

UNSATISFACTORY TRANSPORTATION AND ITS EFFECTS IN SOCIAL EXCLUSION: THE CASE OF THE ELDERLY IN A DEVELOPING COUNTRY

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Super-aging societies and urbanization are global trends in both developed and developing countries. The general concern is that elderly people's low level of mobility limits their ability to travel to social activities and opportunities, leading to the problem of social exclusion. However, the pattern of social exclusion caused by transportation difficulty might be different among seniors living in developed and developing countries. This study aims to investigate the process of social exclusion of elderly people related to the degree of satisfaction with transportation by conducting count data and ordered logistic regression analyses.

The results of survey data from senior citizens living in Bangkok, Thailand, indicated that the proportion of Thai elderly who needed assistance to support transportation needs was significantly larger than that in the US. Interestingly, older people considered non-mandatory activities more important than mandatory activities. However, most of these people had to rely on their own transportation to reach non-mandatory activities during weekdays because of a temporal mismatch with their assistants. When dissatisfaction with daily transportation generated a gap between desired and actual trip frequency, feelings of social exclusion occurred. The importance of fighting social exclusion by increasing older people's satisfaction with their daily transportation is discussed.

Key Words : *developing countries; elderly people; degree of satisfaction with transportation; social exclusion; trip frequency*

1. INTRODUCTION

Aging populations have become a global phenomenon. From 2006 through 2050, there will be a dramatic growth in the number of people 60 years old and over, from 11% to 22%¹⁾. In the US, the Baby Boom generation born between 1946 and 1964 began to turn 65 in 2011. In the near future, the US will experience significant growth in its population aged 65 and over, from 43.1 million in 2012 to an estimated 83.7 million in 2050²⁾. However, older

people's low mobility often limits their transportation ability and consequently, their participation in social activities and opportunities, leading to feelings of social exclusion^{3, 4)}. Many changes in older people's living environments and conditions are needed to support their quality of life. This problem occurs not only in developed countries but also in developing countries^{5, 6)}. The pattern of transportation-related social exclusion of the elderly living in developing countries might be dissimilar to that of the elderly living in the US and other developed countries.

In developing countries such as Thailand, the capital city has rapidly developed without sufficient infrastructure, appropriate urban planning or adequate transportation to accommodate the needs of senior citizens⁷⁾. Consequently, transportation difficulties discourage the elderly from leaving their homes to participate in society. This problem has become a key obstacle to social inclusion from the perspective of urban planning in developing countries. Although there is broad awareness in developed countries of social exclusion caused by transportation disadvantages, this issue has received little attention in developing countries.

Focusing on data collected from elderly people living in a developing country, this study aims to measure the feeling of social exclusion of the elderly caused by unsatisfactory transportation. Although several studies have evaluated the degree of social exclusion by measuring a person's travel ability, such as trip frequency and access to public activity spaces⁸⁻¹¹⁾, the desired level of social participation might not be precisely evaluated by relying exclusively on that person's existing transportation. Therefore, this study introduces the concept of the gap between existing and desired trip frequency. In addition, because feelings of social exclusion can be evaluated by indicators other than transportation ability, psychological indicators are also applied to measure the exact degree of social exclusion.

The rest of the study is organized as follows. Section 2 reviews the related literature. Section 3 demonstrates methodologies and data collection. Section 4 performed statistical analyses and conducts a discussion. Finally, Sections 5 and 6 provide implications and conclusions, respectively.

2. LITURATURE REVIEW

The process of social exclusion can be described as a person's inability to reasonably access or participate in mainstream social activities and opportunities because of reduced accessibility and inadequate mobility^{12, 13)}. Social exclusion can be categorized into multiple dimensions, such as psychological, sociological, political, economic and educational^{9, 14, 15)}. Social exclusion is not a static state; instead, people can move in and out of it¹⁶⁾. It has been found that transportation disadvantage is a factor that leads to the problem of social exclusion, resulting in lower well-being, quality of life and life satisfaction¹⁷⁾.

