Analysis on the Influence of Introduction of Shopping Support Services in Suburban Areas on Trip Demand to Central Town Area

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Abstract: Recently, the food desert problem has been becoming serious in mainly rural areas of Japan. Therefore, over the past few years, some estimation models about 1) the number of people in food desert (PFD) and 2) demand for and profit from each shopping support service for PFD were developed. However, all researches were focused on only shopping support for PFD. In other words, they do not care about some social influences by introducing shopping support services. Therefore, this study focuses on the change of trip demand to central town area as one of social influences, and mainly aims to clarify the influence factors of the change of trip demand to central town area by introducing shopping support services in suburban areas, in order to obtain fundamental knowledge to develop the estimation model to investigate the shopping support services.

Keywords: People in Food Desert, Central Town Area, Shopping Support Services

1. INTRODUCTION

Recently, the food desert problem has been becoming serious in mainly rural areas of Japan, because of recent social changes: 1) declining in level of public transport services, 2) declining birth rate and growing proportion of elderly people, 3) increasing nuclear families and 4) decreasing the number of local grocery stores and so on. Food desert problem is that the number of People in food desert (hereinafter called “PFD”) increases. PFD are those who have difficulty with daily shopping for groceries and daily necessities.

Ministry of Economy, Trade and Industry (METI) (2010, 2011) and Ministry of Agriculture, Forestry and Fisheries (MAFF) (2012, 2014) have been making various efforts to solve the food desert problem, such as estimation of the number of PFD based on original methods and publishing of the shopping accessibility aid manuals and so on. On the other hand, Ise *et al*. (2013) and Hirai *et al*. (2012) pointed out that the estimation methods developed by METI and MAFF are impossible to estimate the number of PFD on a local level, and they had conducted fundamental studies to develop the new estimation method of the number of PFD.

It can be said that the following matters are essential to decide to introduce or not the shopping support services for local needs: 1) the number of PFD, 2) demand for and profit from each shopping support service, 3) discussion with various kinds of parties such as local government, local residents, private companies and academic experts and so on. However, the manuals mentioned above are not enough to do that, because they do nothing but introduce some of pioneering projects.

Kuramochi *et al*. (2014) developed the discrete choice model to estimate the number of

home delivery service users based on the questionnaire survey for elderly people in rural areas. Tanimoto *et al*. (2012) determined five choice patterns of shopping support services by combination of 1) two shopping support services and 2) relative use frequency of them transformed into ordinal scale, and developed the multinomial probit model to estimate the number of users of "transport support service" and "home delivery service" considering mental and physical functions of elderly people. However, there are some issues in these researches such as 1) non-elderly people are not considered and 2) it is impossible to estimate the use frequency of shopping support services for PFD. Kishino *et al*. (2011) clarified the relationship between use frequency of shopping support services and some valuables such as individual attributes, family structure and physical ability and so on. However, some findings from this research are not enough to estimate the demand of shopping support services, because they analyzed the relationship between use frequency of shopping support services and some valuables separately. Ise *et al*. (2014) suggested the overall framework to consider and decide the shopping support service for local needs, and they clarified some factors influencing use frequency and WTP of PFD for each shopping support service, in order to develop the estimation models of them.

However, all researches mentioned above are focused on only shopping support for PFD. In other words, they do not care about some social influences by introducing shopping support services, such as "change in sales of local grocery stores" and "change of trip demand to central town area" and so on.

As a result, local government cannot decide to introduce or not the shopping support services considering some social influences.

Many local governments set some goals and objectives in their comprehensive plans, such as "solution of food desert problem", "revitalization of central town area" and "road safety improvement". There are many evaluation indexes of revitalization of central town area. Among them, "pedestrian traffic volume" is popular index to evaluate the revitalization of central town area in many center city area activation basic plans. It can be said that the pedestrian traffic volume has a relationship with the trip demand to central town area. Introduction of shopping support services in suburban area might decrease the trip demand to central town area. It means negative influence on revitalization of central town area.

That is, it is important to develop the estimation model to quantify the social influences by introducing shopping support services.

Therefore, this study focuses on the change of trip demand to central town area as one of social influences, and mainly aims to clarify the influence factors of the change of trip demand to central town area by introducing shopping support services in suburban areas, in order to obtain fundamental knowledge to develop the estimation model to investigate the shopping support services.

