Food Access Condition and Residents' Evaluation on Daily Shopping in a Regional Metropolis: A Case Study Based on a Web-based Survey in Sendai City, Miyagi Prefecture

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Contents

1. Introduction

Ensuring food availability is essential for a healthy life and reducing food access insecurity is one of the most urgent social challenges. According to Policy Research Institute, Ministry of Agriculture, Forestry and Fisheries (PRIMAFF; 2011), food access problem refers to 'the situation where older people face inconvenience or difficulty in accessing food', and as of 2015, 24.6% of those aged 65 and above and 33.2% of those aged 75 and over nationwide have been categorised as 'food access difficult population' facing food access problems (Takahashi, 2020). This term covers other similar terms, such as shopping refugees, food deserts, and household food. Thus, the food access problem is comprehensive as it covers problems regarding physical and social access to food[1]. Although the problems and corresponding terms have similar conceptual schemes, their contexts differ depending on the country. For instance, in G7 countries, which are the major global leading sovereignties, the study's focuses largely on the poor, who are insecure about their socioeconomic situation resulting from the sex, race, ethnicity, or occupation. The research focuses on the analysis of economic rather than physical access insecurity associated with the ageing of the population, as is the case in Japan[2].

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Food access problems can be broadly divided into two factors: supply and demand-side. Supply-side factors refer to circumstances wherein no individual directly commits to its change such as store closure and/or withdrawal and the condition of infrastructure. Demand-side factors include personal conditions such as individual attributes, the decline in mobility due to ageing, and the weakening of connections with family and residents. These problems negatively impact the nature of the local community, such as living infrastructure and food intake, which is an extension of food procurement[3]. However, Yakushiji (2015) pointed out that even those aged under 65 years, who are not the main focus of food access problems, experience inconvenience and difficulties during shopping, similar to those who are over 65 years, specifically, in metropolises. The research suggested that the breadwinner's occupation, the presence of a nearby family member, and that of a certified carer in the household influence food access conditions of those under 65 years.

Since people under 65 years have been compared to older people in previous studies such as PRIMAFF (2011), Takahashi (2020), and Yakushiji (2015), the characteristics of those under 65 years and mechanism(s) of why they could face food access problems have not been discussed sufficiently. Moreover, regarding 'metropolis', which is an area where the food access problems occur for those under 65 years, case studies examined in the previous studies were limited to Tokyo. For depicting a more detailed picture of food access problems in metropolises, more case studies targeting regional metropolises (chihou chūsū toshi: *地方中枢都市*) should be added. Therefore, the study aims to examine a case study in a regional metropolis in Japan, analyse the current circumstances and occurrence factors of food access problems based on the residents' evaluations, and capture more characteristics of young residents.

2. Hypothesis

This study assumes that a regional metropolis has characteristics similar to those of the metropolitan areas (Tokyo) examined in previous studies, and that food access insecurity occurs for older and non-older people. The detailed causes will be examined with variables related to the age, gender, household and income status of the shopper,

physical distance to the shop, and means of transport, referring to previous studies (Kikushima & Takahashi, 2018; Takahashi 2020; and Yakushiji, 2015). The hypotheses for each variable are as follows:

First, store proximity comprises two categories: one-way distance to the most used store and travel time. Since Yakushiji (2015) confirmed that the decline in proximity contributes to the occurrence of shopping difficulties, specifically those who live 2 km or more away from a grocery store, it is assumed that each result is positive.

Second, factors related to individual attributions could fall into five minor categories: age, sex, household income, household composition, and occupation. As Yakushiji (2015) highlighted, certain people aged under 65 years struggle with daily shopping, similar to older people. Considering this, a variable for age would turn positive if they are aged under 60s. The variable may not be significant, as it may occur regardless of whether the person is older or not. As an objective is to capture the characteristics of the non-elderly population, the respondents were divided into two groups regarding those under 60s.