In terms of social participation, general activities can be categorized into three groups, including the following: 1) Anchoring activities, or activities on a fixed schedule that change little, such as working; 2)

Mandatory activities, or activities required to satisfy basic human needs such as daily shopping, whose date and time can be adapted; and 3) Non-mandatory activities, or those that are engaged in to satisfy a person's desires, such as leisure activities, for which the time and place are more flexible¹⁸⁾. The dimensions of social exclusion differ by age group. Whereas the social exclusion of younger people is commonly evaluated using education and family support, the social exclusion of working-age people generally focuses on employment and income level^{19, 20)}. However, the dimensions of the social exclusion of older people (generally, those who are retired) highlight such people's level of access to basic needs, degree of social participation, and transportation ability^{3, 18)}.

The causes of social exclusion among older people include low mobility, health conditions and inadequate income^{3, 4)}. In addition, the elderly tend to have different living conditions; for instance, they are likely not only to be introverted and widowed but also to live with fewer family members than do other people. Therefore, it seems that older people are at risk of exclusion not only from social networks but also from social activities²¹⁾.

To measure the degree of transportation-related social exclusion, previous researchers have developed several methods, as shown in Table 1. First, it is clear that most previous studies were conducted in developed countries, whereas this study highlights data collected in a developing country. Second, the majority of former studies evaluated social exclusion based on existing travel ability, which sometimes varied according to other transportation policy scenarios. As noted above, current transportation ability might not accurately represent a person's desired level of transportation. Therefore, to obtain a satisfactory level of social participation, this study focuses on not only existing but also desired travel abilities. Finally, few studies have applied psychological indicators to measure the degree of social exclusion and well-being, and little attention has been paid to the relationship between psychological scores and the desired level of transport ability. In addition, whereas previous studies applied psychological indicators to general age groups, this study adopts psychological questions from questionnaires specific to older people's quality of life and well-being^{4, 22-25)}, which enables a focus on the dimension of social exclusion among the elderly.

3. METHODOLOGY

The inconvenient transportation of elderly people,

low-mobility population, might reduce their degree of satisfaction with transportation and limit their transportation ability, leading to feelings of social exclusion. Therefore, our analysis aimed to examine the degree to which Bangkok's elderly population feels socially excluded because of dissatisfaction with daily transportation. One approach that was useful for understanding the process of social exclusion was to use statistical analyses to investigate the relationships among the following three elements: 1) degree of satisfaction with transportation, 2) the gap between existing and desired trip frequency, and 3) feelings of social exclusion.

Table 1 Summary of the literature of social exclusion related to transportation.

Author	Method	Evaluated factor used to measure social exclusion						Sampling			Study area
		Person's speech	Accessibility	Mobility	Trip frequency	Travel distance	Psychological score	Elderly	Disadvantage	Low-income	
26)	In-depth interview	X							X	UK	
27)	In-depth interview	X					X	X		Brazil	
8)	Spatial approach		X							US	
9)	Spatial approach		X	X						UK	
28)	Spatial approach				X	X	X		X	German	
10)	Spatial approach			X				X		UK	
29)	Spatial approach		X	X	X	X			X	Canada	
30)	Spatial approach		X				X			UK	
31)	Spatial approach		X				X			AUS	
18)	Spatial approach			X					X	Portugal	
32)	Spatial approach		X						X	Pakistan	
33)	Logit model				X		X			Scotland	
11)	Logit model				X					UK	
34)	Discussion					X				AUS	
35)	Structural equation model					X				AUS	

In March 2016, 201 samples were collected from elderly people in Bangkok aged 60 or over. The interviews were conducted at gathering places and major transit connection points in Bangkok. The questionnaire consisted of the grouped questions described below.

(1) socioeconomic information

Because elderly people of varying backgrounds might exhibit different patterns of social exclusion, respondents were asked questions about their living

condition, including personality [from 1 (considerably introverted: prefer staying at home) to 7 (considerably extroverted: prefer going out to engage in social activity)], number of family members living with them, degree of social assistance to support their transportation needs [from 1 (lowest) to 7 (highest)], physical health condition related to transportation ability [walking, vision and driving abilities ranked from 1 (very poor) to 7 (very good)] and general information such as age, gender and income.

