Exploring the Effects of Household Structure on Elderly Grocery Shopping Behavior in Korea

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Traditionally, Koreans in their old age tend to reside with adult children and receive physical and psychological support from them. This feature may have positive effects on the quality of life for the elderly. However, recent official statistics show Korea's soaring elderly households residing without adult children, indicating a need to pay more attention to the effects of household structure on the elderly in order to improve the quality of life for the elderly. In this context, this study explored the effects of household structure on elderly grocery shopping behavior with a focus on grocery shopping frequency, accompanying behavior, and enjoyment with grocery shopping activities by estimating full structural equation models. In addition, aggregate urban modeling applications on the relationship between accessibility and trip/tour frequency commonly produce either non-significant or negative associations which violate the basic economic theory, that is, lower travel cost leads to more travel. We speculated that individuals' subjective satisfaction with activities could lead to such unreasonable results. Therefore, the other objective of this study is to identify the possible causes to lead the unreasonable relationship between accessibility and trip/tour frequency. First of all, a hypothesized single population model (using an entire survey dataset conducted in this study) was statistically tested by estimating a full structural equation model. Second, the entire survey dataset was segmented into four comparison groups by four dichotomous segmentation variables: co-residence with adult children, auto availability, presence of companions, and presence of daughters-in-law in the household. The results showed that co-residence with adult children and better family relationship significantly alleviate difficulties with elderly physical mobility and residential accessibility to grocery shopping places, consequently improving grocery shopping enjoyment of the elderly and then the quality of life for the elderly.

Key Words : elderly,household structure, accessibility,quality of life,grocery shopping

1. INTRODUCTION

Population aging has recently come to the fore as a prevalent social issue all over the world. The case of the Korean Society is not an exception in the world-wide phenomenon. However, there are two distinct differences in Korea as compared with other countries. One of the major differences is the intensity of aging as a result of a very low fertility rate (1.23 for Korea in 2010, 1.87 for France, 2.07 for U.S. 1.37 for Japan). According to the official population projections[1], the elderly population (defined as 65 and older) will reach 14% (aged society) of the national population in 2018, only 18 years after it first exceeded 7% (aging society) in 2000. It took France 115 years and the U.S. 73 years to go from an aging society to an aged society; it took Japan 26 years for this change. The other major difference is that Korea has a traditional custom where adult children live with and support their old parents. As a result, despite the rapid population aging, the associated problems with population aging have not been frequently observed and consequently, the issue of aging has not received enough attention from the

Korean society. Recently, however, the trend of living with their old parents has been rapidly decreasing, probably due to a low fertility rate, rapid industrialization, and the influence of Western culture. According to the "2008 Social Survey"[2] in Korea, 55% of household heads in 1998 were living with their parents when one of their parents was still alive and it had dropped to 37% in 2008. From these changes over the last 10 years, it is clear that elderly singles (residing alone) and couples (residing with spouse) who cannot receive support from their adult children will proliferate. In other words, more elderly people will need to do their out-of-home household maintenance tasks for themselves regardless of whether they like them or not. Consequently, the increasing unwanted out-of-home activities will lower the quality of life for the elderly. In this context, this study aims to explore the effects of household structure in Korea on elderly grocery shopping behavior and their satisfaction. Grocery shopping was focused because it is a typical out-of-home household maintenance task of the elderly in everyday life. In addition, Ortúzar and Willumsen[3] pointed out that empirical aggregate urban modeling applications commonly produce either non-significant or negative relationships between accessibility and trip frequency which, in a sense, violates the basic economic theory, that is, lower travel cost leads to more travel. We speculated that individuals' satisfaction level with activities could lead to such unreasonable results. Therefore, the other objective of this study is to identify the possible causes to lead the unreasonable relationship between accessibility and trip frequency.

The remainder of this paper is organized as follows: the following section briefly summarizes previous studies on the relationship between accessibility and trip/tour frequency. The third section provides an overview of the survey design, including the context of grocery shopping in Korea, survey area, and survey contents. The fourth section analyzes the original survey data using basic descriptive analysis methods focusing on grocery shopping frequencies, accompanying persons with the elderly, and enjoyment level of elderly grocery shopping. In the fifth section, the theoretical methodology of structural equation modeling and model specification are briefly described. In the sixth section, the estimation results of baseline model are first provided and then the elderly respondents are segmented into four paired comparison groups by four dichotomous segmentation variables. Each paired-comparison group is compared through modeling the groups separately. In the final section, the conclusions, limitations, and future directions are discussed.

2. LITERATURE REVIEW

Improving accessibility is a common element in the goals of almost all transportation plans[4]. Consequently, many researchers have used many different forms of accessibility measures and have raised many important issues about those measures[5]. Accessibility can be defined in several ways. Dalvi and Martin[6] defined it as 'the ease with which any land-use activity can be reached from a location using a particular transport system' and Burns[7] defined it as 'the freedom of individuals to decide whether or not to participate in different activities under space-time constraints'. According to a literature review on accessibility measures by Geurs and van Wee[8], most accessibility measures are composed of four types of major components; land-use, transportation, temporal and individual. In other words, most of the studies in this field commonly ignore the impacts of household structure and subjective satisfaction with activities when considering accessibiliy measures.

As the definitions of accessibility suggests, accessibility measures have been widely used to probe into the relationship between land use and activity participation with a common hypothesis "greater accessibility leads to more travel"[9]. However, interestingly, some studies showed inconsistent findings with the common hypothesis. For example, Handy[10] showed that accessibility does not affect the frequency of shopping trips and Kitamura et al.[11] showed that accessibility is not significantly or positively related to the total number of trips and tours. In the case of aggregate modeling applications, many researchers and practitioners have attempted to incorporate a measure of accessibility into trip generation models, generally in order to consider changes to the network/land-use and induced travel demand. One of the earliest examples in this field could be the work of Nakkash and Grecco[12]. Their results showed statistically significant effects (positive) of accessibility only on school trip production and attraction; accessibility measures were not significant in most trip generation equations. Ortúzar and Willumsen[3] also pointed out that empirical aggregate urban modeling applications commonly produce either non-significant or negative (wrong sign) relationships between accessibility and trip frequency. For this reason, many practiconers rarely incorporate a measure of accessibility into trip/tour generation models for induced demand consideration.

In addition, Smith[13] showed that the elderly who have access to auto service are frequently willing to bypass local grocery stores to patronize large-scale retail stores. This implies that the more mobile el-

derly's choice of grocery shopping is not merely dependent on accessibility factors, but also on product selection, price level, and various outlet characteristics. This bypass phenomenon might also lead to a biased relationship between accessibility and grocery shopping frequency.

3. MAJOR GROCERY SHOPPING PLACES AND STUDY AREA

(1) Three major grocery shopping places

This subsection briefly describes the characteristics of three major shopping places in order to give the reader a broad understanding of the context of grocery shopping in Korea. There are three major grocery shopping places: discount store, traditional market, and small supermarket.

The first major shopping place is large-scale retail stores (also called discount stores). Since 1996 in Korea, discount stores have become the most attractive grocery shopping place to Korean consumers because of lower prices and wider variety of products[14]. In this place, wide varieties of products are available in a single location and most of consumers purchase groceries in bulk because of bulk purchase discounts. Each town has usually one or two discount stores, thus compared to other smaller grocery stores, discount stores are relatively far away from residential areas that results in requiring private motor vehicles for consumers to bring groceries into their home.

The second major shopping place is traditional markets. The traditional markets can be divided into traditional permanent market and traditional road market. The two markets are very similar in available products and relative locations and both of them sell groceries piece by piece, thus we did not differentiate between the two traditional markets. Compared to discount stores, these markets are relatively close to residential areas. The permanent one is generally located near detached housing districts rather than apartment complexes and open almost every day while road markets are open 2-3 times a week near the entrance of each apartment complex. Therefore, the residents living in detached housing districts tend to use the permanent market while apartment residents tend to use the road markets. Both of markets are located very near to the home, so most of them visit them by walk.

The third major shopping place is small supermarkets (similar to convenience stores). One or two small supermarkets are located inside each apartment complex and also located inside each detached housing district (the nearest place from the home).

These grocery stores provide very limited varieties of groceries, thus usually the purpose of these stores is to supplement the discount stores and traditional markets.

(2) Study area

Sanbon was decided as a study area for this study (shown in **Fig.1**). Sanbon is one of the first planned towns constructed in the early 1990s located in Gunpo city, a satellite city of Seoul in Gyeonggi province. This town is located about 50 minutes south of the city center (around City Hall) of Seoul by railway being nested at the base of a mountain range with one large-scale discount store (called E-Mart) in the central area. There are two major reasons to select this town for this study. The first reason is that it is surrounded by mountains, railways, and high-level roads, meaning that it is relatively independent of neighboring areas, especially in terms of grocery shopping. These physical features narrow down the possible grocery shopping places for the elderly to be considered. Second, it is a planned town and most of the residents live in an apartment. The apartment complexes are similar in scale each other (about 300X300m), separated by road network and has at least one small supermarket in the central of each complex. Furthermore, traditional road markets are open 2-3 times a week around the entrance of each apartment complex. In other words, each resident has almost the same number of opportunities for grocery shopping and the distances to the traditional road market and small supermarket from each residence are also very similar each other (no variation in accessibility). A considerable difference is only the distance (accessibility) to the discount store from their houses. These features of the town reduce the modeling efforts and also make the results more reliable.

