Study on Transportation Behavior of Middle-Class Households with Children in Bangkok, Thailand

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Abstract: This study focuses on households with children in Bangkok and vicinity, Thailand and explore their automobile ownership and commuting transportation behavior and affecting factor. Data is collected by questionnaire survey, and logistic analysis is employed. As results, their heavy dependence on an automobile is revealed. Automobile ownership is affected by existing of children who commute to school by automobile and household income. Regarding with affecting factors, the followings are identified: Parents' transportation mode to work place is affected by existing of children who commute to school by automobile and office location close to a station. Children's transportation mode to school is their age and housing location close to a station.

Keywords: Household with children, Middle class, Transportation Behavior, Bangkok

1. INTRODUCTION

It is reported that use of private automobiles in Asian countries has been increasing in recent years, accounting for 34 per cent of trips in Jakarta, 32 percent in Bangkok, and 30 per cent in Metropolitan Manila (UN Habitat, 2010). And these automobile dependency causes several serious problems, such as traffic jam, air pollution, global warming, etc.,

On the other hand, another trend in Asian cities is the introduction of rail-based transport systems (UN Habitat, 2010), for example, Hanoi and Ho Chi Minh, capital city and economic center of Vietnam is now constructing urban rail transit and in Dhaka, a capital of Bangladesh, construction of Metro is in the process. Bangkok, a capital city of Thailand, is one of the progressive cities in Asian developing countries regarding urban rail transit development. The first urban rail transit, called BTS started its operation in 1999, and now five lines (BTS Sukhumvit line, Silom line, MRT subway, Airport Rail Link (ARL) and MRT purple line) makes urban rail transit network. However, motorization in Bangkok is still progressing and has still heavy traffic jam and serious air pollution problem (Tulyasuwan, 2013).

To tackle with problems cause by motorization, to understand people's travel behavior and its effecting factors are essential. Various scholars emphasis impact of household structure on transportation demand and behavior (Gordon et al. :1988, Oster:1979, Strathman et al., 1994), so to understand transportation behavior by the household structure is very important.

This study selects Bangkok as a study area because it is one of the progressive cities which have developed urban rail transit network in Asian developing countries. In Bangkok, School trips made by private cars is identified one of major factors of traffic congestion (Bangkok Metropolitan Administration, 2001). Therefore, this study focuses transportation behavior of household with schoolchildren in Bangkok and vicinity. As middle-class people can afford automobiles and they are now a major social class in Bangkok, and it is still further

increasing in size, this study focuses on middle-class households.

Objectives of this study are as follows; 1) to identify middle-class households' automobile ownership and parents' and children's commuting transportation behavior in Bangkok and vicinity, and 2) to identify affecting factors on their automobile ownership and transportation behavior.

There are a lot of studies on transportation behavior in Bangkok and vicinity. For example, Dissabayake et al. (2010) investigate household travel behavior in Bangkok Metropolitan Area by a Nested Logit Model.

Recently, the number of studies on transportation behavior related with urban rail transit has been increasing. Matsuyuki et al.(2013) investigate transportation behavior of condominium residents along urban rail transit in Bangkok and reveals that most of the residents are single or couple household without children and they decrease the number of owned automobile and decrease automobile use ratio and commuting distance by moving in the proximity of stations. Sanit et al.(2012) examined condominium residents' BTS ridership and its affecting factors.

Some scholars focus on a specific household structure, for example, Sanit et al.(2013) focuses on a multi-worker household in Bangkok and explore factors affecting transportation mode choice.

Almost of all above studies have variables of having child/not, and some of them include a variable of child's age in their numerical analysis, but they didn't analyze how children's transportation behavior affect parents' transportation behavior. Additionally, studies which analyze children's transportation behavior in Bangkok is very rare.

