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## Determinants of Unequal Distribution of Fresh Vegetable and Cut-Vegetable Consumption across Age in Japan

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### **Abstract:**

*This paper examined two issues. First, the hypothesis that the elderly tend to consume more fresh vegetables than other consumers because of their different food orientations, and second, a comparison of the impact of food orientations towards cut and fresh vegetables on purchasing behavior. Based on these issues, we showed the implications of promotional activities for vegetable purchases. This paper used the structural equation modeling analysis method, which can identify causal connections. The results were as follows: First, we were able to confirm the following causal connection: the elderly purchase fresh vegetables frequently because they are strongly health- and weakly convenience-oriented. Second, in the case of cut vegetables, both health-orientation, as in the case of fresh vegetables, and convenience-orientation were found to have a positive effect on purchase frequency. This study further confirmed that cut vegetables are positioned as a product matching the recent convenience-oriented trend. Based on this knowledge, encouraging young people to be more conscious about their health and to avoid being convenience-orientated, by cooking for themselves, may be useful in promoting the consumption of fresh vegetables.*

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—Case Study of Consumers in the Tokyo Metropolitan Area—

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This paper examined two issues. First, the hypothesis that the elderly tend to consume more fresh vegetables than other consumers because of their different food orientations, and second, a comparison of the impact of food orientations towards cut and fresh vegetables on purchasing behavior. Based on these issues, we showed the implications of promotional activities for vegetable purchases. This paper used the structural equation modeling analysis method, which can identify causal connections.

The results were as follows: First, we were able to confirm the following causal connection: the elderly purchase fresh vegetables frequently because they are strongly health- and weakly convenience-oriented. Second, in the case of cut vegetables, both health-orientation, as in the case of fresh vegetables, and convenience-orientation were found to have a positive effect on purchase frequency. This study further confirmed that cut vegetables are positioned as a product matching the recent convenience-oriented trend. Based on this knowledge, encouraging young people to be more conscious about their health and to avoid being convenience-orientated, by cooking for themselves, may be useful in promoting the consumption of fresh vegetables.

Keywords: Path analysis, Vegetable, Consumer Behavior, Health orientation

## I. Introduction

It is known that the amount of vegetables consumed by Japanese people varies significantly among age groups. The results of the National Health and Nutrition Survey in Japan by the Ministry of Health, Labour and Welfare show the vegetable intake per day per person in 2015 varies widely among age groups: 241.3 g for the 20s, 256.2 g for the 30s, 286.5 g for the 50s and 331.2 g for the 60s.

What causes different consumption behaviors among age groups? A survey by Radishbo-ya Co., Ltd.<sup>\*1)</sup> asked the 907 respondents who said “I like very much” or “I rather like” vegetables why they like vegetables. The result shows that the percentage of respondents who answered “because they are good for health” is higher in older age groups. It also shows that the percentage of respondents who gave “low prices” and “easy to eat without effort” as reasons for their liking for vegetables is higher in older age groups.

Thus, different age groups have different reasons for liking vegetables. As a possible reason for such differences, this paper suggests the difference in “food orientation” among age groups. For example, as people age, they have more health problems and therefore become more health-oriented, and more likely to consume vegetables, which are good for health. In Japan, where the seniority-based wage system prevails, older people earn higher incomes and therefore do not need to save money. This weakens their “economic orientation,” making them evaluate vegetables as having “low prices.”<sup>\*\*2)</sup> Moreover, older people have habitually preferred

eating at home, which weakens their orientation toward convenience, resulting in their evaluation of vegetables as “easy to eat without effort.”<sup>\*3)</sup> This difference in food orientation, such as health orientation, may be a determinant of the different vegetable consumption behaviors of different age groups. Thus, the primary task of this paper is to set a hypothetical model in which differences in consumer attributes, such as age, influence their “food orientation” and their food orientation influences their fresh vegetable purchasing behavior, and verify the model.

This paper also aims to examine how the influence of food orientation on purchasing behavior changes depending on the way vegetables are served. To be specific, focusing on cut vegetables, which are cut in advance and sold in packs, this paper compares the impact of food orientation on purchasing behavior for cut vegetables and fresh vegetables as the second task of the paper. As meals are becoming increasingly simplified and convenient, this paper presents the characteristics of cut vegetables and confirms their effectiveness. Thus, the objective of this paper is to examine the results of the above two tasks and present implications on for the expansion of vegetable consumption.