In terms of survey locations, there are 34 senior centers in this area and at least one senior center is located in the central area of each apartment complex. All of these senior centers were visited and only the elderly (aged 65 or over) were surveyed. In addition, on the streets around the senior centers, dis-
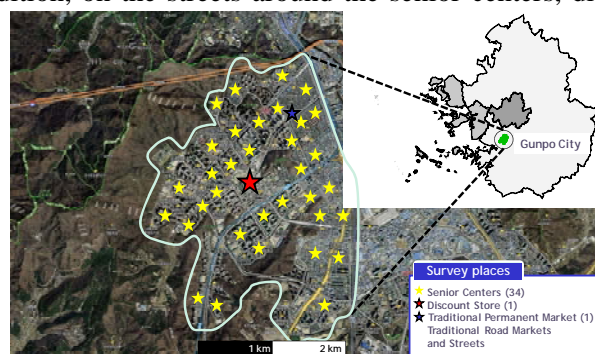

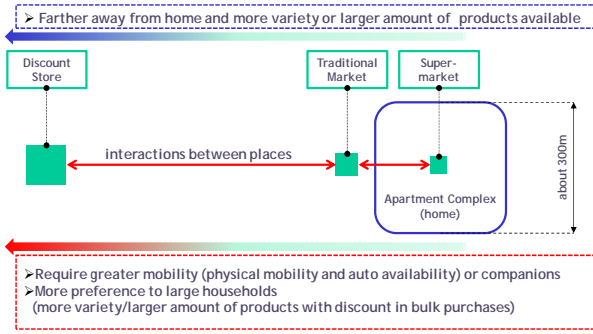
Fig.1 Survey Loactions.

Fig.2 Relative locations of major shopping places.

count store, and traditional markets (both permanent and road markets), the elderly were surveyed.

(3) Grocery shopping places in the study area

Fig.2 describes the relative locations of the three major shopping places in the study area. As explained in the previous subsection, the discount store is located farthest away from home, followed by the traditional market and then the small supermarket. Because of the characteristics of discount stores (e.g. far away from home and sell in bulk), large households (HHs) or auto available HHs tend to prefer the discount store to traditional market and small super market. Additionally, this study hypothesized that the required total amounts of HH groceries are relatively fixed, thus the interactions among the three major shopping places will be considered and also verified in the modeling procesure.

Unlike the discount store, the other two places are very close to home and accessibility to each shopping place is almost the same for every resident, thus there is no significant variation of accessibility: hence, we did not consider accessibility to the two places in modeling process.

(4) Survey questionnaire and implementation

Seven types of survey questions were determined and **Table 1** summarizes the questionnaire survey. The target population of this study is the elderly who is aged 65 or older. In general, the elderly are expected to have some difficulties in understanding survey questionnaire compared to the general population. Therefore, face-to-face interview was considered the most suitable for this study rather than self-administered survey methods using mail or the internet. As shown in **Table 2**, the total sample size is 304 and male elders are a little under-represented compared to 2010 population census data (sample: 74.0, census: 73.3)[1]. About 63% of the respondents answered they have some difficulties with walking (the respondents were asked to report their walking difficulty (3-point scale) when they walk 100 meters: e.g., 1. Very hard, 2. A little hard, 3. No Problem).

Table 1 Attributes of the original survey.

Question Type	Question Attributes
Companion	With whom, by what mode, and where the elderly go grocery shopping
Enjoyment of Grocery Shopping	Enjoyment level of each grocery shopping place (9-point scale), whether or not they stay longer after shopping, tendency of meeting friends/neighbors while shopping, whether or not enjoy watching street scenes/people while traveling, tendency of bargaining and conversation with store clerks/owners
Grocery Shopping Frequency	Monthly grocery shopping frequencies for each shopping places, travel mode, travel time, staying time at shopping places, desire to increase the frequency of grocery shopping, preference of delivery service
Family Relationship (including both in-home activity and family closeness)	Tendency of adult children reporting their out-of-home activities (where, what purpose, expected time to return home), with whom they have each meal, conversation time with each household member
Household/ Individual Characteristics	Walkability (3-point scale), age, sex, driving license, job, auto availability (3-point scale), grocery shopping participation level (3-point scale), holidays, working hours of all household members, monthly household income, individual income, household size, household address
Leisure time	Weekly leisure times (classified into 7 types of leisure activities), no. of friends/neighbors/relatives living near their house, the frequency of meeting friends/neighbors/relatives
Life Satisfaction	Satisfaction level of respondent's current life (9-point scale)

4. DESCRIPTIVE ANALYSIS

Before modeling process, the survey data was analyzed using cross-tabulations with a focus on frequency, accompanying behavior and enjoyment of

Table 2 Elderly sample size.

HH Type	No. of Respondents	HH Size	Average Age	% of Workers
Single	82	1.0	76.0	5%
Couple	103	2.0	72.8	6%
Multi	119	3.8	73.7	4%
Total	304	2.4	74.0	5%

Note: 1) "single" indicates elders living alone

2) "Couple" indicates elders living with spouse

3) "Multi" indiciates elders living with adult children

grocery shopping. The analysis shows the impacts of many variables are strongly interrelated, thus their different impacts cannot meaningfully be interpreted separately. Hence, structural equation modeling was deemed the best appropriate method for this study.

(1) Participation level of grocery shopping

Grocery shopping is a typical traditional role of wives and daughters-in-law in Korea. To confirm this traditional role, the respondents were asked to rate the grocery shopping participation level of all household members (3-point scale). **Table 3** shows the typical traditional role of wives and daughters-in-law. In the couple HHs, 92.2% of elderly females answered their grocery shopping participation level is very high while 51.4% of elderly females and 87.8% of daughters-in-law answered very high in multi-generational HHs. Interesting point is, although single elderly people do not have anybody to do grocery shopping for them, only 87.5% of elderly males and 75.8% of elderly females answered it is very high, not 100%. The majority of the elderly, who answered not very high, replied that their children living near to the elderly regularly do grocery shopping for them, so they do not need to go grocery shopping or just sometimes they go grocery shopping when they run out of some particular groceries before their children' next grocery shopping time. Just a couple of people answered their neighborhoods or friends do shopping for them due to their physical mobility problems. In the original survey, the respondents were asked to report how many relatives they have who they frequently see or have contact with, living near his/her home inside the town. Although the exact locations of their close relatives were not collected, it can be inferred that the elderly and their relatives (the majority of them are their adult

Table 3 Participation level of grocery shopping by HH type.

HH Type	Participation Level	Elderly Males	Elderly Females	Adult Children	Daughters-In-Law
Single	Never	6.3%	1.5%	-	-
	Medium	6.3%	22.7%	-	-
	Very High	87.5%	75.8%	-	-
	Total	100%	100%	-	-
Couple	Never	37.9%	2.9%	-	-
	Medium	42.7%	4.9%	-	-
	Very High	19.4%	92.2%	-	-
	Total	100%	100%	-	-
Multi	Never	40.4%	11.4%	52.6%	4.1%
	Medium	53.2%	37.1%	28.1%	8.1%
	Very High	6.4%	51.4%	19.3%	87.8%
	Total	100%	100%	100%	100%

Note: "Multi" indicates multi-generational HHs living with adult children

Table 4 Participation level of grocery shopping by presence of relatives.

HH Type	Participation Level	Not Have Close Relatives	Has Close Relatives
Single	Never	2.2%	2.8%
	Medium	6.5%	**36.1%**
	Very High	91.3%	**61.1%**
	Total	100%	100%
Couple	Never	23.5%	17.6%
	Medium	19.4%	**27.8%**
	Very High	57.1%	**54.6%**
	Total	100%	100%
Multi	Never	22.1%	17.5%
	Medium	40.0%	45.6%
	Very High	37.9%	36.8%
	Total	100%	100%

children) live very close by, mostly within 2 kilometers because the radius of the city is about 2 kilometers.

As shown in **Table 4**, about half of the elderly answered that their close relatives live near their houses and when they have close relatives, their participation levels become lower than their counterparts. For example, only 61.1% of singles who have close relatives answered very high while 91.3% of singles who have no close relatives was very high. However, the levels of couple and multi-generational elderly are not very different from their counterparts although the level of couples is slightly lower than their counterparts. These informations show that HH members do not evenly share grocery shopping tasks and the presence/absence of daughters-in-law and close relatives are considerable determinants of elderly grocery shopping needs as well as gender difference. These findings of this subsection were considered in the modeling process. For example, only the HH members who participate in grocery shopping were taken into account in calculating the available times of other HH members for grocery shopping.

(2) Grocery shopping frequency

Although the majority of the elderly do not drive (only 8% of the elderly answered they drive in the survey), auto service is available to many of the elderly, usually from their children. Hence, when auto is available to either the elderly or their grocery shopping companions, it was considered "auto service available" to the elderly in this study. **Table 5** shows the impact of auto service availability on elderly grocery shopping frequencies. It seems that there is no significant difference in the discount store frequency by auto service availability in single and

Table 5 Monthly frequencies by HH type and auto service availability.