Regarding the respondents' sex, it is expected that females tend to play a more active role in daily grocery shopping. Thus, the male dummy could become positive. For household income, the affluence of financial power would enable people to use more food procurement methods, regardless of the cost. Hence, a variable set for household income is expected to become negative, similar to previous studies.

The household composition (or the number of people) is directly related to the amount of food that needs to be prepared. As the number of people increases, the financial and time costs of preparing a meal increase; thus, the result is expected to be positive.

Three types of occupations were examined: full-time workers, part-time workers, and housewives or househusbands. It will be relatively difficult to find time for shopping, as each type of work involves a certain time commitment. Therefore, it was assumed to be positive for each occupation. Moreover, since previous research (Yakushiji, 2015) found that the results were significantly positive at the 10% level for part-time workers, the results are likely to be particularly significant for part-time workers.

Third, regarding the means of transport, the use of private cars was examined. It should greatly reduce the burden of shopping, as it substantially compensates for

the individual's mobility. Hence, the private car use dummy could be negative.

Finally, regarding the presence or absence of persons in the household who generally require assistance in some form of physical, instrumental, or emotional support. In this case, the term 'persons in need of assistance' refers to persons who need some kind of support, such as persons with disability certificates, those who require nursing care, and preschool children. Through assistance, caregivers are subject to physical and time constraints, which are likely to increase the shopping burden. Therefore, the results regarding the presence or absence of a person requiring physical assistance would show a positive sign.

3. Research Design and Method

1) Survey Design

Sendai City in Miyagi Prefecture was selected as the survey site. As of 31 March 2021, the total population was 1,925,629, and the ageing rate for people aged 65 years and older was 27.6 %[4]. According to the Food Access Map (PRIMAFF, 2018), as of 2015, the population of Sendai City with difficult food access was more than 20%. However, the hilly and mountainous areas and the coastal areas that were affected by the 2011 Great East Japan Earthquake are the only areas in Miyagi Prefecture where the difficult population is 50% or more[5].

A web survey for monitors registered to Rakuten Insight Co., Ltd. was conducted from 22 to 26 November 2019 for data collection. The respondents were 300 males and females aged from 18 to 79 living in Sendai City (50 each in their 20s, 30s, 40s, 50s, 60s, and 70s). Respondents, who are registered monitors with the survey company and obtain their consent to participate in this research, were selected from those who purchased food more than once or twice per week. The response rate was 100%, and the number of valid responses was 299, excluding one unidentifiable respondent.

The respondent profiles are presented in Table 1. A total of 54% were men, and the rest were female. Office workers accounted for the largest proportion (41%). Regarding the number of household members, 34.0% selected 'living with children', 31.0% answered 'married couples', 22.3% answered 'single', and 12.7% selected 'others'.

Table 1.　Socio-demographic Characteristics of the Respondents

		Number	Ratio (%)
Sex	Male	161	54.0
	Female	138	46.0
Age	Under 20s	49	16.3
	30s	50	16.7
	40s	50	16.7
	50s	50	16.7
	60s	50	16.7
	70s	50	16.7
Number of household members	Single	67	22.3
	Married couple	93	31.0
	Live with child(ren)	102	34.0
	Others	37	12.7
Presence of specific household members	Preschool	41	17.6
	Over 65	72	30.9
	Certified person requiring nursing care	12	5.2
	Person with a disability certificate	9	3.8
	Not applicable	117	50.6
Occupation	Student	11	3.7
	Housewife/husband	33	11.0
	Part-timer	41	13.7
	Office worker	123	41.0
	Civil servant	12	4.0
	Self employed	23	7.7
	Pensioner	48	16.0
	Others	9	2.6
Household income (JPY)	Below 1 million	13	4.3
	Bellow 1-3 million	54	18.3
	Below 3-5 million	93	31.0
	Below 5-7 million	68	22.7
	Below 7-10 million	43	14.3
	Below 10-15 million	21	7.0
	Above 15 million	7	2.3

Source : Author
Note : 1) Household income includes remittance and livelihood protection.