The preceding studies include those by Giskes et al. (2002) and Laaksonen et al. (2004), which examined the relationship between income and vegetable consumption, Wandel (1995), which shows the influence of education, household composition and annual income, and Ozawa et al. (2013), which discusses the influence of the status of employment, household annual income, etc. Regarding cut vegetables, Ragert et al. (2004) examines the points that are given high priority by consumers when purchasing or consuming cut vegetables, and Tamaki et al. (2016) compares the annual frequency of purchasing cut vegetables per person by household composition, gender and age group. As far as I know, however, there is no literature that clarifies the interrelationships among consumer attributes, their various forms of “food orientation,” such as health orientation and orientation toward convenience, and their purchasing behavior.<sup>\*4)</sup>

Specifically, path analysis is employed. An advantage of path analysis is that it enables verification of a series of causal connections by testing goodness of fit of an entire model. For example, it can verify a series of causal connections, such as: “older people are more strongly health-oriented, which increases the frequency of their purchasing fresh vegetables.” Thus, this is a proper analysis method for addressing the primary task of this paper. In this paper, “fresh vegetables” are defined as vegetables, whole or cut into halves or so for adjusting quantity, while “cut vegetables” are defined as vegetables pre-cut for cooking or for salads. The term “vegetables” includes both forms.

## Notes

- \*1): In reference to “Survey on Attitudes toward Vegetables 2010,” a press release document by Radishbo-ya Co., Ltd. [https://corporate.radishbo-ya.co.jp/company/press/images/survey\\_vegetable2010.pdf](https://corporate.radishbo-ya.co.jp/company/press/images/survey_vegetable2010.pdf) (accessed on April 4, 2017), presenting the results of an online questionnaire survey conducted in August 2010, targeting 1,000 married men and women in age groups between 20s and 60s.
- \*2): In this paper, “economic orientation” is considered as a tendency to reduce food costs.
- \*3): A survey by Japan Finance Corporation (JFC) actually shows that those in older age groups are more health-oriented and less conscious about economy and convenience. In reference to the press release by Japan Finance Corporation [https://www.jfc.go.jp/n/release/pdf/topics\\_160901d.pdf](https://www.jfc.go.jp/n/release/pdf/topics_160901d.pdf) (accessed on April 4, 2017) presenting the results of an online questionnaire survey conducted in July 2016, targeting 2,000 men and women in age groups between 20s and 70s.
- \*4) Though Yagi et al. (2015, 2016) demonstrate that attributes of consumers influence their “food

orientation” and determinate their consumption of fruits and cut fruits.

## II. Hypothesis

This paper employs “health orientation,” “economic orientation” and “convenience orientation” as variables for “food orientation.” These three variables are set based on the results of the above-mentioned survey by Radishbo-ya Co., Ltd. explaining the reasons for older people’s liking vegetables. As variables representing consumer attributes, age, gender (female dummy), household attributes (two-or-more-person household dummy), and food cost per person are used.<sup>\*5)</sup> For consumption behavior with regard to fresh vegetables and cut vegetables, respective purchasing frequencies are used.

First, the hypotheses below are formulated regarding a model to explain the frequency of purchasing fresh vegetables.

Hypothesis 1: As people age, the food cost per person increases, resulting in weaker “economic orientation.”

In Japan, where the seniority-based wage system prevails, older people tend to earn higher income. It is therefore assumed that the food cost per person rises, resulting in weaker economic orientation.

Hypothesis 2: Older people are more strongly health-oriented and less convenience-oriented.

Based on the grounds provided in the previous section.

Hypothesis 3: Women are more strongly health-oriented and less convenience-oriented.

For health orientation, according to the “Survey on Awareness and Reality concerning Health Management” conducted by GMO Research, Inc.<sup>6)</sup>, in which 44.8% of male respondents chose “Doing nothing in particular” for their health while 25.2% of female respondents chose the same. For convenience orientation, according to Tamaki et al.<sup>6)</sup>, which statistically demonstrated that the frequency of eating out or eating home-meal replacements is significantly higher for men than women.

Hypothesis 4: Two-or-more-person households are less convenience-oriented and with lower food cost per person.

Kusakari (2006) points out the diminishing household scale as a determinant factor of the outsourcing of meals, and thus assumes that two-or-more-person households have weaker orientation toward convenience. Similarly, food cost per person is assumed to decline as the number of household members increases due to economies of scale.