HH Type	Elderly Auto Service Availability	Distance to D.S. (meters)	D.S. Freq.	T.M. Freq.	S.S. Freq.
Single	Not Available	1,520	1.67 (25%)	2.74 (57%)	4.42 (57%)
	Available	2,343	1.50 (83%)	4.00 (83%)	5.67 (67%)
Couple	Not Available	1,518	3.34 (43%)	2.62 (43%)	5.10 (57%)
	Available	1,927	3.33 (95%)	0.90 (24%)	8.38 (76%)
Multi	Not Available	1,694	2.06 (31%)	3.27 (41%)	4.04 (45%)
	Available	1,688	3.20 (98%)	1.39 (39%)	7.78 (77%)

Note: 1) Values in parentheses are the percentage of respondents who use corresponding shopping place
2) D.S.: discount store, T.M.: traditional market, S.S.: small supermarket

couple HHs while there is considerable difference in multi-generational HHs. The reason could be that auto service available single and couple respondents live farther away from the discount store than their counterparts. However, there is no significant difference in the distance to the discount store between multi-generational respondents. This distance difference to the discount store might have caused this peculiar result. In order to verify this speculation, the impact of distance to the discount store (D.S.) from home was analyzed in **Table 6**. As expected, the D.S. frequency decreases with the increase of the distance when auto service is not available. However, inversely, when auto service is available, the D.S. frequency increases. This could be explained by the difference of the number of auto available adult

Table 6 Grocery shopping frequencies by auto availability and distance to D.S..

Elderly Auto Service Availability	Distance to D.S. (meters)	D.S. Freq.	T.M. Freq.	S.S. Freq.	No. of Auto Available Children
Not Available	290-1000	**3.85**	2.20	3.68	0.20
	1000-2000	**1.76**	2.77	5.48	0.32
	2000-3450	**1.60**	3.75	4.16	0.26
Available	290-1000	**2.42**	0.67	8.33	**1.00**
	1000-2000	**2.82**	1.06	10.39	**0.89**
	2000-3450	**3.83**	2.48	3.74	**0.65**

Note: 1) When the elderly drives or his/her shopping companions drive, it is defined "auto service available" to the elderly
2) "Auto available children" are who drive and also participate in grocery shopping in the household

Table 7 Grocery shopping frequencies by walkability.

Walkability	Distance to D.S. (meters)	D.S. Freq.	T.M. Freq.	S.S. Freq.	Total Freq.
Very Hard	1,421	**1.81 (31%)**	2.24 (53%)	3.13 (50%)	7.18
A Little Hard	1,660	**1.89 (44%)**	2.78 (45%)	6.46 (72%)	11.14
No Problem	1,714	**3.70 (60%)**	2.47 (39%)	5.04 (39%)	11.21

Note: Values in parentheses are the percentage of respondents who use corresponding shopping place

children in the HH. For example, the respondents who live less than 1 km away from the discount store live with 1.0 auto available children while the respondents who live greater than 2 km away live with 0.65 auto available adult-children. In other words, the auto available children reduce the need of elderly grocery shopping at the D.S..

Table 7 shows the impact of walkability on the frequency. Only the D.S. frequency increases with elderly walkability while traditional market (T.M.) and small supermarket (S.S.) frequencies seem to be not associated with individual walkability: probably, because the distances to traditional markets and small supermarkets are very close to home.

(3) Grocery shopping accompanying behavior

Table 8 shows shopping companions of the elderly by HH type and shopping place. In single/couple HHs, many elders are accompanied by adult children even though they do not live together in the same HH because their children live around home. Shopping at the D.S. usually requires companions because it is relatively far away from home and also need to bring large amount of groceries (sell in bulk) compared to the T.M. and S.S. (the need of companions is different by shopping place). As a result, the percentage of the elderly shopping with children at the D.S. is the highest, followed by T.M.

Table 8 Companions by shopping place.

HH Type	Companions	D.S.	T.M.	S.S.
Single	Alone	75%	88%	94%
	Children	**17%**	**8%**	**6%**
	Friends	8%	4%	0%
Couple	Alone	20%	53%	73%
	Spouse	56%	35%	24%
	Children	**22%**	**5%**	**3%**
	Friends	2%	8%	0%
Multi	Alone	22%	58%	71%
	Spouse	8%	8%	3%
	Children	**66%**	**33%**	**26%**
	Friends	5%	0%	0%

Table 9 Impact of conversation time on companionship with a spouse (when living with a spouse).

Shopping Place	Companions	Spouse Chat
D.S.	Spouse	**44 min./day**
	Without Spouse	32 min./day
T.M.	Spouse	**47 min./day**
	Without Spouse	29 min./day
S.S.	Spouse	**41 min./day**
	Without Spouse	34 min./day

Table 10 Impact of conversation time on companionship with children (when living with children).

Shopping Place	Companions	Children Chat	Children Available Time
D.S.	Children	**48 min./day**	**10 hrs/day**
	Without Children	27 min./day	5 hrs/day
T.M.	Children	28 min./day	**13 hrs/day**
	Without Children	**35 min./day**	7 hrs/day
S.S.	Children	**43 min./day**	**18 hrs/day**
	Without Children	38 min./day	17 hrs/day

Note: Children available time (for grocery shopping) was calculated using children working hours in the HHs and each shopping place's opening hours: D.S. 10-24, T.M. 8-22, S.S. 8-24

and then S.S. regardless of HH type.

The closeness among possible companions will also probably influence the accompanying behavior. As a proxy of closeness, conversation time with family was used as shown in **Table 9** and **Table 10**. In **Table 9**, when elderly couples answered they go shopping, their conversation time is longer than their counterparts regardless of shopping places. On the other hand, only in the discount store, longer conversation time with children seems to be positively associated with elderly accompanying tendency. In the T.M., longer available time of children seems to be more associated with elderly accompanying tendency rather than conversation time.

(4) Grocery shopping enjoyment level

In the original survey, the respondents were asked to rate their enjoyment level of grocery shopping on a 0 to 9 scale for each shopping place. In the survey, the term "enjoyment" was used rather than "satisfaction" because people generally tend to judge the level of satisfaction in comparison with peer groups rather than in absolute levels[15]. On a cardinal utility scale, 5 can be thought of as equivalent to a zero point, with higher numbers being positive and lower numbers negative. In this sense, 13.3%, 25.0%, and 25.5% (in the order of D.S., T.M., and S.S.) of respondents rated as a negative on grocery shopping

and 49.7%, 42.6%, and 26.7% of respondents rated as a positive. In other words, although grocery shopping is generally seen as an unpleasing activity which individuals do not receive positive utility, but many elderly people receive positive utility from grocery shopping; in a sense, it could be a leisure activity for the elderly under certain conditions. Therefore, it is important to understand what factors make the elderly satisfy with grocery shopping which is focused in this subsection. One of hypotheses is "The elderly can obtain utility not only while shopping but also after shopping such as from eating meals, additionally depending on with whom they have meals including their closeness". Consequently, this subsection considers the possible factors both while shopping and after shopping.

One of factors to affect the enjoyment level of grocery shopping might be the walkability of the elderly because better walkability alleviates the difficulties of traveling and bringing groceries into the home. As shown in **Fig.3**, elderly walkability seems to be positively associated with enjoyment level, but not significantly associated with travel time in **Table 11** (even though it was divided by travel mode, it was not significant), probably because traditional market and small supermarket are very close to home. As for discount store, the distance to discount store is, in a sense, not extremely far (average distance is 1.61 km) and many of people use a car with companions.

From the perspective of obtaining utility after shopping, the impacts of family relationship variables were tested. To reflect the family relationship, four variables were selected: the number of having meals with family members, conversation time with a spouse and children, and tendency of adult children reporting their out-of-home activities. As shown in
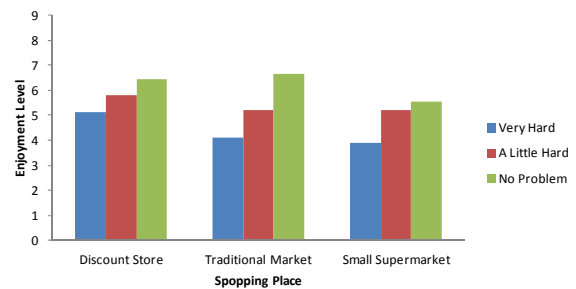

Fig.3 Impact of walkability on grocery shopping enjoyment.

Table 11 Correlations between travel time and enjoyment.

Shopping Place	Enjoyment of D.S.	Enjoyment of T.M.	Enjoyment of S.S.
Travel Time to Shopping Place	0.040 (0.552)	0.055 (0.416)	0.033 (0.600)

Note: 1) Kendall's Tau-b Rank Correlation was used
2) Values in parentheses indicate significance level

Table 12 Correlations between family relationship and enjoyment.

	Enjoyment of D.S.	Enjoyment of T.M.	Enjoyment of S.S.
No. of Meals Having Together	0.046 (0.509)	**0.146 (0.039)**	**0.135 (0.036)**
Spouse Chat Time	0.063 (0.356)	0.132 (0.062)	**0.168 (0.008)**
Children Chat Time	**0.159 (0.018)**	**0.184 (0.008)**	0.101 (0.109)
Children Report	0.005 (0.962)	0.213 (0.088)	0.352 (0.352)

Note: 1) Kendall's Tau-b Rank Correlation was used
2) Values in parentheses indicates significance level and bolding indicates a significant coefficient at a 95% level of confidence

Table 12, family relationship variables seem to be positively associated with enjoyment level, supporting our hypothesis. This result is partially consistent with the argument of Thomas Juster[16] who argued that "Consumers do not generally get utility directly from any of goods and services purchased in the market, but utility is obtained directly from activities like eating meals". In addition, this analysis also confirmed that being accompanied by others and better mobility can alleviate the difficulties of traveling (accessibility impact) and bringing groceries into the home and also improve their enjoyment level.