2. METHODOLOGY

2.1 Data Collection

In this study, data was collected by questionnaire survey. The target of the questionnaire survey is middle-class households with school-year children. Therefore, a questionnaire survey was conducted to a parent who came to pick up their child/ren at elementary, junior high and senior high schools in Bangkok (21 schools), Nakhon Pathom (9 schools), Nonthaburi (8 schools), Samut Prakan (7 schools), and Pathum Thani (8 schools). The survey was conducted from Nov. 1st to 20th, 2014. The questionnaire asks respondent's characteristics (age, gender, education, etc.,), household's characteristics (location of house, household income, tenure of a house, number of household member, age of household members, number of child, number of owned car, etc.,), respondents and his/her spouse's commuting transportation behavior, if they have jobs (location of work place, commuting mode, commuting time) and school-year children's commuting transportation behavior to school (location of school, transportation mode, transportation time, etc.,).

Totally, 204 samples were collected, but some data were missed in 19 samples, so 185 samples were the valid response. When a statistical population is more than one million, 384 samples are necessary for the 95% confidence interval. The registered population in Bangkok and its surrounding five provinces is about 10,650,000 (as of 2015), and the share of middle-income household (monthly household income is 15,001-50,000 Baht) is 54% in Greater Bangkok (Bangkok and surrounding five provinces)(Household socio-economic survey, 2009) and average household size is 2.7 in Bangkok and its vicinity respectively in 2010 (population and household senses). From these figures, the number of middle-class household in Bangkok and its vicinity is expected 2,130,000. According to the National Senses 2010, the share of the population from 7 to 22 years old in about 20% in Bangkok.

Therefore, the maximum estimation of middle-class households with school-year children is around 420,000 households. The required number of samples for the statistical population 420,000 is 385 for the 95% confidence interval and, by comparing this figure with our sample number, 185, the sample number might not be sufficient. Summary of socio-economic characteristics of respondents and their household is summarized in Table 1.

As the monthly income of a household in Greater Bangkok (Bangkok, Nonthaburi, Pathumthani and Samut Prakarn) is 35,004 Baht (WHO, 2011), almost all of the respondents can be categorized as middle class or upper than middle class. 96% of them graduate university or graduate school, so their education level is quite high. The age of respondents is 43.0 years old, so most of the respondents are middle age. An average number of children is 1.37 children, and the average number of household is 3.62 persons, so most of the respondents' families are nuclear families. Location of a house, work place and a school is summarized in Table 2. About 70 % of households lives in Bangkok and rest of them lives in Bangkok Vicinity.

Table 1. Socio economic characteristics of respondents

Sex	Age	Education
Male 44% Female 56%	20's 3% 30's 37% 40's 38% 50's 18% 60's- 3% Average=43.0 years old	High School 4% Undergraduate 58% Graduate 38%
Household Number 2 persons 2% 3 persons 59% 4 persons 23% 5 persons 10% 6 persons 3% 7 persons 2% 8 persons 1% Average=3.62 persons	**No. of Children** 1child 67% 2 children 24% 3 children 5% 4 children 1% Average=1.37 persons **Age of Children** 0-5 years old 28 persons 6-11 years old 85 persons 12-15 years old 47 persons 16-18 years old 43 persons 19 years old- 34 persons	**Occupation** Government officer 5% Office worker 62% Self-owned business 21 % Teacher 1% Profession 2% (ex. Lawyer, doctor, accountant) Housewife 3% Student 1% Retired 2% Other 3% No job 0%
Location of Residence Bangkok 69% Nonthaburi 12% Nakhon Pathom 1% Samut Prakarn 11% Samut Sakhon 0% Pathumthani 7% Other 1%	**House Ownership** Owner 73% Rental 7% Rental from parents/relatives 21% **Types of Residence** Detached house 54% Condominium 21% Town house 16% Shop house 9%	**Monthly Household Income** Less than 30,000THB 8% 30,000-Less than 40,000THB 3% 40,000-Less than 50,000THB 4% 50,000-Less than 60,000THB 15% 60,000-Less than 70,000THB 11% 70,000-Less than 80,000THB 10% 80,000-Less than 90,000THB 12% More than 90,000THB 36%