2. OUTLINE OF TARGET TOWN

Hidakagawa town in Wakayama, Japan is the target town in this study, which was born by the municipal merger between Kawabe town, Nakatsu village, and Miyama village in May 2005, as shown in Figure 1. This town is located at the center of Wakayama prefecture, which has an area of 331.65 km^2 (35km from east to west in width, 10km from north to south in width).

Figure 2 shows the characteristics of population and households in Hidakagawa town based on 2010 population census of Japan.

Population size is very small (population is 10,509 and the number of household is 3,750). The density of population is also very small, but the ratio of elderly people is

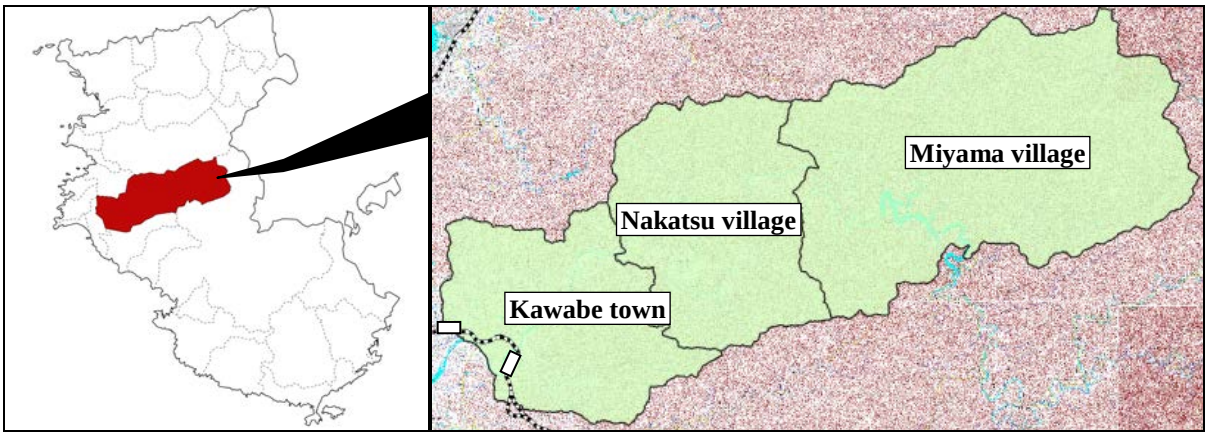

Figure 1. Hidakagawa town in Wakayama, Japan

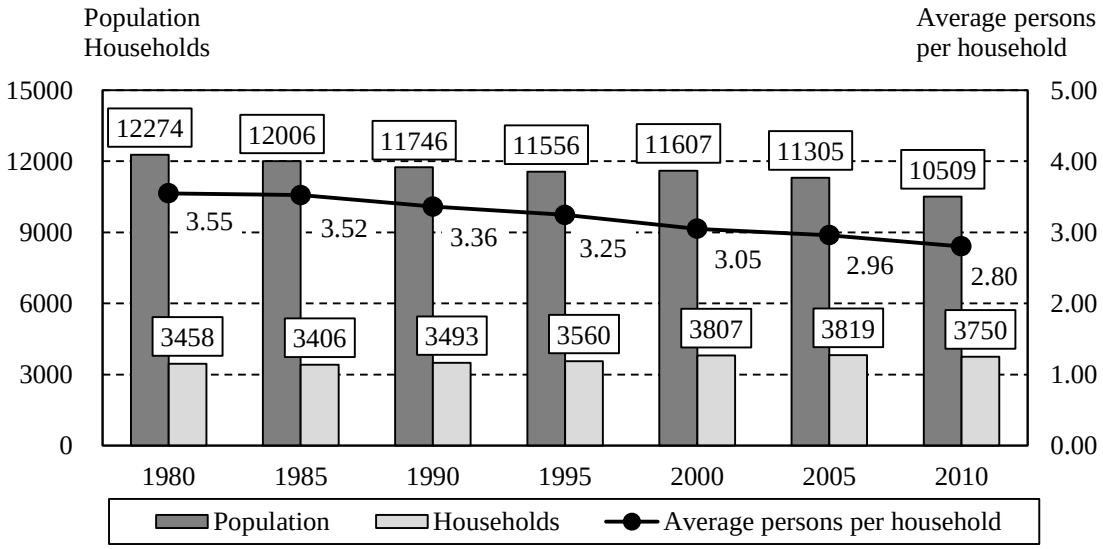

Figure 2. Characteristics of population and households in Hidakagawa town
Source 2010 population census of Japan