(2) Desired Level of Social Participation

Because the existing trip rate might not represent the desired trip frequency, the study introduced the question of the unwanted gap in the number of trips (per week), which refers to the difference between the numbers of desired and actual trips taken to participate in social activities. Trip purposes were categorized into the following two groups: 1) mandatory activities such as shopping, administrative, financial and health activities (health checkup and going to the hospital); and 2) non-mandatory activities such as visiting family or friends and pursuing hobbies (leisure, sport, and recreation). Irregular trips that were rarely made, such as annual journeys, were not included in the analysis. In addition, respondents were asked to rate the degree of importance of each trip [from 1 (not important) to 7 (very important)].

(3) Transportation

Questions were asked about transportation mode and other transportation-related information, and respondents were required to assess their degree of satisfaction with their transportation [from 1 (completely dissatisfied) to 7 (completely satisfied)]. Transportation mode was categorized into 6 groups, including non-motorized (walking and cycling), private vehicle, transit (all types of bus), metro, taxi and relying on others, the latter of which refers to social assistants who support the transportation of elderly people.

(4) Psychological indicators

Because the feeling of social exclusion might not be accurately evaluated by relying exclusively on travel ability, this study also applied psychological indicators [ranked from 1 (strongly disagree) to 7 (strongly agree)], which represent the feeling of social exclusion in five dimensions:

1. You are part of society;
2. You have adequate relationships with relatives;
3. You have adequate relationships with friends;
4. You are able to participate in social activities; and
5. You are able to access social resources and

opportunities.

To investigate whether the gap number of trips affected feelings of social exclusion, respondents were required to assess their psychological scores twice, i.e., once for each situation of actual and desired trip frequencies.

4. RESULT AND DISCUSSION

(1) Socioeconomic characteristics

Socioeconomic information about the 201 respondents is summarized in Table 2. The proportion of men (59.70 percent) was slightly larger than the proportion of women. Half of the respondents were from the young-elderly group (60 to 64 years old), and approximately one-fifth of the respondents were single or widowed. In contrast with previous studies, Bangkok seniors tended to live with a higher number of family members (3.56 persons) than their counterparts in the US, where 80% or more of the elderly lived either alone or with only one other person^{3, 36}. In terms of employment, only a small proportion of the sampled elderly were still working and following fixed schedules. Therefore, most of the respondents tended to have more free time each day than members of younger groups. Nevertheless, the income of 46.77 percent of elderly was less than 10,000 Baht per month, which is low compared to the average monthly wage in Thailand (13,495.58 Baht per month)³⁷. The respondents' average walking ability (4.58 points) and vision (4.47 points) were moderate. Although about half of them were able to drive a car (51.74 percent) and ride a motorcycle (54.23 percent), the average driving ability was relatively low (3.68 points and 3.15 points for car and motorcycle, respectively).

(2) Trip purposes

Trip purposes and frequencies are presented in Figure 1, in which one trip refers to one occurrence of an activity. The highest trip frequency involved shopping (2.64 trips per week), followed by hobbies (1.66 trips per week), meeting friends (1.58 trips per week) and visiting relatives (1.36 trips per week). Interestingly, although mandatory activities to meet basic human needs tended to be considered more essential among people in younger age groups (such as people of working age), shopping and non-mandatory activities were more important to Bangkok's elderly. The reason may be that mandatory activities seemed like duties for the elderly, who preferred activities that could satisfy their desires and make them happy late in life. The shopping habits of elderly Asian people might be relatively dissimilar from those of the elderly in

developed countries. Based on the interviews, the respondents seemed to enjoy daily shopping because they could also walk, relax, and chat with others at the same time. Accordingly, shopping was also considered a leisure activity.

Table 2 Socio economic information.