Table 2. Location of house, work place and school

	House	Work Place*	School
Province			
Bangkok	69%	84%	81%
Nonthaburi	12%	4%	4%
Nakhon Pathom	1%	0%	2%
Samut Prakarn	11%	8%	5%
Samut Sakhon	0%	0%	0%
Pathumthani	7%	2%	6%
Other	1%	2%	3%
Linear distance from city center (Silom station)			
0-5km*	7%	25%	28%
5-10km	29%	35%	25%
10-15km	11%	17%	17%
15-20km	16%	11%	8%
20-25km	12%	7%	8%
25-30km	12%	2%	6%
30km-	4%	3%	7%
Proximity of a station			
Within a radius of 1km	15%	33%	13%
Outside a radius of 1km	85%	67%	87%
Linear distance from a house			
0-5km		35%	39%
5-10km		18%	16%
10-15km		18%	16%
15-20km		9%	13%
20-25km		10%	6%
25-30km		5%	6%
30km-		5%	4%

* including 0km (work at home)

3. AUTOMOBILE OWNERSHIP AND TRANSPORTATION BEHAVIOR

3.1 Household Automobile Ownership

The number of owned automobiles is summarized in Table 2. Most of the households have at least one automobile, and about 60% of households have not less than two automobiles. Therefore, the households with children are considered to heavily depend on an automobile.

Table 3. Household automobile ownership

No. of automobile	No. oh household
0	4 (2%)
1	71 (38%)
2	70 (38%)
3	22 (12%)
4	12 (6%)
More than 5	6 (3%)
Average	1.93

3.2 Commuting Transportation Behavior

In this section, parents' and schoolchildren's commuting transportation behaviors are analyzed.

3.2.1 Parents' commuting transportation to work

(1) Workers' Commuting Transportation Mode
Figure 1 shows parents' commuting transportation mode, excluding parents who work at home and do not need to commute. In total, 79% commute by automobile, so it shows that middle-class people with children are heavily depend on an automobile in their commuting to work place. Mothers tend to be fellow passengers in automobile, and about 10% of automobiles is shared by parents.
Only 10% uses public transportation, such as urban rail transit (BTS/MRT/ARL), bus and rot-tu (van-style mini bus). Mothers tend to use more public transportation than fathers.
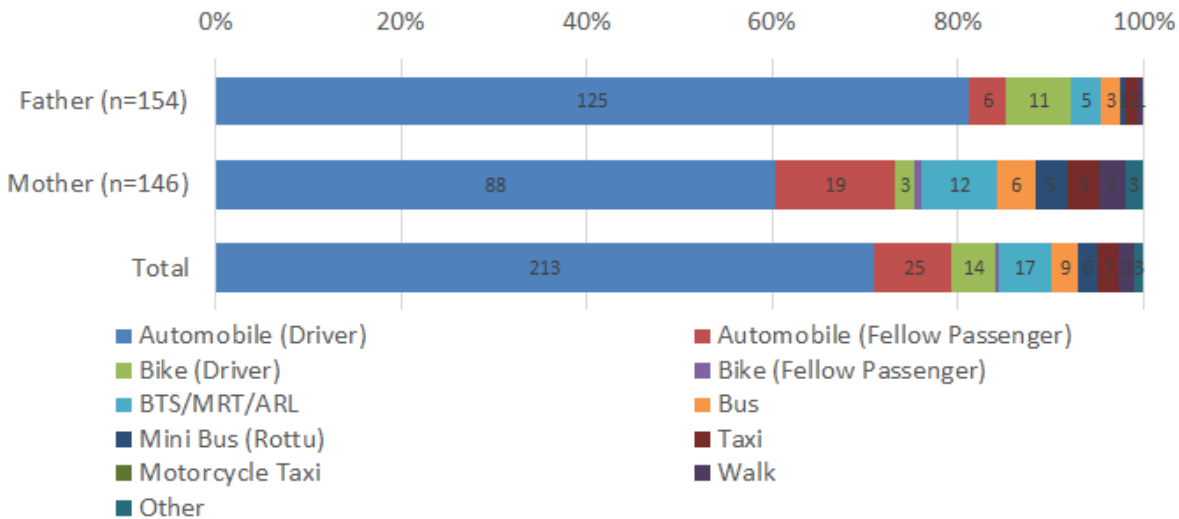

Figure 1. Commuting transportation mode to work

Parents' commuting time linear distance and time are summarized in Table 4. Their average linear commuting distance is 13.3km and commuting time is 43.5 min.. Fathers' commuting distance is longer than mothers' for 1.1km but their commuting time is almost same.