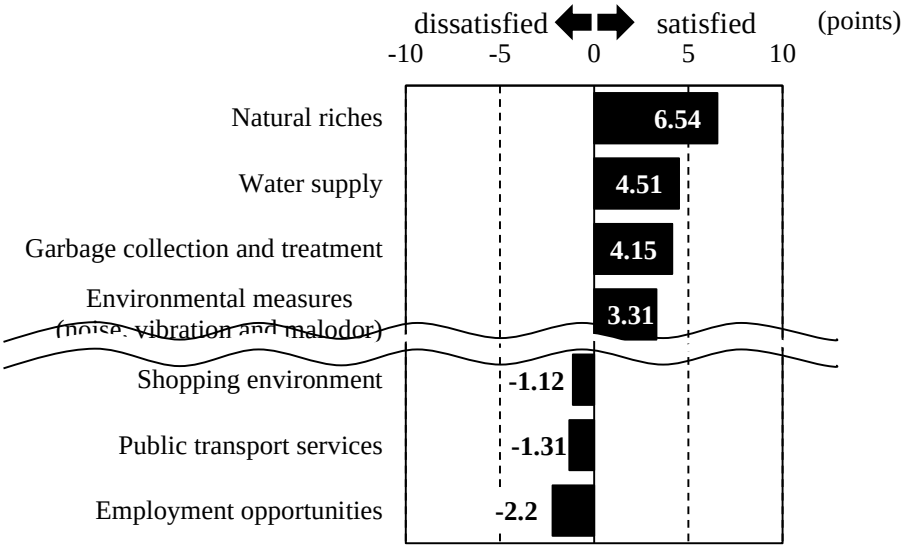

Figure 3. Satisfaction level to residential environment in Hidakagawa town
Source the first long-term comprehensive plan of Hidakagawa town

8.3% higher than the national average (23.0%). In addition to the above, this town faces some problems such as decreasing of population and increasing of nuclear families.

A railway is located in the southwest of this town, but there are only two stations. In addition to a few stations, train runs once every hour. Bus, community bus and share-ride taxi run in this town, but they run about two to eight times a day. All these things make it clear that the conditions of public transport in this town are poor. A lot of local residents pointed out that the conditions of public transport and daily shopping are poor, in the first long-term comprehensive plan of this town (Figure 3).

As mentioned above, it is very urgent and important to support for grocery shopping of PFD in this town.

3. OUTLINE OF QUESTIONNAIRE SURVEY

The questionnaire survey was conducted from October to November 2013, in order to mainly clarify the factors influencing, 1) difficulty with grocery shopping, 2) use frequency of PFD for shopping support services, 3) WTP of PFD for shopping support services and 4) change of trip demand of PFD to central town area by introducing shopping support services such as mobile vendor and home delivery service in suburban areas.

Table 1. Main items of questionnaire survey

Items	Details
Individual attributes	- Address - Sex - Age - Family structure - Certification of care need - Pain-free walking time - Availability of car and motorbike
Public transport conditions	- Walking time to access to the nearest station - Walking time to access to the nearest bus stop (including share-ride taxi)
Grocery shopping environment	- Type of the nearest grocery store - Distance from home to the nearest grocery store - Availability of “mobile vendor” and “home delivery service” - Presence of the person who support grocery shopping
Difficulty with grocery shopping	- Difficulty with grocery shopping
Use frequency of shopping support services	- Use frequency of shopping support services such as “mobile vendor” and “home delivery service”
Needs of shopping support services	- Needs for introduction (including improvement) of shopping support services such as “mobile vendor” and “home delivery service” - Potential demand for shopping support services - WTP (willingness-to-pay) for shopping support services - Change of trip demand to central town area by introducing (including improving) shopping support services such as “mobile vendor” and “home delivery service”

The main questionnaire items are individual attributes, public transport conditions, grocery shopping environment, difficulty with grocery shopping, use frequency and needs of shopping support services as shown in Table 1. The respondents are residents in Hidakagawa town except students and pupils, who were randomly sampled.

As a result, 1,749 respondents were obtained from distributed 6,000 questionnaire sheets.

