
| Station information & overall services for elderly<br><br>ข้อมูลเกี่ยวกับการใช้สถานีแล้วบริการต่างๆสำหรับผู้สูงอายุ | | | | | |

Section 3: Elderly Passengers' Characteristics

| 1 | Gender<br><br>เพศ | หญิง Female<br><br>ผู้ชาย Male<br><br>ไม่อยากระบุ Prefer not to say |
|---|---|---|
| 2 | Age<br><br>อายุ | Please write down your age (60 years old and above)<br><br>…………<br><br>กรุณาเขียนอายุของคุณ |
| 3 | Are you still working?<br><br>คุณยังทำงานอยู่ไหม | ยังทำงานอยู่- Yes<br><br>เลิกทำงานแล้ว No |

| | | |
|---|---|---|
| 4 | Do you have a regular income like a pension?<br><br>คุณมีรายได้ประจำเช่นเงินบำเหน็จบำนาญไหม | มี Yes<br><br>ไม่มี No |
| 5 | Do you have medical insurance that covers minor injuries?<br><br>คุณมีประกันสุขภาพหรือประกันอุบัติเหตุที่ครอบคลุมอุบัติเหตุเล็กน้อยหรือการบาดเจ็บไหม | มี Yes<br><br>ไม่มี No |
| 6 | Who do you usually travel with when taking the BTS?<br><br>เวลาคุณใช้บริการ BTS คุณเดินทางกับใคร | Please select up to 2 options<br><br>กรุณาเลือกไม่เกิน2ทางเลือก<br><br>คนเดียว - No one<br><br>คนในครอบครัว - Someone from my family<br><br>เพื่อน ๆ -Friends<br><br>ผู้ดูแล -Caregiver |
| 7 | Do you frequently request assistance from the staff when boarding the platform?<br><br>คุณขอความช่วยเหลือจากเจ้าหน้าที่สถานี BTS เมื่อต้องการขึ้นไปที่ชั้นชานชาลาไหม | เสมอ almost always<br><br>บางครั้ง Sometimes<br><br>ไม่เคย Never |
| 8 | Do you require a walking aid, such as a walking stick, when you go out?<br><br>เวลาคุณออกจากบ้าน คุณต้องใช้อุปกรณ์ช่วยเดิน เช่นไม้เท้าช่วยพยุง หรือไม่ | ○ใช้ Yes<br>○ไม่ใช้ No |
| 9 | If you answered YES, what kind of walking or moving assistance do you use/require? | Please select one option<br><br>กรุณาเลือก1ทางเลือก<br><br>○ ไม่ใช้อะไร - Nothing |

| | | |
|---|---|---|
| | ถ้าคุณตอบคำถามคำถามก่อนหน้านี้ว่า<br><br>"ใช้" คุณใช้อุปกรณ์ช่วยเดิน อะไรบ้าง | O ไม้เท้าช่วยพยุง - Walking Stick (or Walking Cane)<br>O ไม้ค้ำ - Crutches<br>O รถเข็นคนพิการ - Wheelchair<br>O วอล์คเกอร์ช่วยเดินผู้สูงอายุ - Walking frames or rollators<br>O Others ...... อื่น ๆ |
| 10 | Do you have any physical health issues, whether severe or minor, that may limit your ability to go out? (Chronic pain, such as back pain, leg ache, or knee pain)<br><br>คุณมีขีดจำกัดของสุขภาพในด้านการเดินทางไปที่สถานี BTS หรือไม่ เช่น ปวดเรื้อรัง อาการปวดหลัง อาการปวดเข่า อาการปวดขา | มี Yes<br><br>ไม่มี No |
| 11 | How do you think your vision or physical health concerns will influence your decision to ride the BTS?<br><br>คุณคิดว่าปัญหาทางด้านสายตาหรือสุขภาพ จะมีผลกับการเลือกที่จะใช้บริการ BTS หรือไม่ | o **Answer** - โปรดอธิบาย<br>**Good**<br>**Bad**<br>**Others**<br>.....................................… |
| 13 | Will you use the BTS more often if the stations have **facilities** on both sides of the street and every level?<br><br>ถ้าสถานี BTS มีลิฟต์จากชั้นพื้นถนน ขึ้นสู่ชั้นจำหน่ายตั๋ว และจากชั้นจำหน่ายตั๋วขึ้นชั้นชานชาลา คุณจะใช้บริการ BTS บ่อยขึ้นหรือไม่ | ใช่ Yes<br><br>ไม่ใช่ No<br><br>ไม่แน่ใจ Not Sure |

**Thank you for answering and involving in the survey for my research.**

ขอบคุณที่ร่วมตอบแบบสอบถามค่ะ

# VITA

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