Table 4. Parents commuting distance and time

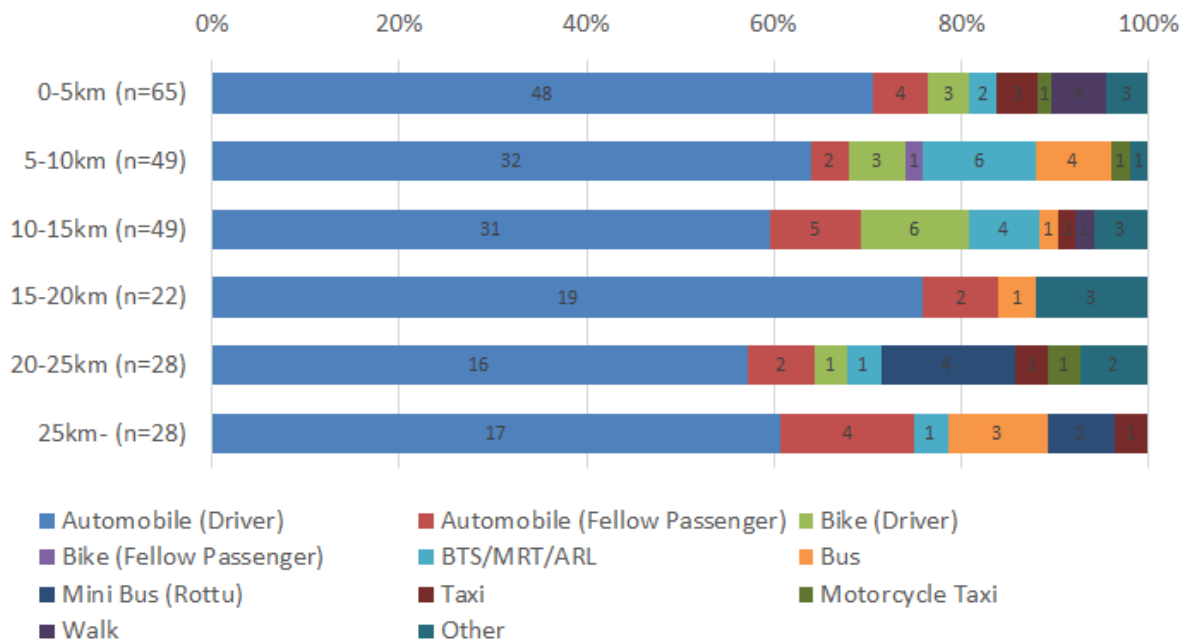|	Linear distance*	Commuting time* (one way.)
Father	13.8km (SD:17.3)	43.2 min. (SD:26.6)
Mother	12.7km (SD:10.2)	43.7 min. (SD:25.2)
Total	13.3km (SD:14.4)	43.5 min. (SD:26.0)

*Exclude parents who works at home

Figure 2. Linear commuting distance and transportation mode

The relationship between linear commuting distance and transportation mode is summarized in Figure 2. From this figure, a clear relationship between commuting distance and transportation mode can not be found. However, regarding public transportation, we can find a tendency that urban rail transit and bus are used for short, and medium-distance transportation and rot-tu is used for ling-distance transportation.

3.2.2 Children's commuting transportation to schools

(1) Children's commuting transportation mode

Figure 3 shows schoolchildren's commuting mode by generation and in total. Totally, about 58% of children goes to their school by automobiles, and only 23% use public transportation.