4. PUBLIC TRANSPORT CONDITIONS AND PRESENT SITUATION OF PFD

4.1 Public Transport Conditions

As for the accessibility to the nearest station, all residents in Nakatsu and Miyama villages and a half of residents in Kawabe town cannot access to the nearest station within 30 minutes on foot, as shown in Figure 4, because of the location of each residential area (See Figure 1).

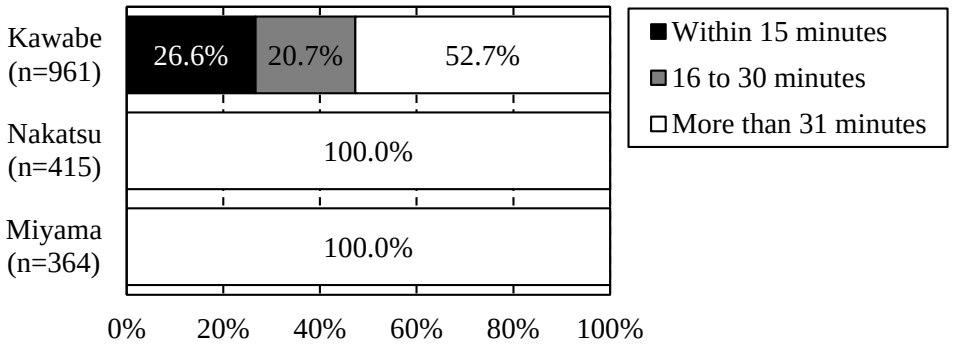

Figure 4. Walking time to access to the nearest station

On the other hand, almost all of residents are able to access to the nearest bus stop within 15 minutes on foot, as shown in Figure 5.

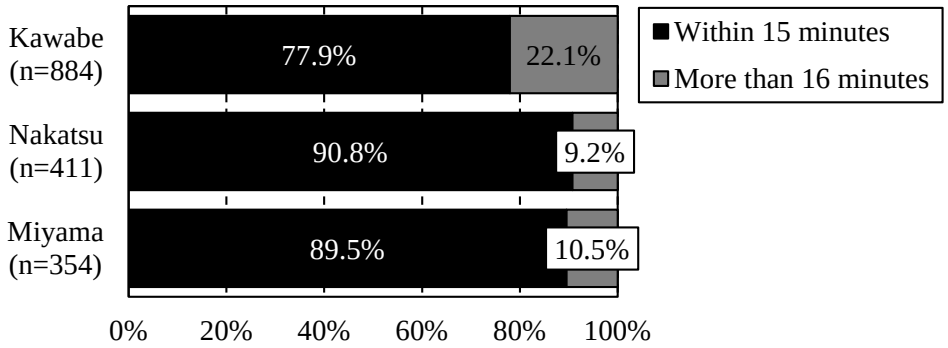

Figure 5. Walking time to access to the nearest bus stop

4.2 Ratio and Age Distribution of PFD

The Figure 6 shows the result concerned with the difficulty with grocery shopping. In this study, the PFD are respondents who answered "*Usually difficult*", "*Sometimes difficult*" and "*Occasionally difficult*", to question "*How often do you have difficulty with grocery shopping*?".

According to this figure, the ratio of PFD in Nakatsu village is the highest in Hidakagawa town. Therefore, it can be seen that factors other than public transport conditions also have an influence on difficulty with grocery shopping.

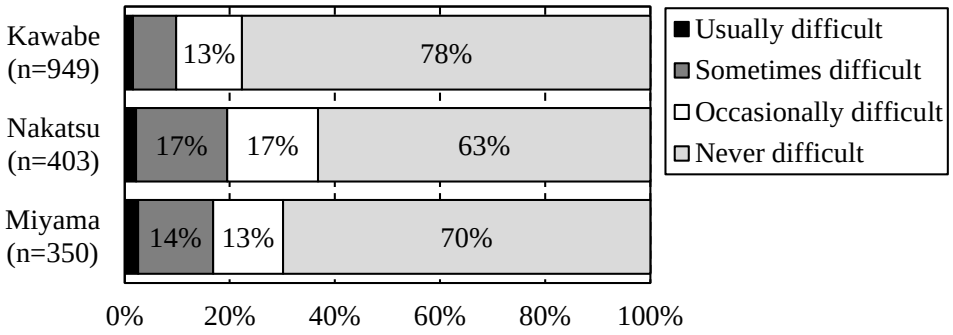

Figure 6. Difficulty with grocery shopping

The Figure 7 shows the age distribution of PFD. As can be seen from this figure, some of those under 65 years old have difficulty with grocery shopping.