General information		
	N	%
Gender		
Male	120	59.70
Female	81	40.30
Status		
Single or widowed	35	17.41
Married	166	82.59
Employment status		
Non-worker	115	57.21
Fixed schedule working	35	17.41
Non-fixed schedule working	51	25.38
Vehicle ownership		
Car ownership with driving driver's license	104	51.74
Motorcycle ownership with driving driver's license	109	54.23
Age (year)		
60-64	101	50.25
65-69	58	28.86
70-74	28	13.93
>75	14	6.97
Income (Baht per month)		
<=10000	94	46.77
10001-20000	26	12.94
20001-30000	34	16.92
30001-40000	24	11.94
>40001	23	11.44
Avg. Std.		
Health status (ranked from 1=very poor to 7=very good)		
Walking	4.58	1.24
Vision	4.47	1.22
Ability to drive a car	3.68	1.87
Ability to drive a motorcycle	3.15	1.61
Personality and living condition		
Free time (hours per day)	8.53	3.73
Number of members in family (person)	3.56	1.09
Personality (ranked from 1=introverted to 7=extroverted)	4.14	1.75
Degree of support from social assistance for transportation needs (ranked from 1=strongly disagree to 7=strongly agree)	3.06	1.22

The results showed that the gaps between the number of desired and actual shopping and non-mandatory activities were larger than the gaps associated with mandatory activities. The respondents did not engage in trips involving shopping and non-mandatory activities at their frequency. The gap between the desired and existing numbers of shopping and non-mandatory activities should be reduced to fulfill the travel needs of elderly people in Bangkok. Nevertheless, respondents did not report other preferred destinations because they tended to already be familiar with existing places and with the people there. It could be that the respondents' destination choices were also strongly

affected by the social connections available there.

(3) Daily transportation

a) Transportation mode

The transportation modes used to reach activity destinations are categorized by trip purpose and presented in Figure 2. The majority of the transportation modes used were transit (24.14%), followed by private vehicle (18.41%), metro (9.08%), taxi (6.93%) and non-motorized transportation (6.51%). The proportion of Bangkok’s elderly that relies on others for transportation (32.36%) was larger than that found in a previous study in the US (25.00%)³. However, the average degree of social assistance for transportation needs was only 3.06, according to Table 1. The statistics indicated that the proportion of the elderly who had social supporters was significantly larger during weekends (51.37%) than during weekdays (14.85%). It seemed that their assistants worked on workdays (Monday to Friday), and the temporal mismatch between the elderly and social assistants was not likely to be remedied. Therefore, on workdays, most of the elderly needed to use their own transportation. Except for the respondents who traveled by non-motorized mode, non-drivers had to rely on public transportation (43.41%) and taxi (8.91%). However, approximately half of the weekday trips made by public transportation and taxi (52.33%) were for shopping and non-mandatory activities; according to Figure 1, the desired frequencies of these activities were not satisfied.

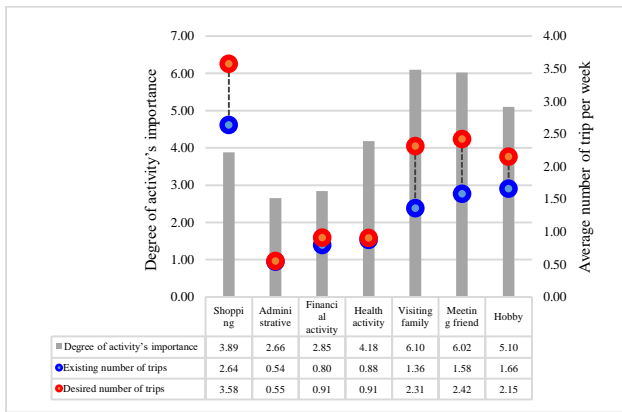


Fig.1 Degree of importance of activities and gap in desired number of trips by activity.

b) Gap in number of trips categorized by transportation mode

According to Figure 2, elderly taxi users had the highest gap in the number of trips (as a percentage of existing trip rate; 74.04%), and those who traveled by non-motorized mode had the smallest gap (18.39%). It is possible that the gap between the numbers of

desired and actual trips was caused by dissatisfaction with aspects of daily transportation. Statistical analyses were conducted to investigate the effect of the degree of satisfaction with transportation on the gap in the number of trips. First, factor analysis was conducted to avoid the problem of multicollinearity, as shown in Table 3. Subsequently, count data regression analysis between explanatory variables (x: degree of satisfaction with transportation and person’s characteristic) and the dependent variable (y: gap in the number of trips) was performed, as presented in Table 4. The count data model with the lowest Akaike Information Criterion (AIC) was selected as having the best fit. The regression analysis for those who needed to rely on others for transportation is not provided.