(5) Elderly leisure activities

This subsection analyzes weekly leisure time use of the elderly and the impact of leisure time on life satisfaction level. The majority of current Korean elderly people are very poor because they couldn't afford to prepare for their old age in their young age due to the responsibility caring for both their old parents and their children. In the original survey, 38% of elderly answered "No Income" & 40% "0-500,000 Won": Korean minimum wage is about 1 million Won as of 2011. As a result, the majority of the current elderly do not have enough disposable income for leisure activities and leisure service providers are also not interested in the elderly because It is hard to get investment returns. Therefore, the majority of the elderly are spending time in senior centers or on the streets sitting on the bench or strolling (it is nearby and free).

In terms of elderly grocery shopping benefits, several previous studies[17, 18] outside Korea showed that grocery shopping gives a level of social interaction between shop employees and other customers. Hence, the original survey included the tendency to talk with shop employees and close neighbors and to meet close neighbors/relatives at shopping places in order to capture the effect of social interaction (talking with and meeting others while shopping) on elderly grocery shopping enjoyment. However, no considerable impacts of social interaction (while shopping) on grocery shopping enjoyment were found although in-home activities had considerable impacts on it. This means that social interactions while shopping are not a good indicator to explain the benefit of social interaction for Korean elderly people. The possible reason might be that the Korean elderly can easily meet other people at nearby senior centers and on the street and talk with them (even with strangers) because they are very open to strangers. In other words, they do not lack of social interaction with other people outside family and this contextual specificity of the Korean elderly caused the inconsistent results with those of other countries' studies, indicating a need to consider the contextual specificity across countries.

Before analyzing elderly leisure activity behavior, it is necessary to differentiate between leisure time at senior centers or on the streets and the other leisure activities because of several differences between them. For example, the leisure activities at senior centers or on the streets are free and it is very near to the home (every apartment complex has at least one senior center) while other leisure activities generally cost (e.g., traffic fare, entry fee, etc.) and require better mobility than its counterpart. Therefore, leisure time was classified into two types, neighborhood leisure time and distant leisure time. As shown in **Table 13**, the in-home activities (Spouse Chat Time, Children Chat Time, and Meals with Family) are positively correlated with leisure time. Additionally, as expected, walkability is positively correlated with distant leisure time while it is negatively correlated with neighborhood leisure time. This might mean that the elderly prefer distant leisure activities, but

Table 13 Correlations between leisure time and in-home activities/walkability.

	Spouse Chat Time	Children Chat Time	Meals with Family	Walkability
Neighborhood Leisure Time	-0.207 (0.000)	-0.167 (0.004)	-0.186 (0.001)	-0.053 (0.250)
Distant Leisure Time	0.074 (0.198)	0.176 (0.002)	0.027 (0.642)	0.147 (0.004)

Note: 1) Neighborhood leisure time includes leisure activities at senior center and strolling
2) Distant leisure time includes all leisure activities except for neighborhood leisure time
3) Pearson Linear Correlation was used except for Walkability (Kendall's Tau-b Rank Correlation)
4) Values in parentheses are significance levels

Table 14 Correlations between leisure time and in-home activities/walkability.

Neighbor-hood Leisure Time	Distant Leisure Time	Enjoyment of D.S.	Enjoyment of T.M.	Enjoyment of S.S.
-0.063 (0.143)	0.244 (0.000)	0.365 (0.000)	0.489 (0.000)	0.328 (0.000)
Walkabil-ity	Spouse Chat Time	Children Chat Time	Children Report	Meals with Family
0.342 (0.000)	0.107 (0.023)	0.212 (0.000)	0.166 (0.035)	0.180 (0.000)

Note: Kendall's Tau-b Rank Correlation was used and values in parentheses are significance levels

they tend to give them up and spend more time in senior centers or on the streets as their physical mobility deteriorates with age.

Additionally, the elderly were asked to rate their current life satisfaction level on 9-point Likert scale. Despite its popularity as an endpoint in the evaluation of public policy, quality of life (QOL) is a multi-dimensional and amorphous concept making it difficult to measure[19]. This study does not aim to explicitly measure QOL indicators, rather to identify the contributions of grocery shopping and leisure activities to the quality of elderlylife. In the literature on QOL, good health, functional ability, social participation, social networks, social support and level of income have often been reported to be significantly associated with the quality of life in older age[19]. Based on the findings in the literature, this subsection tested the correlations with leisure time, enjoyment level of grocery shopping, household income, walkability, conversations times, and family absence time as shown in **Table 14**. As expected, most of variables are reasonably associated with elderly life satisfaction. However, neighborhood leisure time is negatively correlated while distant leisure time is positively correlated. This might mean that the majority of the elderly do not consider neighborhood leisure activities as pleasing leisure activities.

5. METHODOLGY

(1) Structural equation model

Structural equation model (SEM) is a set of simultaneous equations, resulting in strength in modeling interaction and causal relationship between variables, thus this method was applied in order to capture the intra/inter-household interactions and inter-shopping interactions. SEM consists of two components: a measurement model depicting the links between the latent variables and their observed measures (indicators) and a structural model depicting the links among the latent variables themselves. SEM without the structural model is called confirmatory factor analytic (CFA) model and when both models are included, it is called full latent variable (LV) model (or full structural equation model) because it allows for the specification of regression structure among the latent variables[20]. This study used the full structural equation model to examine the causal relationship between the two latent variables, enjoyment level of grocery shopping and companionship. In the measurement model, one thing to be noted is that the indicators should be internally consistent as a set, meaning that their inter-correlations should be positive[21]. The indicators of the two latent variables in this study met this condition, that is, positively inter-correlated.

(2) Conceptual model structure

The conceptual model structure is illustrated in **Fig.4**. First of all, it was hypothesized that the frequencies of each shopping place, accompanying persons with the elderly, and the out-of-home leisure are influenced by household and individual characteristics. Once the total need of elderly grocery shopping is determined by their own household and individual conditions, they assign the fixed need of grocery shopping to each shopping place considering their own conditions and the characteristics of each shopping place. For example, D.S. is relatively far away from home (accessibility) and requires better individual mobility (auto availability and physical mobility), that is, both the accessibility to the D.S. and individual mobility matter to the elderly. On the other hand, other places are very close to home and accessibility to each shopping place is almost the same for every resident, thus there is no large variation of accessibility effects when considering to use the T.M. and S.S.. In other words, the effects of accessibility and mobility vary by shopping place. Additionally, the amount of groceries purchased at
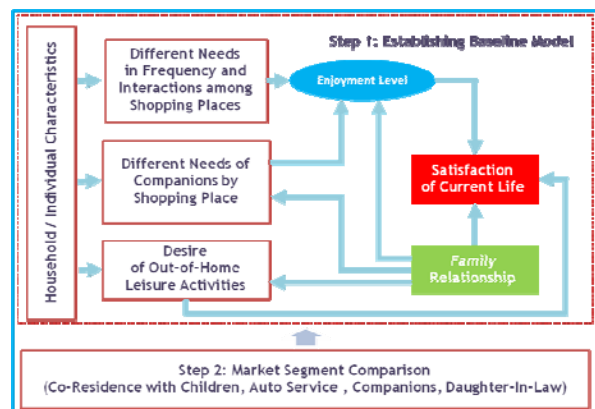

Fig.4 Conceptual model structure.

one place reduces the needs of grocery shopping at the other shopping places (trade-offs) because the total need of grocery shopping is relatively fixed. Therefore, the model hypothesizes that the frequency of D.S. is first determined considering both accessibility and mobility, and then the frequency of traditional market is determined because it is farther away than the S.S. (requires better mobility). Sequentially, the S.M. is determined considering the reduced need of grocery shopping by the pre-determined frequencies of D.S. and T.M.. This mechanism will be tested statistically by estimating a structural equations model system.

Accompanying behavior, whether to go out alone or with companions, is not only the outcome of individual decision but also the interplay between the individual and the companions. For this reason, many studies[22-25] have focused on the interactions between HH members. However, most of them did not give much attention to the different needs of companions by activity place and their psychological closeness among companions. This conceptual model structure considers the different needs of companions by activity place and also the psychological closeness (family relationship). For example, when they go to the S.S., generally both the individual and his/her possible companions do not think that it is much helpful for the individual if he/she is accompanied by others because it is very near and the amount of groceries to carry is very small. On the other hand, when they go to the D.S., both of them know it must be helpful if the elderly is accompanied by other members. In addition, many of adult children live near to their old parents and tend to support them regularly. Therefore, this conceptual model structure takes into account the effects of the in-

Table 15 Variables and descriptions.