Therefore, it can be said that those under 65 years old should be taken into consideration to estimate the number of PFD and decide the shopping support services for PFD.

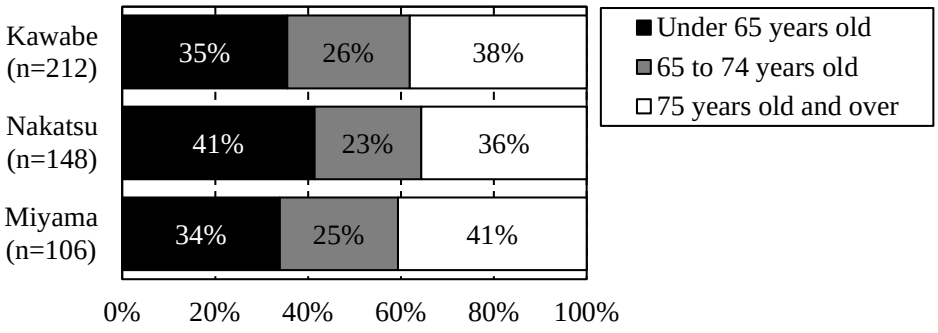

Figure 7. Age distribution of PFD

5. POTENTIAL DEMAND OF PFD FOR SHOPPING SUPPORT SERVICES

5.1 Needs of PFD for Introducing Shopping Support Services

About 80% of PFD desire the introduction of shopping support services as shown in Figure 8. Especially, about 50% of PFD need the introduction of them.

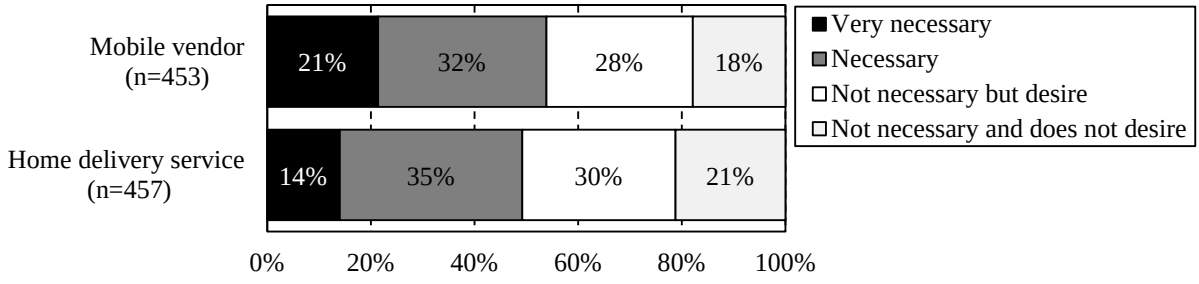

Figure 8. Needs of PFD for introducing shopping support services

5.2 Potential Demand of PFD for Shopping Support Services

Figure 9 shows the average potential demand of PFD for shopping support services. The potential demand is the incremental use frequency by introducing shopping support services, that PFD assumed.

As indicated in this figure, average potential demand of PFD for mobile vendor is 0.181 times/(person-day), and that for home delivery service is 0.196 times/(person-day).

That is, it is possible to stimulate potential demand by introducing shopping support services.

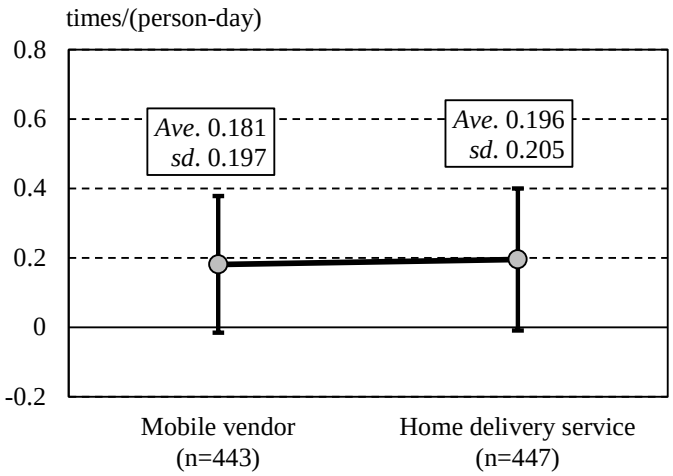

Figure 9. Average potential demand of PFD for shopping support services

5.3 WTP of PFD for Shopping Support Services

The graph of Figure 10 illustrates the average WTP(willingness-to-pay) of PFD for shopping support services. Here, WTP means the charge of the service and elicitation method is payment card.