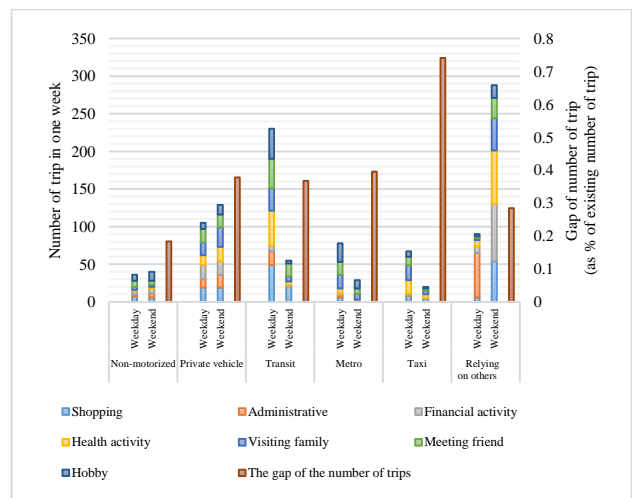


Fig.2 Mode uses and gaps of the numbers of trip by mode.

According to Table 4, the statistical models indicated that elderly people with lower degrees of satisfaction with transportation (with respect to the aspects that had significant relationships to the outcome) tended to have larger gaps between the desired and actual numbers of activities. It can be implied that although the elderly would like to travel to participate in society, unsatisfactory transportation discouraged them from going out, resulting in the sacrifice of a portion of their desired trips.

Both degree of satisfaction with transportation and age-related characteristics and living conditions affected respondents’ decision to go out. Elderly people who traveled by non-motorized modes of travel with higher degrees of social assistance tended to have smaller gaps in the number of trips. In this case, the caretakers who looked after the elderly when they walked or rode bikes offered important support for their travel, especially for those with lower walking ability. In contrast to the typical image of the elderly, the results showed that older people in Bangkok did not always want to go out more

frequently, as was generally believed. Some of the older people were introverted and had less motivation to go out than did people who were more extroverted. In addition, the existing trip rate affected the size of the gap between the numbers of desired and actual trips. Elderly taxi users who could travel more often in their current situation tended to have smaller gaps because they were already satisfied with their existing trip rate.

Table 3 Factor analysis of degree of satisfaction with transportation.

Factor	Private vehicles		Transit		Metro		Taxi		
	Factor1	Factor2	Factor1	Factor2	Factor1	Factor2	Factor1	Factor2	Factor3
Walkway and access walkway condition and environment	-	-	0.85	-	0.85	-	0.83	-	-
Safety aspect	0.85	-	0.85	-	0.84	-	0.86	-	-
Comfort and convenience	0.88	-	0.86	-	0.91	-	-	-	0.94
Fare or travel cost	u	u	0.79	0.89	-	-	-	0.94	-
Road traffic condition	-	0.87	0.80	-	-	-	0.88	-	-
Parking space	-	0.86	-	-	-	-	-	-	-
Space in vehicle	-	-	0.85	-	0.78	-	-	-	-
Seat availability	-	-	0.85	-	0.88	-	-	-	-
Service frequency	-	-	-	0.69	-	0.58	-	-	-
Service information system	-	-	0.82	-	0.69	u	u	u	u
Reliability of punctuality	-	-	0.68	-	0.53	0.81	-	-	-
Reliability of driver	-	-	-	-	-	0.89	-	-	-
Kaiser-Meyer-Olkin (KMO)	0.65		0.88		0.85		0.63		
Name of grouped variable	WS_PRI1	WS_PRI2	WS_TRANSIT1	WS_TRANSIT2	WS_METRO1	WS_METRO2	WS_TAXI1	WS_TAXI2	WS_TAXI3

Note: - is non-applicable, and u is unloaded factor but still used to fit model

Table 4 Count data regression analyses of gaps in the numbers of trips categorized by transportation mode (see the meaning of variables in Appendix).