Variables	Descriptions
Companionship Variables	
Companionship (latent variable)	Overall companionship in elderly grocery shopping
Companion of D.S.	1 if accompanied by someone for D.S.; 0 others
Companion of T.M.	1 if accompanied by someone for T.M.; 0 others
Companion of S.S.	1 if accompanied by someone for S.S.; 0 others
Enjoyment Variables	
Enjoyment (latent variable)	Overall enjoyment level of elderly grocery shopping
Enjoyment of D.S.	Enjoyment level of Discount Store (9-point scale)
Enjoyment of T.M.	Enjoyment level of Traditional Market (9-point scale)
Enjoyment of S.S.	Enjoyment level of Small Supermarket (9-point scale)
Frequency Variables	
Frequency of D.S.	Monthly grocery shopping frequency at Discount Store
Frequency of T.M.	Monthly grocery shopping frequency at Traditional Market
Frequency of S.S.	Monthly grocery shopping frequency at Small Supermarket
Family Relationship Variables	
Children Report	Tendency reporting children activities (3-point scale)
Meals with Family	Number of having meals with family a day
Spouse Chat Time	Conversation time with his/her spouse (100 minutes)
Children Chat Time	Conversation time with children (100 minutes)
Household/Individual Variables	
Individual Walk	Walkability level of the elderly respondent (3-point scale)
Relatives	1 if has close relatives near home; 0 others
Daughter-In-Law	1 if live with daughter-in-law; 0 others
Children T.M. Time	Children available time during opening hours of T.M.
Children D.S. Time	Children available time during opening hours of D.S.
Household Size	Number of household members
Household Income	Gross household income per month
Auto Service	1 if drives or his/her companions drive; 0 others
Distance to D.S.	Distance to Discount Store from home (Kilometers)
Spouse Walk	Walkability level of the spouse of respondent (3-point scale)
Male	1 if male; 0 others
Leisure Time Variables	
Neighborhood Leisure Time	Weekly Time to spend at senior centers or on the street
Distant Leisure Time	Weekly leisure time except neighborhood leisure time
Life Satisfaction Variable	
Satisfaction of Current Life	Satisfaction level of current life (9-point scale)

tra/inter-household interaction and also the different needs of companions by shopping place on elderly accompanying behavior.

In terms of grocery shopping enjoyment, this model structure hypothesizes that the elderly obtain utility both during shopping and after shopping. For example, the elderly can receive both physical and emotional supports from their companions, as some studies[16, 22] argued. In addition, because grocery shopping is basically not only for the shoppers themselves but also for their family, they will obtain utility from activities of having meals which is also associated with their closeness. Finally, the effects of grocery shopping frequencies, enjoyment, companionship, family relationship and leisure activities on the satisfaction of elderly current life will be tested.

(3) Model specifications

Based on the conceptual model structure (**Fig.4**) and descriptive analysis in the previous section 4, a full structural equation model was specified to reflect our hypotheses. The two latent variables and observed variables are summarized in **Table 15** with descriptions.

The hypothesized structural equation model is represented in **Fig.5** with hypothetical direct effects among variables. First of all, in order to test the different needs of grocery shopping and companions by

individual/household characteristic and shopping place, the frequency, companion, and enjoyment level variables were differentiated by three major shopping places.

Second, the frequencies of grocery shopping are simultaneously determined by individual/household characteristics, trade-offs among shopping places, and personal preferences. The direct relationships between frequencies and accompanying behaviors were not specified in this hypothesized model because there were no significant correlations between them. In other words, it was hypothesized there is no significant direct causal relationship between them. In terms of the priorities among shopping places, the frequency of discount store is prioritized. The underlying hypothesis is that discount store is the most attractive/efficient place in terms of varieties of groceries, followed by traditional market, and then small supermarket. In addition, accessibility constraint (e.g. distance) matters to the elderly only when they go to discount store. In this sense, if the elderly feel some difficulties to go to discount store, they tend to give it up and then choose the next attractive/effective grocery shopping places (subsequently, T.M. and S.S.).

Third, the latent variable, companionship is directly affected by family relationship variables as well as individual/household characteristics. Subse-
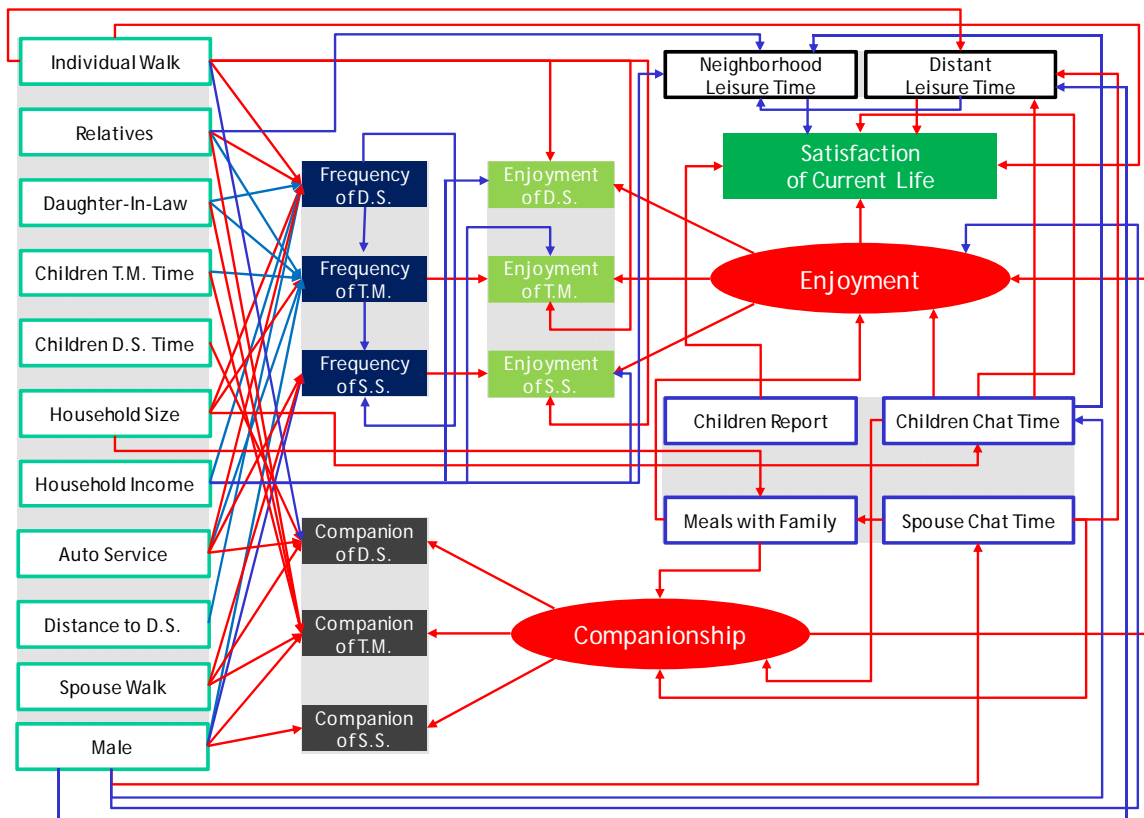
Note: Red color arrows indicate positive direct effects and Blue color arrows indicate negative direct effects
Fig.5 Hypothesized model structure of baseline model.

quently, it affects the overall enjoyment level of grocery shopping and then their current life satisfaction and also grocery shopping frequencies. The current life satisfaction is also affected by additional variables such as individual walkability, leisure time, and family relationship.

The directionalities of those effects which reflect the hypotheses of this study do not mean exclusively confirmatory, just the start of analysis[21]. Therefore, the directionalities were tested through reversing the directions or in a reciprocal manner during modeling process. In addition, the results from the entire sample might vary across subsamples, especially in an elderly sample, thus the baseline model will be first estimated and then four different segment groups will be compared.

6. ESTIMATION RESULTS AND DISCUSSIONS

Based on the hypothesized model in **Fig.5**, a full structural equation model was estimated using maximum likelihood estimation method (AMOS 20.0) to verify the hypotheses. This model confirmed a number of general findings and also some original findings. The goodness-of-fit statistics also showed a good level of fit. Estimation of the final model resulted in an overall χ^2 value of 639 with 257 degrees of freedom and a probability value of 0.000. The ratio of χ^2 to degrees of freedom is 2.488 which is less than the widely recommended reference value 5.0 in the literature[26]. CFI of 0.908 and RMSEA 0.070 are also close to acceptable thresholds of fit[27], supporting the plausibility of the hypothesized model structure. Nonetheless, it assumed that only one population was distributed within the dataset. The potential which two or more subpopulations exist in the dataset should be taken into consideration, especially in the elderly population. In this sense, the entire sample was classified into four paired-comparison groups by four dichotomous segmentation variables in order to identify the differences among segment groups. The model with the entire sample was used as baseline for the segment comparison purpose.

(1) Estimation result of final baseline model
The initial conceptual model structure (**Fig.5**) was repetitively modified and tested considering statistics of individual direct parameters and also overall model fit based on the findings from the descriptive analysis in the previous section 4. The final model specification is represented in **Fig.6** using SEM path diagram. The standardized total and direct effects of

exogenous variables on endogenous variables are also presented in **Table 16** and **Table 17**, respectively. In addition, all double-headed arrows are not represented in **Fig.6** to ensure the clarity of hypothesized causal relationships which represent correlations among the independent (i.e., exogenous) factors, as well as error terms associated with the observed variables. These correlations capture possible correlations between variables rather than explicit casual relationships. For example, Distance to D.S. (residential location) is positively correlated with both Auto Service and Individual Walk variables (mobility) which capture the effects of residential self-selection. In other words, residents who are more mobile may consciously choose to live farther away from the D.S. or residents who live farther away from D.S. may be more likely to own private vehicles (increase mobility) in order to overcome the difficulty to access the relatively distant D.S.. These causal relationships are not explicitly explained in the current models, but reduce the possible biases caused from correlations between variables. In the estimation results, only significant standardized parameters are presented at a 90% confidence level for easier interpretation purpose. The interpretations and discussions on the estimation results are as follows, with a focus on frequencies, accompanying behavior, enjoyment, and leisure time.