2) Method of Analysis

In this study, a binary logit model was applied to estimate the results. According to Greene (2011), this model can be described as follows:

$$P_i(Y_i = 1) = \frac{e^{x\beta}}{1 + e^{x\beta}}.$$

The binary logit model is a type of regression model that considers the response Y_i assumes two values: 0 or 1. P_i is the probability of the occurrence of one event, β is a vector of parameters, X is a vector of the factors affecting, and i is an individual

respondent. This study estimates consumer behaviour as to whether an individual has experienced difficulty in daily shopping.

Therefore,

$$y_i = \begin{cases} 1 & \text{if } y_i^* > 0 \ \text{(if an indivisual struggled with daily shopping)} \\ 0 & \text{otherwise,} \end{cases}$$

The marginal effect for analysing the binary logit model is calculated based on the following formula (Greene, 2011):

$$ME = \frac{\partial \Lambda(X'\beta)}{\partial X} = \Lambda(X'\beta)[1 - \Lambda(X'\beta)]\beta$$

where X is an independent variable matrix in the logistic model, β is a matrix of parameters in the logit model.

For estimations, Stata 14.2 was used.

4. Estimation and Discussion

1) Estimation Results

The variables and descriptive statistics used for the estimation are listed in Table 2. The following 12 independent variables were set based on the following hypothesis.

For the estimation, considering that the proximity of shops includes factors of distance and travel time, two models are specifically set: Model I applies to distance and Model II to travel time. The estimation results using the binary logit model are presented in Table 3. Pseudo R2 is 0.1378 for Model I and 0.2018 for Model II, and is considered reliable.

In Model I, the estimated coefficient of 'Private car usage dummy' is negative and significant at the 1% level. The estimated coefficients of 'Household income' are negative and significant at the 5% level. The estimated coefficients for 'Distance (one way)' and 'Under 60s dummy' were positive and significant at the 10% level.

The marginal effects show that inconvenience and difficulty in shopping may increase by 2.2% for every increment in the parameter. Similarly, being under theage of 60 years suggested a 5.3% increase in inconvenience and difficulty with shopping.

Table 2. Descriptive Statistics

Variables	Definitions of variables	Mean	Std. dev.	Hypo-thesis
Dependent variable				
Difficulty in shopping	0=No inconvenience or difficulty, 1=Feeling inconvenienced or difficulty	0.103	0.305	
Independent variables				
I : Distance	I : 1= Less than 500m, 2= Less than 500m - 1 km, 3= Less than 1- 2 km, 4= Less than 2 - 5 km, 5= Less than 5 to 10 km, 6= More than 10 km	2.411	1.182	+
II : Travel time	II : 1= Less than 5 mins, 2= Less than 5 - 10min, 3= Less than 10 - 15 mins, 4= Less than 15 - 30 mins, 5= More than 30 mins	2.257	0.939	+
Under 60s dummy	Under 60s ＝1, others＝0	0.665	0.499	-
Sex dummy	Male= 1, female= 0	0.538	0.499	-
Household income	1= Less than 1 million yen, 2= Less than 1 to 3 million yen, 3= Less than 3 to 5 million yen, 4= Less than 5 to 7 million yen, 5= Less than 7 to 10 million yen, 6= Less than 10 to 15 million yen, 7= More than 15 million yen	3.551	1.365	-
Household composition	1= Single-person households, 2 = Two-person households (two couples or other two-person households), 3 = Households with three or more persons	2.180	0.773	+
Full-time employee dummy	1= Full-time employee (company employee or civil servant), 0= Others	0.451	0.498	+
Part-time employee dummy	1= Part-time employment (part-timer or those who answered 'temporary employment' in the optional comment field), 0= Others	0.143	0.351	+
Housewife/ husband dummy	1= Housewife/ husband, 0= Others	0.113	0.317	+
Private car use dummy	1= Go shopping in a private car driven by myself, someone in my household or someone else in my household, 0= Others	0.602	0.490	-
Living with someone who needs assistance dummy	1= Living with a person who needs some kind of assistance (preschool child, person who needs nursing care, those with disability certificate), 0= Others	0.200	0.401	+

Source: Author

Yet, the inconvenience and hardship could decrease by 2.4% and 12%, respectively, with an increase in household income and accessibility to private cars.