Variable	Non-motorized mode	Private vehicle	Transit	Metro	Taxi
S_WALK	Coef.	Coef.	Coef.	Coef.	Coef.
WS_PRI1	-0.108**	-0.098*			
WS_TRANSIT1			-0.515***		
WS_METRO1				-0.127**	
WS_TAXI1					-0.247***
WS_TAXI2					-0.114*
P1	-0.122**				
P2	-0.203***	-0.112***		-0.114**	
H_W	-0.14*				
NUM_F		-0.164***	-0.201*	-0.136**	
EN					-0.080*
AGE		0.051**	-0.109***		
INC			-0.001***		
Constant	3.637	-0.307	10.357	2.688	2.954
Number of obs.	51	70	109	58	46
LR chi2	0.141	0.135	0.124	0.092	0.11
Log likelihood	-110.583	-144.237	-176.76	-116.84	-89.458
AIC	229.165	296.474	361.52	239.68	184.916

Note: * is 90% significance level, ** is 95% significance level and *** is 99% significance level

(4) Measurement of the degree of social exclusion

a) Psychological scores

The difference in the respondents' psychological

scores with respect to existing and desired trip rates is shown in Figure 3. In the existing situation, the psychological scores of the elderly in most dimensions were approximately 4 and over, except for the dimension of being part of society, for which the average score was only 2.50. It seemed that although Bangkok's senior citizens thought that they were moderately able to participate in social activities and opportunities, they had a serious problem in that that they felt socially isolated. However, the score of this dimension most significantly improved by 2.41 if they were able to travel to participate in society at their desired frequency.

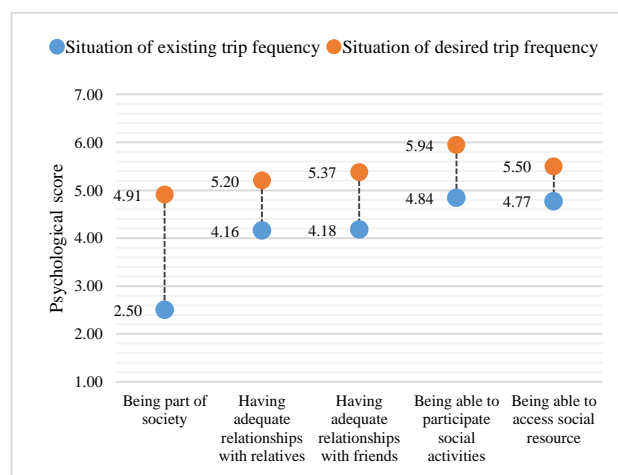


Fig.3 Differences of psychological scores between the situation of existing and desired trip frequencies.

b) Effect of gaps in the numbers of trips on psychological scores

The statistics indicated that psychological scores in all dimensions increased if the elderly had the ability to travel at their desired frequency. Although they traveled to participate in several social activities, the issue of which activities most improved the psychological score should be investigated. Therefore, ordered logit models between the explanatory variable (x: gap in the numbers of trips for each activity) and the dependent variable (y: improvement of psychological scores) were conducted, as shown in Table 5.

According to Table 5, the statistical models showed that only the gap in the numbers of shopping and non-mandatory trips improved the psychological score. This result corresponded to the degree of trip importance shown in Figure 1. Therefore, to achieve the goal of social inclusion, it is important to design approaches to supporting elderly people's ability to travel to places for shopping and non-mandatory activities, especially to visit relatives, meet friends and participate in hobbies, which were significantly related with the most unsatisfied dimension, being

part of society. One possible approach was to increase the degree of satisfaction with transportation to reduce the gap in the numbers of trips, as discussed in the next section.

Table 5 Ordered logit models of the differences of psychological scores between existing and desired trip frequencies (see the meaning of variables in Appendix).