Hypothesis 5: Women and older people are often in two-or-more-person households.

According to the national census 2015 by the Ministry of Internal Affairs and Communications, among the men and women in their 20s through 70s in Tokyo, Chiba, and Kanagawa Prefectures, the target areas of the study of this paper, women account for as low as 42.3% of single-person households. This is presumably because compared to men, women are less likely to live alone, as it is sometimes associated with danger. Thus, gender is considered to be a determinant of household composition. As for age, according to the national census 2015 by the Ministry of Internal Affairs and Communications, the number of people in single-person households in Tokyo, Chiba, and Kanagawa Prefectures by age was 1,045,000 for the 20s and 894,000

for the 30s, while it was 579,000 for the 50s and 653,000 for the 60s, showing that the number in older age group is lower than that in younger age group. Because chances for marriage increase as people get older, it is assumed that age also partly determinates household composition.

Hypothesis 6: Health orientation weakens orientation toward convenience and economy.

As for “convenience orientation,” strongly health-oriented people tend to avoid meals that they can eat without effort, such as pre-made meals sold at convenience stores. Similarly for “economic orientation,” strongly health-oriented people tend to choose foods that are relatively expensive but good for their health.

Hypothesis 7: Health orientation has a positive effect on the frequency of purchasing fresh vegetables, while economic orientation and convenience orientation have negative effects.

Regarding health orientation, the above-mentioned press release document by Radishbo-ya Co., Ltd. shows that 80.8% of the respondents say that they like vegetables “because they are good for health.” This resulted in the assumption that health orientation has a positive effect on the frequency of purchasing fresh vegetables.

As for economic orientation, 53.5% of all respondents in a survey by the Japan-Cooperative General Research Institute<sup>[2]</sup> chose “low unit selling price” as the point on which they place priority when they purchase vegetables. Thus, it is assumed to have a negative effect. Convenience orientation is also presumed to have a negative effect on consumption of fresh vegetables based on a January 2013 report by the Ministry of Agriculture, Forestry and Fisheries on the circumstances surrounding vegetable consumption, which indicates that increased orientation toward convenience in recent years is associated with a decrease in demand for fresh foods.

Hypothesis 8: Women purchase fresh vegetables more frequently than men.

For the female dummy, habitual factors that cannot be explained by indirect effects of health orientation and convenience orientation, such as that women are often in charge of housework, are assumed to influence the behavior of purchasing fresh vegetables.

Moreover, the hypotheses below are formulated for conducting path analysis regarding the model to explain the frequency of purchasing cut vegetables. For the model to explain the frequency of purchasing cut vegetables, relationships among variables for attributes and food orientation of respondents follow those explained in Hypotheses 1 through 5.

Hypothesis 9: Health orientation, convenience orientation and economic orientation have positive effects on the frequency of purchasing cut vegetables.

Health orientation is presumed to have a positive effect for the same reason as for fresh vegetables. For convenience orientation, Tamaki et al.<sup>[6]</sup> point out that as people work longer, the annual frequency of their using cut vegetables becomes higher. This resulted in the assumption that escalation of convenience orientation has a positive effect on the frequency of purchasing cut vegetables. Economic orientation is also assumed to help raise the frequency of purchasing cut vegetables because cut vegetables, which are adapted to the trend of eating alone, are associated with lower per-unit sales prices, as well as an added value of requiring no cooking skills.

Table1 Outline of Analysis Subjects

	Total (persons)	Age group(%)			Type of household(%)	
		20s and 30s	40s and 50s	60s and 70s	Single-person	Two-or-more person
Men	194	32.5	33.0	34.5	28.9	71.1
Wome	199	33.7	31.2	35.2	19.1	80.9
Occupation(%)						
	Full-time worker	Part-time worker	Student	Housewife/ husband	Unemployed	Other
Men	62.4	7.7	3.1	0.0	21.6	5.2
Wome	27.6	11.1	2.0	44.7	10.6	4.0
Monthly food cost per person(%)						
	Less than 20,000yen	20,000yen to 40,000yen	40,000yen to 60,000yen	Over 60,000yen		
Men	40.2	41.2	14.4	4.1		
Wome	50.8	38.7	8.5	2.0		