In Model II, the estimated coefficients of 'Travel time (one way)' and 'Private car use dummy' were positive and negative, respectively, and were significant at the 1% level. The estimated coefficients for 'Household income' were negative and

Table 3. Estimation Results

Variables	Model I (Distance)					Model II (Travel Time)				
	Coef.		z value	ME		Coef.		z value	ME	
Distance (one way)	0.345	*	1.80	0.022	*					
Travel time (one way)						0.839	***	3.82	0.045	***
Under 60s dummy	0.910	*	1.61	0.053	*	1.011	*	1.67	0.048	*
Sex dummy	-0.494		-1.04	-0.032		-0.549		-1.10	-0.030	
Household income	-0.383	**	-2.00	-0.024	**	-0.402	**	-1.96	-0.021	**
Household composition	0.489		1.39	0.031		0.366		1.01	0.019	
Full-time employee dummy	-0.384		-0.66	-0.024		-0.379		-0.60	-0.020	
Part-time employee dummy	-0.851		-1.05	-0.043		-0.836		-0.97	-0.035	
Housewife/ husband dummy	0.384		0.55	0.028		0.271		-0.37	0.016	
Private car use dummy	-1.535	***	-2.95	-0.120	***	-1.320	***	-2.84	-0.084	***
Living with someone who needs assistance dummy	0.576		1.07	0.043		0.941	*	1.66	0.066	*
Constant	-2.404	***	-2.69			-3.570	***	-3.70		
Log-likelihood	-85.8					-79.5				
Pseudo R2	0.1378					0.2018				
Sample size	299					299				

Source: Author

Note: 1) ***, **, and * are significant at the 1%, 5%, and 10% levels, respectively.

significant at the 5% level. Moreover, 'Under 60s dummy' and 'Living with someone who needs assistance dummy' were positive and significant at the 10% level. Based on the comparison of Pseudo R2, Model II seems more fittable.

The marginal effects show that inconvenience and difficulty with shopping could increase by 4.5% for every increment in the parameter by 4.8% when the age of the person is under 60s, and by 6.6% for those who need assistance in the household. However, it could decrease by 2.1% with higher household income and by 8.4% when using a private car.at the 10% level. Based on the comparison of Pseudo R2, Model II seems more fittable.

The marginal effects show that inconvenience and difficulty with shopping could increase by 4.5% for every increment in the parameter by 4.8% when the age of

the person is under 60s, and by 6.6% for those who need assistance in the household. However, it could decrease by 2.1% with higher household income and by 8.4% when using a private car.

2) Discussion

(1) Model I: Distance

It can be inferred that people with food access difficulties under Model I conditions are those who live far away from grocery shops, do not have access to a private car, are aged under 60 years, and have a low household income.

First, 'Distance (one way)' is significant at the 10% level of significance. This result supports previous studies showing that an increase in the proximity of shops causes food access problems. Moreover, the negative in the 'Private car use dummy', which can complement the mobility of the individual, indicates the importance of ensuring physical access to the shop.

Second, the fact that the 'Under 60s dummy' was positive and significant at the 10% level, as assumed in the hypothesis, suggests the occurrence of food access problems among young people; it supports Yakushiji (2015). Currently, these problems are mainly considered as affecting the older population. These research findings could help show the necessity of further research on how young people face the food access problem.

Moreover, a result about 'Household income' suggests that stability and sufficiency in a household's financial situation ease difficulties in shopping. Financial power could directly affect the choice and frequency of food to purchase and grocery shops to visit; therefore, a correlation could be found in this research.