Variable	Being part of the society	Having adequate relationships with relatives	Having adequate relationships with friends	Being able to participate social activities	Being able to access social resource
	Coef.	Coef.	Coef.	Coef.	Coef.
GAP_A1				0.359**	1.257***
GAP_A5	1.343***	1.981***		0.732***	
GAP_A6	0.993***		1.578***		
GAP_A7	0.869***		0.999***	1.515***	1.074***
_cut1	-4.329	1.546	1.363	0.770	0.995
_cut2	0.456	3.023	2.384	2.683	3.257
_cut3	2.435	4.687	4.068	4.622	8.229
_cut4	5.763	8.412	6.494	7.775	
_cut5	9.430	10.524	9.757		
_cut6	11.768				
Number of obs	201	201	201	201	201
Pseudo R2	0.294	0.341	0.249	0.200	0.209
Log likelihood Max	-201.37	-174.67	-211.21	-216.53	-176.22

Note: * is 90% significance level, ** is 95% significance level and *** is 99% significance level

(5) Approaches to improving satisfaction with transportation

To decrease the gap between the numbers of desired and existing shopping and non-mandatory trips, satisfaction with transportation should be improved. The reduction of these gaps would improve psychological scores in all dimensions.

As mentioned above, a large proportion of elderly people needed to rely on others to travel to their activity destinations, but they tended to have assistance only on weekends because of temporal mismatch. Therefore, most elderly people (69.75%) needed to rely on their own transportation on weekdays. The statistics indicated that most such trips were made by public transport and taxi (52.33%), as shown in Figure 2. Thus, improving the degree of satisfaction with public transport and taxi would significantly contribute to promoting social inclusion among Bangkok senior citizens.

To investigate possible methods of improvement, the ordered logit models between the explanatory variable (x: transport information) and the dependent variable (y: degree of satisfaction with transportation aspects significantly related to the outcome in Table 4) were conducted, as shown in Table 6. It must be noted that there was no significant variable for non-motorized travel mode and private vehicle.

a) Implication

According to the data, the average service frequency of transit was 4.7 times per hour, but the probability of the elderly finding a seat on the vehicle was only 48.07%, which was a serious problem. As implied by the statistical model in Table 6, bus service frequency should be increased during weekdays, when most of the elderly had to rely on their own transportation, especially on the routes that link them to places to shop and engage in non-mandatory activities. As the number of buses per hour increases, the probability that the elderly will find a seat will also increase. In addition, the number of priority seats can be increased without a substantial impact on service performance because when no elderly passenger is present, other passengers can sit on those seats.

Table 6 Ordered logit models of degrees of satisfaction with transportation (see the meaning of variables in Appendix).

Variable	Transit	Metro	Taxi	
	WS_TRANSIT1	WS_METRO1	WS_TAXI1	WS_TAXI2
	Coef.	Coef.	Coef.	Coef.
W_DIST	0.210***			0.079*
SPEED	-0.010***	-0.007**		
AC_WALK	0.446***			
S_FRE	0.062***	0.070***		
P_SEAT		-0.208*		
T_COST				-0.146**
TAXI_COST			-0.202***	
_cut1	-3.842	-5.548	-14.139	-4.573
_cut2	-0.515	-4.097	-10.687	-2.350
_cut3	3.296	-0.881	-8.203	-1.173
_cut4	4.283	-0.068	-4.552	-0.281
_cut5	6.811	2.372	0.104	1.941
_cut6	12.045	5.324	1.699	2.928
Number of obs	109	58	46	46
Pseudo R2	0.390	0.243	0.445	0.093
Log likelihood Max	-103.705	-67.219	-40.365	-70.099

Note: * is 90% significant level, ** is 95% significant level and *** is 99% significant level

The cost of the metro tended to affect the degree of satisfaction with the form of transportation. The average fare (5.43 Baht per kilometer) was more expensive than that of other modes of public transportation such as transit (2.09 Baht per kilometer). Recently, metro and bus fares have been discounted by 50% for all senior citizens. However, the metro fare can be more heavily subsidized to support low-income elderly people. Like transit, the probability of finding an available seat on the metro was only 41.72%. This problem can also be solved by adding priority seats. In terms of walking distance to access points, the number of metro stations was much lower than that of transit stations. Thus, metro stations covered smaller areas than bus stops, causing a longer average walking distance to metro stations (578.96 meter) than the distance to transit stations (303.03 meter). For this range of access distance, it is

possible to introduce a feeder system, such as a small bus or van, to carry elderly people to metro stations, especially on weekdays.