a) Frequencies of grocery shopping
As expected, Individual Walk and Auto Service variables directly increase Frequency of D.S. while Distance (accessibility) to D.S. reduces it. Family Relationship variables also indirectly increase it through Companionship and Enjoyment latent variables. In other words, physically, the elderly who are better mobile or live in higher accessible areas to D.S. tend to go shopping more frequently than their counterparts. Psychologically, better family relationship positively encourages shopping companionship and then it makes the elderly more enjoyable shopping. Subsequently, the elderly increases the frequencies of D.S.. At the same time, the increased frequency of D.S. (directly) and better mobility, accessibility, and family relationship (indirectly) reduce the frequencies at the T.M., followed by S.S. (the total amount of groceries is relatively fixed). In terms of the directionality among shopping places, although the reverse and reciprocal directions were tested, they were not significant at a 90% confidence level. In addition, Daughter-In-Law variable directly reduces the frequencies of D.S. and T.M. while it indirectly increases the frequency of S.S.. Similarly, Household Size variable directly increases the frequencies of D.S. and T.M. while it indirectly reduces the frequency of S.S.. This statistically verified
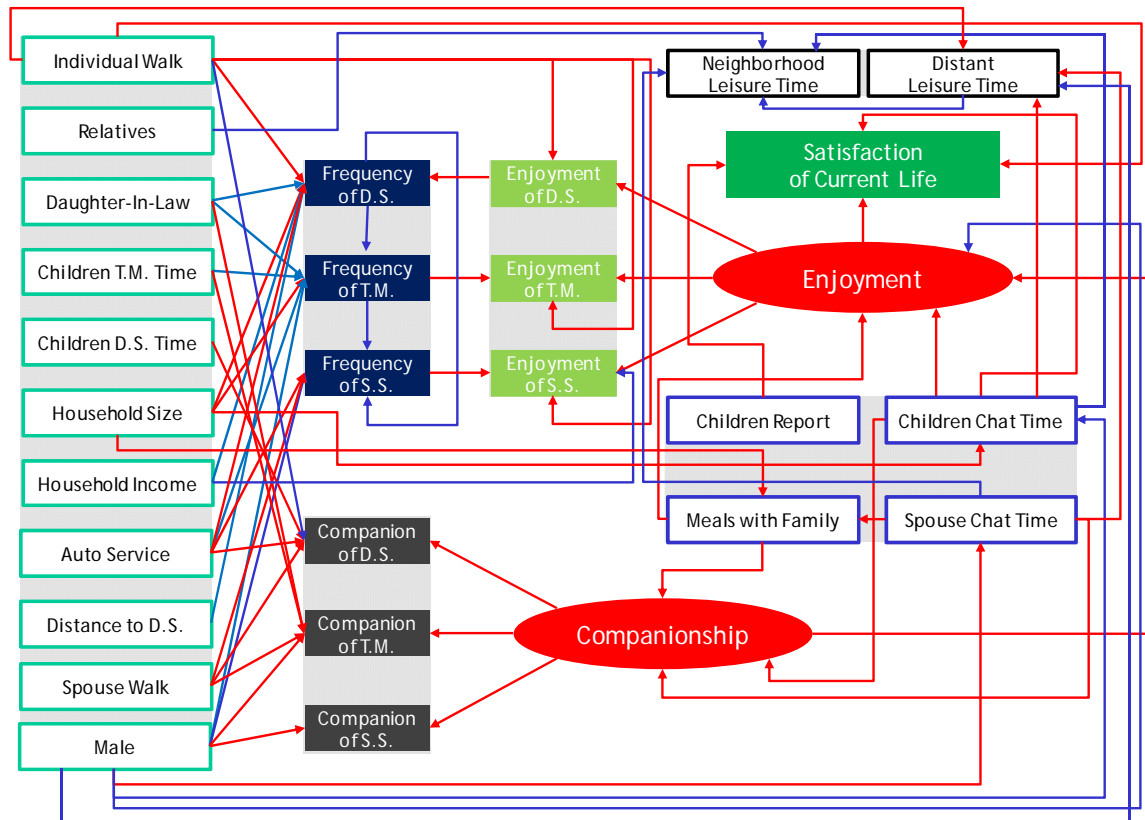
Note: 1) Red color arrows indicate positive direct effects and Blue color arrows indicate negative direct effects

2) Only significant parameters are represented at a 90% confidence level

Fig.6 Final model structure of baseline model.

mechanism shows clear trade-offs among shopping places and the needs of elderly grocery shopping varies according to their mobility, accessibility to D.S. and HH characteristics as well as the complex inter-correlations among those variables.

Unlike the results from the previous descriptive analysis (see section 4), there are neither direct nor indirect effects of close relatives on grocery shopping frequencies. This inconsistent result might be caused by the underlying assumption of this single population model ignoring the potential which two or more subpopulations exist in the dataset. In other words, in the descriptive analysis section, the presence of close relatives reduced the D.S. and T.M. frequencies of only single and couple elderly respondents while the current model did not segment the total sample into single generational (single and couple) and multi-generational household samples, indicating a need to market segmentation approach which is presented in the next subsection.

b) Companions of grocery shopping

Physically, better mobility (individual walkability and auto service availability) directly helps the elderly accompany their family members only for D.S. grocery shopping and at the same time, spouse mobility (spouse walkability) and adult children time budgets (children available times during D.S. and

T.M. opening hours) directly allow other family members to accompany the elderly for D.S. and T.M.. On the other hand, psychologically, better family relationship and larger HH size indirectly encourage the family members to accompany each other through the companionship latent variable. As a result, the effects from Companionship latent variable to each of the three observed variables (Companion of D.S., Companion of T.M., and Companion of S.S.) are quite different each other. The parameter from Companionship to Companion of S.S. is the highest, followed by T.M. and then D.S. (that of S.S. is more than two times than those of T.M. and D.S.). It is very reasonable. For example, S.S. is very close to their home and both the shopper and possible companions generally do not feel that the shopper needs some support for S.S. grocery shopping (very near). Thus, if their companionship is very strong, they will accompany each other. However, D.S. is kind of far away and requires the shopper to bring large amount of groceries into the home, thus there is a great possibility for the family members to feel that the shopper needs support through being accompanied compared to the case of S.S. grocery shopping. This result clearly shows that the needs of companions vary according to shopping places, verifying the hypothesis of this study.

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Table 16 Standardized Total Effects of Exogenous Variables on Endogenous Variables.

Affected Variables (Endogenous)	Household/ Individual Variables (Exogenous)										
	Male	Individual Walk	Distance to D.S.	Auto Service	Daughter-In-Law	Household Size	Children D.S. Time	Children T.M. Time	Spouse Walk	Household Income	Relatives
Companion of D.S.	0.02	-0.13	-	0.43	-	0.08	0.13	-	0.32	-	-
Companion of T.M.	0.21	-	-	-	0.14	0.09	-	0.26	0.28	-	-
Companion of S.S.	0.24	-	-	-	-	0.20	-	-	-	-	-
Companionship (Latent)	0.06	-	-	-	-	0.22	-	-	-	-	-
Enjoyment of D.S.	-0.12	0.28	-	-	-	0.18	-	-	-	-	-
Enjoyment of T.M.	-0.14	0.41	0.00	-0.01	-0.02	0.21	-	-0.01	-	0.00	-
Enjoyment of S.S.	-0.13	0.30	0.01	0.06	0.02	0.13	-	0.01	0.03	-0.13	-
Enjoyment (Latent)	-0.15	-	-	-	-	0.22	-	-	-	-	-
Frequency of D.S.	-0.02	0.15	-0.21	0.09	-0.28	0.36	-	-	-	-0.15	-
Frequency of T.M.	-0.19	-0.02	0.02	-0.12	-0.24	0.27	-	-0.14	-	0.02	-
Frequency of S.S.	-0.07	-0.02	0.03	0.21	0.08	-0.09	-	0.02	0.11	0.02	-
Meals with Family	0.13	-	-	-	-	0.44	-	-	-	-	-
Spouse Chat Time	0.26	-	-	-	-	-	-	-	-	-	-
Children Chat Time	-0.10	-	-	-	-	0.66	-	-	-	-	-
Neighborhood Leisure Time	-0.01	-0.02	-	-	-	-0.15	-	-	-	-	-0.12
Distant Leisure Time	-0.15	0.11	-	-	-	0.14	-	-	-	-	-
Satisfaction of Current Life	-0.08	0.37	-	-	-	0.20	-	-	-	-	-

Affected Variables (Endogenous)	Family Relationship Variables				Frequency Variables			Distant Leisure Time	Enjoyment of D.S.	Enjoyment	Companionship
	Meals with Family	Spouse Chat Time	Children Chat Time	Children Report	Frequency of D.S.	Frequency of T.M.	Frequency of S.S.				
Companion of D.S.	0.07	0.11	0.07	-	-	-	-	-	-	-	0.36
Companion of T.M.	0.09	0.13	0.09	-	-	-	-	-	-	-	0.43
Companion of S.S.	0.18	0.28	0.18	-	-	-	-	-	-	-	0.92
Companionship (Latent)	0.20	0.30	0.20	-	-	-	-	-	-	-	-
Enjoyment of D.S.	0.18	0.12	0.16	-	-	-	-	-	-	0.84	0.16
Enjoyment of T.M.	0.18	0.13	0.16	-	-0.01	0.08	-	-	-0.00	0.87	0.17
Enjoyment of S.S.	0.15	0.11	0.14	-	-0.04	-0.04	0.28	-	-0.01	0.72	0.14
Enjoyment (Latent)	0.21	0.15	0.19	-	-	-	-	-	-	-	0.19
Frequency of D.S.	0.03	0.02	0.03	-	-	-	-	-	0.18	0.15	0.03
Frequency of T.M.	-0.00	-0.00	-0.00	-	-0.11	-	-	-	-0.02	-0.02	-0.00
Frequency of S.S.	-0.00	-0.00	-0.00	-	-0.14	-0.14	-	-	-0.03	-0.02	-0.00
Meals with Family	-	0.51	-	-	-	-	-	-	-	-	-
Spouse Chat Time	-	-	-	-	-	-	-	-	-	-	-
Children Chat Time	-	-	-	-	-	-	-	-	-	-	-
Neighborhood Leisure Time	-	-0.23	-0.22	-	-	-	-	-0.20	-	-	-
Distant Leisure Time	-	0.13	0.21	-	-	-	-	-	-	-	-
Satisfaction of Current Life	0.10	0.07	0.24	0.14	-	-	-	-	-	0.45	0.09

Note: Only significant parameters are presented at a 90% confidence level

Table 17 Standardized Direct Effects of Exogenous Variables on Endogenous Variables.