As this graph indicates, average WTP of PFD for mobile vendor is 205.3 JPY/time, and that for home delivery service is 185.0 JPY/time.

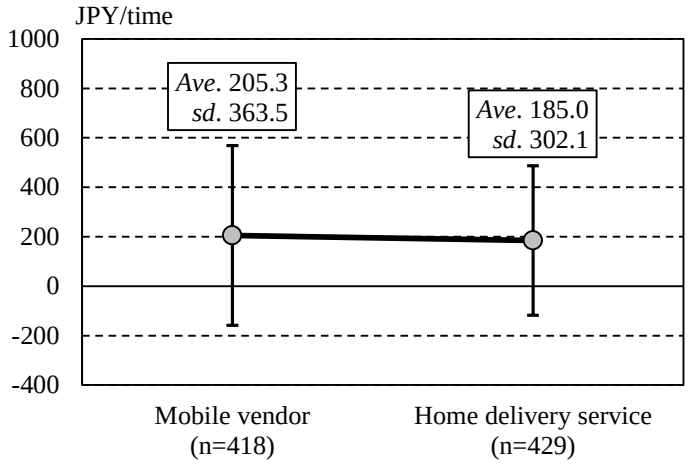

Figure 10. Average WTP of PFD for shopping support services

6. ANALYSIS ON THE CHANGE OF TRIP DEMAND TO CENTRAL TOWN AREA

6.1 Change of Trip Demand to Central Town Area by Introducing Shopping Support Services in Suburban Areas

Figure 11 shows the result of answers of PFD to question "*If the shopping support services are introduced, will you change the trip demand to central town area*?".

As Figure 11 shows, more than 60% of PFD think that the trip demand to central town area will decrease by introducing shopping support services.

Accordingly, it can be said that it is important to consider and decide the shopping support services based on not only local needs but also social influences and so on.

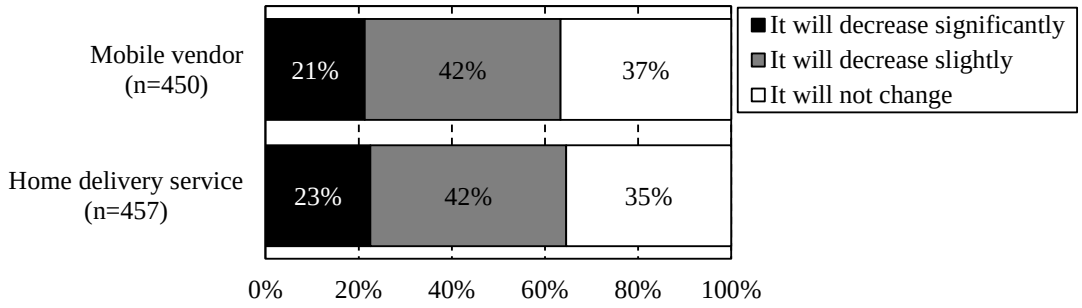

Figure 11. Change of trip demand to central town area by introducing shopping support services

6.2 Influence Factors of the Change of Trip Demand to Central Town Area by Introducing Shopping Support Services in Suburban Areas

In this section, influence factors of the change of trip demand to central town area by introducing shopping support services are clarified by using the quantification theory type I.

The change of trip demand is assumed by the ordinal scale such as "*significantly*", "*slightly*" and "*not change*". Therefore, it is necessary to transformed it into ratio scale in order to use the quantification theory type I. Then, in this analysis, "-2", "-1" and "0" points are given to each answer "*It will decrease significantly*", "*It will decrease slightly*" and "*It will not change*", respectively.

All results of analyses in this section are based on only data of PFD. They are without multicollinearity, and all independent variables achieve statistical significance based on one-way analysis of variance.

6.2.1 Mobile vendor

Figure 12 shows that the result of analysis on influence factors of the change of trip demand to central town area by introducing mobile vendor.