For elderly taxi users, walking distance was not a problem because taxis offer door-to-door service. However, the proportional fare (excluding a 35-Baht fixed charge) was expensive for them and thus affected their degree of satisfaction. Furthermore, some taxi drivers (20.39%) unreasonably denied elderly passengers. To solve these problems, Demand Responsive Transit (DRT) with door-to-door service, cheaper fares, and better reliability may be introduced in response to higher weekday demand, focusing on the routes that link people to places for shopping and non-mandatory activities (as in the case of transit).

Nevertheless, the data indicated that Bangkok's elderly tended to travel to visit relatives and friends at their homes. This makes it relatively difficult to plan the routes for transit and DRT because the destinations (relatives' or friends' homes) were scattered. However, this study introduces the concept of compact destination, such as community cafés, gathering places and elderly clubs that should be linked to transit and DRT routes. The elderly can then travel more easily to meet their relatives and friends at those places.

5. CONCLUSION

This study's objective is to investigate the degree to which the elderly experience social exclusion caused by unsatisfactory transportation, an issue that has been rarely studied in developing countries. This study highlights the application of psychological indicators to measure the degree of social exclusion related to the gap in the numbers of trips between existing and desired trip frequency.

Interestingly, although mandatory activities tended to be considered more essential for other age groups, shopping and non-mandatory activities were considered more important for Bangkok's elderly. However, to access shopping and non-mandatory destinations, a large proportion of the elderly needed social assistants to support them during travel; this help was difficult to acquire because of the temporal mismatch between the availability of the elderly and their assistants. Therefore, most of the elderly had to travel using their own transportation. However, dissatisfaction with daily transportation discouraged the elderly from going out, resulting in the gap between existing and desired trip frequency and leading to feelings of social exclusion. To promote social inclusion among the elderly, the gap between the numbers of desired and existing shopping and

non-mandatory trips should be reduced.

This study took place in Bangkok, and it is possible that other developing countries with different city planning or transportation systems may have dissimilar results. Therefore, the approach used in this study should be replicated in other areas.

APPENDIX

(1) List of variables in Table 4

Outcome variable:

Y = Gap in number of trips (time per week)

Explanatory variable:

S_WALK = Satisfaction level with walkway condition and environment

WS_PRI1 = Weight score 1 of private vehicle (from table 3)

WS_TRANSIT1 = Weight score 1 of transit (from table 3)

WS_METRO1 = Weight score 1 of metro (from table 3)

WS_TAXI1 = Weight score 1 of taxi (from table 3)

WS_TAXI2 = Weight score 2 of taxi (from table 3)

EN = Existing number of all activities (time per week)

AGE = Age (year)

INC = Income (Baht per month)

NUM_F = Number of member in family (persons)

H_W = Walking ability (1: very poor to 7: very good)

P1 = Degree of social assistance to support transportation needs (1: strongly disagree to 7: strongly agree)

P2 = Personality (1: considerably introverted to 7: considerable extroverted)

S_WALK = Satisfaction level of walkway condition and environment (1-7)

(2) List of variables in Table 5

Outcome variable:

Y = Psychological scores (1: strongly disagree to 7: strongly agree)

Explanatory variable:

GAP_A1 = Gap in number of shopping trip (trip per week)

GAP_A5 = Gap in number of visiting relative trip (trip per week)

GAP_A6 = Gap in number of meeting friend trip (trip per week)

GAP_A7 = Gap in number of hobby trip (trip per week)

(3) List of variables in Table 6

Outcome variable:

Y = Degree of satisfaction with transportations

Explanatory variable:

SPEED = Travel speed (kilometers per hour)

AC_WALK = Access walking distance (meters)

S_FRE = Service frequency (times per hour)

P_SEAT = Probability that respondent gets a seat on vehicle (%)

T_COST = Travel cost (Baht per kilometer)

TAXI_COST = Taxi proportional fare (excluding 35 Baht of fixed charge: Baht)

P_DINY = Probability that taxi driver denies passenger (%)

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