Affected Variables (Endogenous)	Household/ Individual Variables (Exogenous)										
	Male	Individual Walk	Distance to D.S.	Auto Service	Daughter-In-Law	Household Size	Children D.S. Time	Children T.M. Time	Spouse Walk	Household Income	Relatives
Companion of D.S.	-	-0.13	-	0.43	-	-	0.13	-	0.32	-	-
Companion of T.M.	0.18	-	-	-	0.14	-	-	0.26	0.28	-	-
Companion of S.S.	0.19	-	-	-	-	-	-	-	-	-	-
Companionship (Latent)	-	-	-	-	-	-	-	-	-	-	-
Enjoyment of D.S.	-	0.28	-	-	-	-	-	-	-	-	-
Enjoyment of T.M.	-	0.42	-	-	-	-	-	-	-	-	-
Enjoyment of S.S.	-	0.30	-	-	-	-	-	-	-	-0.14	-
Enjoyment (Latent)	-0.17	-	-	-	-	-	-	-	-	-	-
Frequency of D.S.	-	0.10	-0.21	0.09	-0.28	0.33	-	-	-	-0.15	-
Frequency of T.M.	-0.20	-	-	-0.11	-0.27	0.31	-	-0.14	-	-	-
Frequency of S.S.	-0.10	-	-	0.21	-	-	-	-	0.11	-	-
Meals with Family	-	-	-	-	-	0.44	-	-	-	-	-
Spouse Chat Time	0.26	-	-	-	-	-	-	-	-	-	-
Children Chat Time	-0.10	-	-	-	-	0.66	-	-	-	-	-
Neighborhood Leisure Time	-	-	-	-	-	-	-	-	-	-	-0.12
Distant Leisure Time	-0.16	0.11	-	-	-	-	-	-	-	-	-
Satisfaction of Current Life	-	0.37	-	-	-	-	-	-	-	-	-

Affected Variables (Endogenous)	Family Relationship Variables				Frequency Variables			Distant Leisure Time	Enjoyment of D.S.	Enjoyment	Companionship
	Meals with Family	Spouse Chat Time	Children Chat Time	Children Report	Frequency of D.S.	Frequency of T.M.	Frequency of S.S.				
Companion of D.S.	-	-	-	-	-	-	-	-	-	-	0.36
Companion of T.M.	-	-	-	-	-	-	-	-	-	-	0.43
Companion of S.S.	-	-	-	-	-	-	-	-	-	-	0.92
Companionship (Latent)	0.20	0.20	0.20	-	-	-	-	-	-	-	-
Enjoyment of D.S.	-	-	-	-	-	-	-	-	-	0.84	-
Enjoyment of T.M.	-	-	-	-	-	0.08	-	-	-	0.87	-
Enjoyment of S.S.	-	-	-	-	-	-	0.28	-	-	0.73	-
Enjoyment (Latent)	0.17	-	0.15	-	-	-	-	-	-	-	0.19
Frequency of D.S.	-	-	-	-	-	-	-	-	0.18	-	-
Frequency of T.M.	-	-	-	-	-0.11	-	-	-	-	-	-
Frequency of S.S.	-	-	-	-	-0.16	-0.14	-	-	-	-	-
Meals with Family	-	0.51	-	-	-	-	-	-	-	-	-
Spouse Chat Time	-	-	-	-	-	-	-	-	-	-	-
Children Chat Time	-	-	-	-	-	-	-	-	-	-	-
Neighborhood Leisure Time	-	-0.21	-0.18	-	-	-	-	-0.20	-	-	-
Distant Leisure Time	-	0.13	0.21	-	-	-	-	-	-	-	-
Satisfaction of Current Life	-	-	0.15	0.14	-	-	-	-	-	0.45	-

Note: Only significant parameters are presented at a 90% confidence level

c) Enjoyment of grocery shopping

The main causes of elderly grocery shopping enjoyment were individual mobility (while shopping) and family relationship (both while shopping and after shopping) regardless of shopping places (see the associated parameter magnitudes in **Table 16**). While shopping, the elderly enjoyment levels of the three shopping places are improved by better mobility and support from companions (indirectly caused from Family Relationship and Household Size). After shopping, the elderly obtain utility both directly and indirectly through preparing for and having meals with their family, depending on their closeness with the family members. In fact, in terms of the magnitude of effects, the sum of family relationship effects (affected by Household Size) is stronger than individual walkability effect. In the context of decreasing Household Size in Korea, it is expected that the future elderly in Korea will be much less satisfied with grocery shopping than the current elderly. Consequently, it will lead to make worse the quality of elderly life.

In terms of the effects between grocery shopping frequencies and enjoyment, both directions between them were tested, but only one-way directions were statistically significant. The effect of S.S. frequency is considerably strong while the effects of both D.S. and T.M. frequencies have no effect and very weak. It can be explained by the previous causes of grocery shopping frequencies. The frequency of S.S. is not strongly affected by mobility and accessibility as compared with its counterparts, due to very close distance from home and small amount of available groceries in S.S.. In other words, mobility and accessibility to S.S. are not considerable matters to the elderly and the frequency of S.S. increases their enjoyment with S.S. grocery shopping. On the other hand, only the enjoyment of D.S. increases the frequency of D.S.. The reason can be found from the causal effects of D.S. frequency. D.S. grocery shopping requires higher mobility and support from their companions, meaning that there are other HH members to do the grocery shopping at D.S. instead for the elderly and more mobile elderly can spend their time on leisure activities rather than grocery shopping for pleasure, that is, for them, it is an optional task. For this reason, when they enjoy grocery shopping at D.S., they tend to go shopping more frequently.

d) Leisure activity time

Leisure activities were classified into two types, neighborhood and distant leisure activity. As expected through the previous descriptive analysis, individual mobility (walkability) and family relationship (conversation times with family members) increase only distant leisure activity time, but reduce neighborhood leisure activity time. Although accompanying behavior of elderly leisure activities was not considered, there is great possibility for the elderly to accompany their family members for out-of-home leisure activities as they have better relationship. Through being accompanied by other members, the elderly will receive support physically and psychologically from their companions. Therefore, the elderly who are more mobile or have more family members tend to spend time on distant leisure activities rather than neighborhood leisure activities (spending at senior centers or on the street strolling). In contrast, the elderly, who are less mobile or have fewer family members, tend to spend their leisure time at nearby senior centers or on the streets due to the difficulty of traveling. In fact, it is just killing their time without obtaining positive utility from them. In general, it is commonly agreed that the leisure time and quality of life are positively related each other. However, although the parameters were not significant at a 90% confidence level, the effect of neighborhood leisure time on satisfaction of elderly current life was negative (t-statistic: -1.26) while the distant leisure time was positive (t-statistic: 0.99) on it. The survey data showed that the neighborhood leisure time accounts for about 91% of elderly total leisure time. This result urges the Korean policy makers to consider better quality of leisure activities, especially for the current single, couple household and less mobile elderly people. In the context of the increases of single-generational households and old elderly, this policy prescription for better quality of elderly life is getting more important in the Korean aging society.