75% of elementary school students commute by automobiles and 13% by public transportation. Rates of automobile passengers in elementary school, junior high, school, high school and university are 75%, 56%, 45% and 33% respectively. The automobile dependence decrease as children get older. Rates of public transportation passengers in elementary school, junior high, school, high school and university are 13%, 32%, 34%, 20% respectively. The rate of public transportation passengers increases as children get older until high school. As university students have more variety of mode choice such as driving bike, so public transportation user rate is not so high.

Commuting distance has only slight difference between elementary school, junior high school and high school students but university students' commuting distance is much longer than lower schools as shown in Table 5. It means even in elementary school, children need to commute for long distance, In Bangkok, middle-class parents are very eager for their children's education, and many of them try to enter their children into 'big-name school', private schools, old public schools and university demonstration schools, etc., even though it locates far from their house.   Therefore, their commuting distance is long, and parents need to drive them to school.
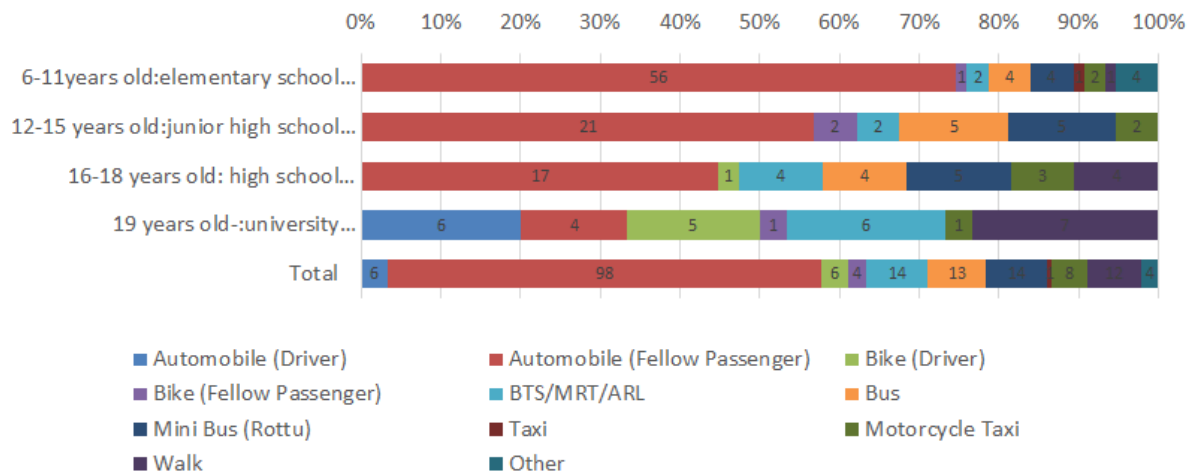
Figure 3. Age and transportation mode to school

Table 5. Average linear commuting distance (km)

Year/kind of school	Linear distance	Commuting time (one way.)
6-11years old: Elementary school	10.9km	29.3 min.
12-15 years old: Junior high school	10.3 km	32.9 min.
16-18 years old: High school	9.4 km	37.4 min.
Not younger than 19 years old: University/graduate school	16.5 km	40.3 min.

4. MODEL ESTIMATION

In this section, logistic regression is employed to identify affecting factors on household's car ownership, parents' commuting transportation mode to their work place and schoolchildren's commuting transportation mode to their schools. Table 7 shows variables that are included in the analyses. SPSS statistics 24 were used for the model estimation.