As the Figure 12 indicates, those who think the trip demand to central town area will decrease are 1) 75 years old and over, 2) support required or need of nursing care, 3) cannot walk more than 21 minutes without pain, 4) do not own private car, 5) cannot access to the nearest station within 1 hour on foot, 6) cannot access to the nearest bus stop within 3 minutes on foot, and 7) live in the area where mobile vendor and home delivery service are not operated.

Hence, PFD with low physical function who live in the area having poor public transport conditions and poor grocery shopping environment, would decrease trip demand to central town area by introducing mobile vendor.

Independent variables			Categorical values
Individual attributes	Age	Under 65	
		65 to74	
		75 and over	
	Certification of care need	Not requiring/Independence state	
		Support required/Need of nursing care	
	Pain-free walking time	Within 10 min	
		11 min to 20 min	
		More than 21 min	
	Private car	Own	
		Not	
Public transport conditions	Walking time to access to the nearest station	Within 1 hour	
		More than 1 hour	
	Walking time to access to the nearest bus stop	Within 3 minutes	
		More than 4 minutes	
Grocery shopping environment	Mobile vendor or home delivery service	Available	
		Not	
Constant term		**Multiple correlation coefficient**	**-0.2 -0.1 0 0.1 0.2**
-0.8213		0.30	

Figure 12. Result of the quantification theory type I for mobile vendor

6.2.2 Home delivery service

Figure 13 shows that the result of analysis on influence factors of the change of trip demand to central town area by introducing home delivery service.

As the Figure 13 indicates, those who think the trip demand to central town area will decrease are 1) 75 years old and over, 2) cannot walk more than 11 minutes without pain, 3) do not own private car, 4) cannot access to the nearest station within 3 minutes on foot, 5) cannot access to the nearest bus stop within 3 minutes on foot, 6) live in the area where mobile vendor and home delivery service are not operated, and 7) cannot ask other person to buy some foods on behalf of ownself every time.

Independent variables			Categorical values
Individual attributes	Age	Under 74	
		75 and over	
	Pain-free walking time	Within 10 min	
		More than 11 min	
	Private car	Own	
		Not	
Public transport conditions	Walking time to access to the nearest station	Within 3 minutes	
		More than 4 minutes	
	Walking time to access to the nearest bus stop	Within 3 minutes	
		More than 4 minutes	
Grocery shopping environment	Mobile vendor or home delivery service	Available	
		Not	
	Person who supports grocery shopping every time	Presence	
		Absence	
Constant term		**Multiple correlation coefficient**	**-0.5 -0.25 0 0.25 0.5**
-0.8507		0.35	

Figure 13. Result of the quantification theory type I for home delivery service

Therefore, as the same as the case of mobile vendor, the trip demand to central town area of PFD with low physical function who live in the area having poor public transport conditions and poor grocery shopping environment, would decrease by introducing home delivery service.

7. CONCLUSION AND NEXT

This study focused on the change of trip demand to central town area as one of social influences, and mainly aimed to clarify the influence factors of the change of trip demand to central town area by introducing shopping support services in suburban areas. These data must be important to investigate the shopping support services for PFD.

As a result, it was cleared that PFD need and require some kinds of shopping support services. On the other hand, their services may decrease the trip demand to the central town area. That is to say, it suggests that consideration and decision of shopping support services from viewpoints of some side effects are necessary. It can also be said that local government should consider introducing transport services such as bus, share-ride taxi and DRT in order to support daily shopping for PFD at the first phase. And also, local government must investigate the introduction of shopping support services, in taking account of these findings obtained in this study.

Future issues are summarized as follows.

1) It is necessary to analyze about other positive and negative social influences such as “change of shopping frequency at local grocery stores”, “change of frequency of going-out” and “change of social capital”.
2) Almost all of results in this paper are based on SP data. Because there were a few pioneering projects of shopping support for PFD in Wakayama prefecture, when this research project was just started. Therefore, next research should focus on some shopping support projects for PFD in Wakayama prefecture which have been increasing recently, and verification of some findings in this research should be important, through the detail analyses based on RP data.

ACKNOWLEDGEMENTS

This study was supported by JSPS KAKENHI Grant-in-Aid for young Scientists (B) of which number is 25820253. And, I would like to give thanks to town officials and people in Hidakagawa town for helping in our questionnaire survey.

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