(2) Market segmentation and comparison

One of limitations in the final model (single population model) could be from the underlying assumption that relationships between variables are consistent across the entire sample. This might be a problematic assumption to understand the elderly grocery shopping behavior since the elderly population is generally considered heterogeneous as Alsnih and Hensher[28] pointed out. For example, the descriptive analysis showed strong effects of close relatives on single and couple elderly grocery shopping frequency, but the final model showed the insignificant effects of close relatives, indicating a need to segment the total sample at least into two segments: single generational and multi-generational households. Therefore, this subsection first decides segmentation variables based on the descriptive analysis and the final baseline model, and then compares the differences among segments through

estimating the segments separately. As have been shown above, the most important determinants of grocery shopping frequency, accompanying behavior, and enjoyment seem to be household structure, mobility, and accessibility. Considering these determinants, four dichotomous segmentation variables were selected: co-residence with adult children, auto availability, presence of companions, and presence of daughters-in-law in the HHs. In the following subsections, only part of estimation results are presented in the form of SEM path diagram due to space limitation and Only significant parameters are presented at a 90% confidence level.

a) Comparison group 1: Single Generational vs. Multi-Generational

In **Fig.7**, the estimation results of single generation group and multi-generation group are presented. There are several interesting differences in the signs and the magnitude of parameters. Especially, the effects of individual walkability and the presence of close relatives are quite different between two segments. First, when the elderly do shopping at D.S. while the effects of individual walkability on accompanying behavior, frequency, and enjoyment are statistically significant in the single generational HHs, it is not significant in multi-generational HHs. In other words, when the elderly live with their children, individual mobility is a considerable matter for grocery shopping, but the difficulty of walking can be significantly alleviated physically or psychologically from supports of their adult children. On the other hand, in the baseline model, the effect of close relatives was not significant, but it is now significant only in the single generational households (increase D.S. frequency) while it is not significant when they live with their children. This finding is consistent with the result of the descriptive analysis
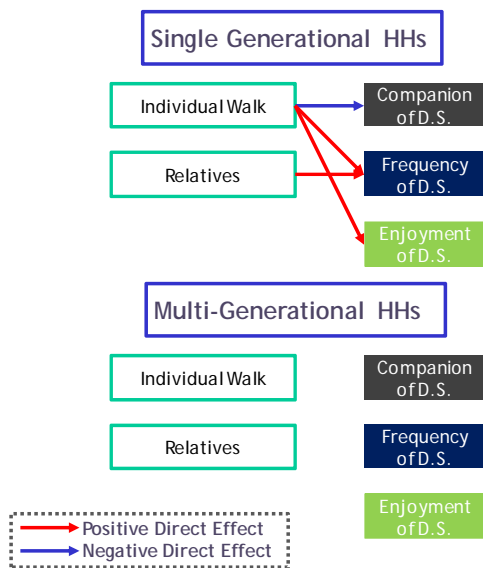

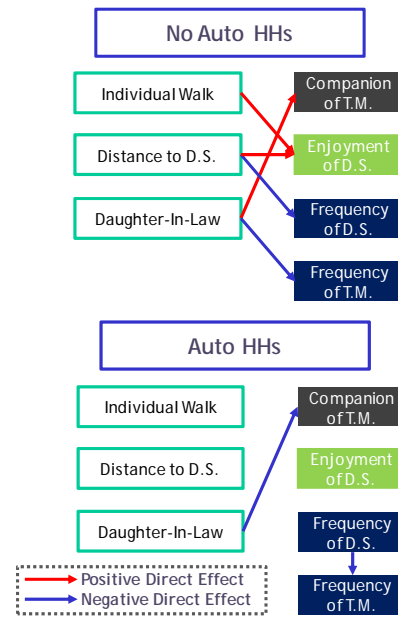**Fig.7** Single Generational vs. Multi-Generational.

Fig.8 No Auto vs. Auto.

in the section 4.

b) Comparison group 2: No Auto vs. Auto

The elderly were classified by auto service availability as shown in **Fig.8**. The distinct differences are mainly in the effects of presence of daughter-in-law, distance to D.S., and individual walkability. As expected, when auto service is available, distance to D.S. (accessibility) and individual walkability (mobility) do not have strong direct effects on D.S. grocery shopping frequency, but they are considerable matters to the elderly to whom auto service is not available.

Interestingly, distance to D.S. is positively correlated with enjoyment of D.S. grocery shopping when auto service is not available while it does not have significant effect in the auto available elderly group. In the original survey, about 44% of people answered that they enjoy watching street scenes or passersby on the way to/from D.S. for grocery shopping. In addition, the distance to D.S. is, on average, about 1.61 km which is not extremely far. For these reasons, probably it showed the positive effect of distance on enjoyment level only in the auto service unavailable group because it is relatively hard to watch street scenes or passersby when using a car.

In addition, the negative effect of D.S. grocery shopping frequency on T.M. frequency is singnificant only in Auto group. The reason might be that auto available shoppers are more likely to purchase groceries in bulk or more amount than auto unavailable shoppers because they can bring groceries into home easily owning to auto availability.

c) Comparison group 3: Alone vs. Together

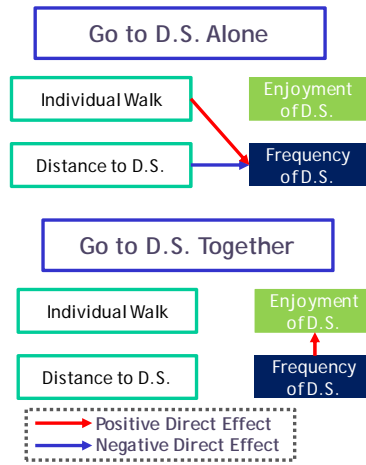In order to understand the effect of companions for grocery shopping, the elderly were classified by the

Fig.9 Alone vs. Together.

Fig.10 No Daughter-In-Law vs. Daughter-In-Law.

presence of companion. However, there are three shopping places and the presence of companions varies across the three places. Consequently, it is difficult to separate the elderly by the presence of companions for each shopping place (it will be six segment groups) due to relatively small sample size. Therefore, only discount store was considered for segment difference test (**Fig.9**) because the need of companions at D.S. is the strongest among the three places. As expected, when the elderly use D.S. alone, the effects of distance to D.S. and individual walkability are significant while it is not significant when they are accompanied by others. In addition, the frequency of D.S. increases their enjoyment level with grocery shopping while it is not significant when the elderly use alone. This finding is partially consistent with the previous findings in the literature[16, 22]. The difference, which is original in this study, is that the elderly are willing to increase grocery shopping frequency or receive positive utility even from grocery shopping not only from leisure activities when they are accompanied by others. In other words, grocery shopping for the current elderly can be considered as a pleasing leisure activity better than the neighborhood leisure activities in Korea.

d) Comparison group 4: No Daughter-In-Law vs. Daughter-In-Law

Daughter-in-law is an important household member in terms of elderly grocery shopping need because traditionally grocery shopping is one of her main household task roles in Korea. In this sense, the elderly were classified into two groups by the presence of daughter-in-law in the household as shown in **Fig.10**. The result of this comparison is similar to the first comparison (Single Generational vs. Multi-Generational) because most of the elderly in multi-generational HHs live with daughters-in-law. As might be expected, when they cannot receive physical support from daughters-in-law, elderly mobility (walkability) and accessibility to D.S. (distance) are
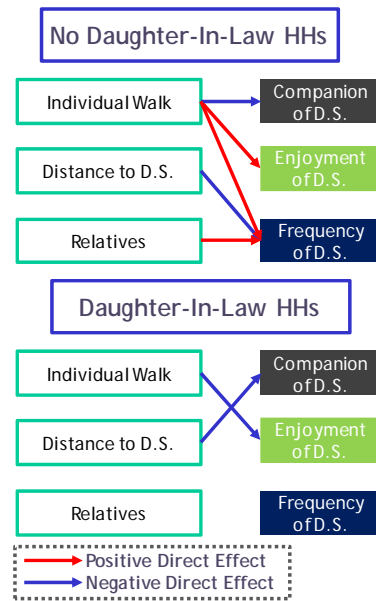
considerable matters to elderly D.S. grocery shopping frequency while they are not significant matters when they can receive physical support from their daughters-in-law. In addition, when the elderly do not live with daughters-in-law, they tend to do more shopping at the discount store with close relatives than their counterparts which is consistent with the descriptive analysis in secton 4.

7. CONCLUSIONS

The Korean society is experiencing a very rapid population aging and decline of household size rarely seen in other countries. In this context, this study explored the effects of household structure on elderly grocery shopping behavior and their satisfaction using an original survey data from 304 elderly residents in Sanbon, Korea. The modeling result verified that the main causes of elderly grocery shopping enjoyment are individual mobility (such as individual walkability and auto service availability), the presence of companions and family relationship. Regarding to mobility and accessibility, segment comparison analyses consistently showed that elderly mobility problems and poor accessibility (distance) can be significantly alleviated by support from their family members. Taking all the factors together, co-residence with other family members is the main cause of improving elderly grocery shopping enjoyment: the same could be true of the other HH maintenance activities. In this sense, it can be said that decreasing household size will force the future elderly to travel more frequently for unpleasing activities rather than for pleasure and hence lower the quality of life for the elderly. However, the majority

of Korean research on elderly-related studies have focused mainly on traffic safety of elderly drivers and pedestrians[29] rather than the effects of household structure on elderly travel behavior. Based on the findings in this study, it is suggested that in addition to considering traffic safety of the elderly, Korean policy makers/researcers should also pay more attention to the effects of household structure changes in order to improve the quality of life for the elderly.

In terms of the unreasonable relationship between accessibility and trip/tour frequency which is often observed in aggregate urban modeling applications[3], this study first verified that subjective satisfaction with activities significantly influences the accessibility effects, and hence leads to either non-significant or negative relationship (wrong sign). In addition, each consumer has his/her own preferred grocery shopping places under their conditions such as household size, auto availability, and the availability of companions (e.g., large HHs prefer large-scale discount stores). For this reason, many consumers bypass nearby small grocery stores, that is, the choice of grocery shopping is not merely dependent on accessibility factors as Smith[13] pointed out. Our modeling results verified that this bypass phenomenon also leads to a inconsistent relationship between accessibility and grocery shopping frequency.

Although this study showed many meaningful findings, there are several limitations which need to be considered in the future research. First of all, this analysis showed strong effects of close relatives on elderly grocery shopping need, but this study considered only the information whether the elderly have close relatives near to the home or not. As a result, it could not explicitly explain the causal relationships between the elderly and their close relatives. Second, this study collected the frequency and enjoyment-related attributes of only the elderly, but those of the other household members are not collected. In other words, it failed to explicitly explain their interactions among household members.

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