Table 7. Variables of models

Household Characteristics	
Household income	1=Less than 30,000THB 2=30,000-Less than 40,000THB 3=40,000-Less than 50,000THB 4=50,000-Less than 60,000THB 5=60,000-Less than 70,000THB 6=70,000-Less than 80,000THB 7=80,000-Less than 90,000THB 8=More than 90,000THB
Car number	1=1 car, 2=2cars, 3= not less than3 cars
Child number	persons
Car commute child	Does a household have children who commute to school by a car? 0=yes, 1=no
Individual characteristics	
Age	Age (years old)
Gender	0=male, 1=female
Location of a house	
Distance city-center house	Linear distance between city center (Silom station) and a house 1=0-5km 2=5-10km 3=10-15km 4=15-20km 5=20-25km 6=25-30km 7=30km-
Distance station house	Distance between the nearest station and a house 0=within 1km (catchment area) 1=further than 1km (not catchment area)
Location of Work place/school	
Distance house work	Linear distance between a house and work place (km)
Distance school work	Linear distance between a house and school (km)
Distance city-center work	Linear distance between city center (Silom station) and work place (km)
Distance city-center school	Linear distance between city center (Silom station) and a school (km)
Distance station work	Distance between the nearest station and work place 1=within 1km (catchment area) 2=further than 1km (not catchment area)
Distance station school	Distance between the nearest station and a school 1=within 1km (catchment area) 2=further than 1km (not catchment area)
Transportation mode	
Transportation mode	0=automobile, bike 1=public transportation (BTS/MRT/ARL, bus rot-tu)

(1) Factors influencing household car ownership

Ordered logistic regression is employed to analyze the relationship between household car ownership and household characteristics. The dependent variable is the number of owned car: 1=1 car, 2=2 cars and 3=not less than three cars. As household characteristics, child number, household income, distance between a house and city center, the distance between a house and the nearest station and the average parents' distance between work place and a house are

included as independent variables from Table 7. By using a stepwise method, the best set of predictors was finally found and summarized in Table 8.

Due to the magnitude of a coefficient, child number is the best predictor of household car ownership. As described in the previous chapter, more than half of schoolchildren are driven to their school by family members, if there are more than one children and their school locations are not close, the household needs to have plural automobiles.

The second best predictor is household income, and it has a positive impact on the number of owned cars. If a household can not afford to buy more than one car, they all family member who commute by automobile need to share one car, and a driver needs to stop several places to drop family member and should drive for a long distance until his/her work place. To avoid such situation, the higher income households have, the more automobile they purchase. Additionally, there is also the possibility that some high-income households have plural automobiles to show their socio-economic status.

Table 8. Model estimation of household car ownership

	Coefficient	Sig.		Odd Ratio
Child Number	.798	.012	**	15.90
Household income	.379	.000	***	2.22
Constant 1	2.767	.000	***	1.46
n				181
Cox & Snell R Square				.174
Nagelkerke R Square				.236
McFadden				.143
Threshold				2.767
Sig. of the regression				.000***

***p value<.01, **p value<05, *p value<.10

(2) Factors influencing parent's commuting transportation mode
Next, to analyze factors influencing parents' commuting transportation mode, especially auto (automobile and bike) or public transportation, binary logistic regression analysis was employed. The dependent variable is transportation mode: 0=auto, 1= public transportation. Parents who commute on foot or by taxi, motorcycle taxi or other mode are excluded from analysis. From Table 7, distance between a house and city center, distance between a house and the nearest station, distance between a house and work place, distance between a work place and city center, distance between a work place and the nearest station, gender, age, household's monthly income, existing of children commuting by a car, are used as independent variables. A stepwise method was used and finally, a set of three explanatory variables were found (Table 9).

The result shows that parents who have children who commute to schools by cars and whose work place is far from a station and whose household income is higher, tend to commute by automobiles. Due to the magnitude of a coefficient, we can say that children's transportation behavior affect parents' transportation behavior greater than parents' work place and household economic situation.