(2) Model II: Travel Time

People with food access difficulties under Model II conditions could be those who take longer to travel to a grocery shop, do not have access to a private car, are under 60s, have a lower household income, and live with someone who needs assistance. The outcomes of Model II show a tendency similar to that of Model I. However, 'Travel time (one way)' was positively significant at the 1% level, and 'Living with someone who needs assistance dummy' was positively significant at the 5% level.

The results for 'Travel time (one-way)', along with 'Distance (one-way)' in Model I, support previous studies on the importance of shop proximity. The

importance of the 'Private car use dummy' is also evident in Model II.

Regarding the result of 'Living with someone who needs assistance dummy', which was positively significant at the 5% level, this outcome supports the hypothesis that assisting as a caregiver in a household imposes a burden on shopping behaviour. This might suggest that the food access problem is caused by subjective factors, such as reduced physical mobility due to ageing, and the environment.

5. Conclusion

This study concludes that food access problems in regional central cities and their causes are as follows. First, it is not limited to older residents. From the estimation, the occurrence of certain access anxiety was confirmed even in those under 60 years in a regional metropolis, Sendai city, supporting the results of previous studies in Tokyo. Second, food access conditions depend on (1) individuals' physical mobility determined by direct factors such as the physical capability to move, and indirect factors such as the presence of those who need additional care in a household, and (2) individuals' financial capability to purchase sufficient food to meet their needs. It is also important to note that unlike the results of previous studies in metropolitan areas (Yakushiji, 2015), none of the occupational variables were significant.

However, this study has several issues that need to be addressed in future research. As indicated in the discussion section, the mechanism of food access problems among younger residents needs further discussion. The results show that the degree of economic and environmental (social) access is as important as physical access to shops when considering the issue of food access. Moreover, the fact that the variable on occupation did not reach significance suggests that variables could be more diverse when analysing the socio-economic situation. Detailed discussions of economic and environmental (social) access are actively taking place in the area of food security, as represented by the FAO (2006). Therefore, a survey should be implemented to allow for consideration of economic and environmental (social) access. Moreover, it is ideal that future research include more variations in food procurement methods such as the development of food delivery services and provide separate estimations for those aged under 65 years and above. Grasping a more detailed picture of the food access circumstances in Sendai city, improvements in data collection, such

as a door-to-door survey of specific areas by mail, should be considered in future surveys.

Acknowledgement

Endnotes

1. Shopping refugees are those who have difficulty shopping (Sugita, 2008), and those who are vulnerable to it, specifically, among the elderly aged 60 and over (Ministry of Economy, Trade and Industry, 2010). The food desert problem is in areas where (1) socially vulnerable people (especially older people) gather and (2) shopping convenience or connections with family and residents are weakened (decrease in social capital) (Iwama, 2017). For more details, see Yakushiji (2015). Household food security is achieved when household members are confident that they have financial and physical access to adequate and acceptable food. The proximity of stores is a measure to estimate the degree of achievement. For details, see Emanuele et al. (2019), DEFRA (2010), and Lambie-Mumford et al. (2014).

2. For examples of food access and corresponding studies in G7 countries see Feargal, M., Jennifer, B. &Matthew, W. (2016), Filippini, R., Mazzocchi, C., & Corsi, S. (2019), Kirkpatrick, S., et al. (2015), Tasta, A & Jackson, D (2019), and Wolf-Powers, L. (2017).

3. Kikushima (2018) and Kikushima & Takahashi (2020) use individual data from the Ministry of Health, Labor and Welfare's 'National Health and Nutrition Survey' to analyse the effects of difficulty in accessing grocery shops on food intake. It has been pointed out that people aged 65 and over who have difficulty accessing the diet have one that is biased toward carbohydrate intake represented by grains.

4. Miyagi prefectural government (2021).

5. A map that visualises the occurrence of food access problems. This map depicts people aged 65 who live 500 meters away from the store and have difficulty using

a bicycle and categorise them as those who have a problem with food access circumstances. For the map, see PRIMAFF (2018).

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