Table 9. Model estimation of commuting transportation mode

	Coefficient	Sig.		Odd Ratio
Car commute child	-2.143	.050	**	.117
Household income	-.315	.081	**	.730
Distance station work 12	-1.968	.013	**	.140
Constant	2.765	.091	**	15.874
n				370
-2 log Likelihood				52.875
Cox & Snell R Square				.127
Nagelkerke R Square				.301
% of Cases correctly predicted				92.2
Sig. of regression				.001**

***p value<.01, **p value<05, *p value<.10

(2) Factors influencing children's commuting transportation mode
Next, to analyze factors influencing children' commuting transportation mode, especially auto (automobile and bike) or public transportation, binary logistic regression was employed. The dependent variable is transportation mode that is 0=auto, 1=public transportation. Children who commute on foot or by taxi, motorcycle taxi or other mode are excluded from the analysis. From Table 7, age, distance between a house and a school, distance between a school and the nearest station, distance between a school and city center, distance between a house and city center, distance between a house and the nearest station and household income, are used as independent variables. By using a stepwise method, two variables are selected as the best set of predictors. The result is summarized in Table 10.

According to Table 10, children whose house is not in the catchment area of a station and who is younger tend to commute by automobiles. The magnitude of coefficient shows that effect of house location is greater than age. This result is consistent with Figure 3.

Table 10. Model estimation of children's commuting mode to school

	Coefficient	Sig.		Odd Ratio Exp(B)
Age	.094	.029	**	1.099
Distance station school	-.622	.013	**	.537
Constant	-.846	.268		.429
n				248
-2 log Likelihood				131.115
Cox & Snell R Square				.069
Nagelkerke R Square				.105
% of Cases correctly predicted				80.0
P value of regression				0.09*

***p value<.01, **p value<05, *p value<.10

5. CONCLUSION

This paper deals with transportation behavior of middle-class households with children in Bangkok and vicinity. A questionnaire survey was conducted, and 185 valid responses were collected. The result of the questionnaire survey, household car ownership, parents' commuting transportation mode and schoolchildren' commuting transportation mode are analyzed based on logistic regression model to identify affecting factors.

It is revealed that in Bangkok and vicinity, middle-class households with children are heavily depend on the automobile. The average number of owned car is 1.93, even though an average number of family member is only 3.62 persons. 79% of parents and 58% of children commute to their work places and schools respectively by automobile.

From the analysis, it is identified that child number in households, and household income affects the number of automobiles positively. Now Thailand is still developing its economy, and then middle-class households are expected to increase their income. Therefore, middle-class households have high possibility to increase their automobile shortly.

The analysis reveals that if there a child/ren who commutes to a school by an automobile and a work place is not in the catchment area of a station, more parent commute by automobiles. Regarding with children's commuting mode to school, children's age and location of their house, that is, their house is in the catchment area of a station, effect their public transportation ride. When children become university students, a variety of their transportation mode widens, and more children commute by public transportation.

To summarize, children's commuting transportation behavior effect both households' car ownership and parents' commuting transportation behavior. Especially, most of younger schoolchildren need to be driven to their school by family members and parents need to have more automobiles and commute by automobiles. When children grow up and change their commuting transportation mode to public transportation, parents can decrease their automobile dependency. One of the reasons that parents drive their children to schools is 'safety' (Bangkok Metropolitan Administration, 2001). To reduce elder children's automobile commuting, enhancement of security in public transportation and catchment area of stations and bus/rot-tu stops are required, and it leads to decrease of parents' automobile dependency.

As a locational relationship between a house and station effect children's transportation behavior, when a house is in the catchment area of a station, more elder children go to their school by public transportation, then more parents use public transportation on their commuting. Additionally, if parent' work place is in the catchment area of a station, more parents use public transportation. Therefore, locating houses and offices in the catchment area of a station is considered to be an effective way to decrease automobile dependency of middle-class households with children.

Now condominium developing along urban rail transit is booming in Bangkok (Chalermpong et al.:2011) but most of the units in the condominium is for a single or couple use because of the high land price. In 2016, a new urban rail transit line, MRT purple line started its operation, and it connects Bangkok and Nonthaburi province. It is the first urban rail transit to connect Bangkok, and other province and extension of the line are planned. There are plans to develop more urban rail transit in Bangkok and vicinity. This study reveals that distance of house from city center does not affect respondents' transportation behavior. Therefore, a housing development in proximity to a station in suburbs is expected to decrease automobile dependency of middle-class households with children.

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