Table2. Description of Variables

Variable name	Description	Average (standard deviation)
Frequency of purchasing fresh vegetables	Choose the answers that most accurately represent the frequency of your meals, shopping, and communication with other people. [Frequency of purchasing fresh vegetables(whole or cut into halves or so for adjusting quantity)] [Frequency of purchasing pre-cut vegetables(for cooking or for salads)]	fresh vegetables 5.78(5.51)
Frequency of purchasing cut vegetables	5 times or more a week(20), 3 or 4 times a week(14), 1 or 2 times a week(6), 1 or 2 times a month(1.5), once every 2 months (0.5), once every 3 to 4 months (0.29), once every half year (0.167), once a year (0.083), never(0)  Figures in parentheses represent the number of times of purchasing per month, and are used as points.	cut vegetables 2.11(3.64)
Health orientation	[Desire to choose foods that are good for health]	5.54(1.13)
Economic orientation	[Desire to choose inexpensive foods or cost-effective foods]	5.32(1.29)
Convenience orientation	[Desire to choose foods that are ready to eat without effort]	4.96(1.23)
Age		49.12(14.84)
Female dummy	Female=1, Male=0	
Two-or-more-person househ	Two-or-more-person household=1, Single-person household=0	
Food cost per person	Choose the approximate monthly food cost of your household. (Less than 10,000 yen; 10,000 yen or more, less than 20,000 yen; followed by figures in increments of 20,000 yen up to 140,000 yen. Each figure answered was divided by the number of household members and classified as scores (20,000yen = 1point).	1.73(0.83)

Note: For health orientation, economic orientation, and convenience orientation, respondents were asked to choose from among seven answers from "I very much think so" to "I don't think so at all" in response to the question "Choose the most appropriate answers regarding your orientation related to food".

Hypothesis 10: Women purchase cut vegetables more frequently than men.

For the female dummy, habitual factors that cannot be explained with indirect effects of health orientation and convenience orientation, such as that women are often in charge of housework, are assumed to also influence the behavior of purchasing cut vegetables, which are often used for meals in households.

## Notes

- \*5) Regarding the two-or-more-person household dummy, a dummy variable is used instead of the number of household members because it is presumed that the eating behavior of single-person households, in which all meals are prepared by the sole member, significantly differs from that of two-or-more-person households, which comprise other members.
- \*6) An online questionnaire survey conducted in March 2013, targeting 100 men and 100 women in age groups from 20s through 60s nationwide, available at <https://www.gmo.jp/news/article/?id=4184> (accessed on April 4, 2017)

## III. Method of analysis

### 1 Data used

This paper uses the data of an online questionnaire survey conducted via Do House Inc. in December 2016. From among approx. 2 million consumer monitors possessed by Do House Inc., 1,323 men and women in their 20s to 70s are sampled so that they are evenly distributed in terms of area (Tokyo metropolitan area (Tokyo, Kanagawa, Chiba); Sapporo City and its surrounding areas; and Fukuoka City and its surrounding areas), age (in every 20-year old groups), gender, and annual household income (less than 3 million yen; 3 million to 8 million yen; 8 million yen or more). For analysis of this study, of the 430 respondents in the Tokyo metropolitan area, data of 393 respondents were used after omitting respondents who answered the same number for all or all but one of the questions about their food orientation.

Table 1 shows an outline of the analysis subjects. Table 2 shows the variables and fundamental statistics used for the analysis. In addition to the hypothetical model described in the previous section, a two-way arrow was drawn between economic orientation and convenience orientation. While economic orientation is explained as preference for cost-effective foods, meals that can be ready without effort are also considered as cost-effective as they require no cooking effort. Thus, there should be a residual correlation.

### 2 Method of analysis

In regular path analysis, when categorical data with a small number of scales are used for endogenous variables, it is inappropriate to employ the Pearson's product-moment correlation coefficient or the maximum likelihood estimation<sup>[7]</sup>, which are based on normal distribution. Since this paper uses binary data for endogenous variables, path analysis based on categorical data is conducted. Specifically, adjusted weighted least squares estimation (WLSMV), which uses as weight a diagonal matrix of the standard error of biserial correlation coefficient, etc., is employed. In other words, where  $S$  represents the correlation matrix of categorical data,  $\Sigma$  represents the correlation matrix model structured with parameters, and  $W$  represents the weight matrix, the parameters  $\theta$  is estimated so that the discrepancy between  $S$  and  $\Sigma$  is minimized.

$$f(\theta) = \text{tr}[(S - \Sigma(\theta))W^{-1}(S - \Sigma(\theta))'] \cdot \cdot \cdot (1)$$

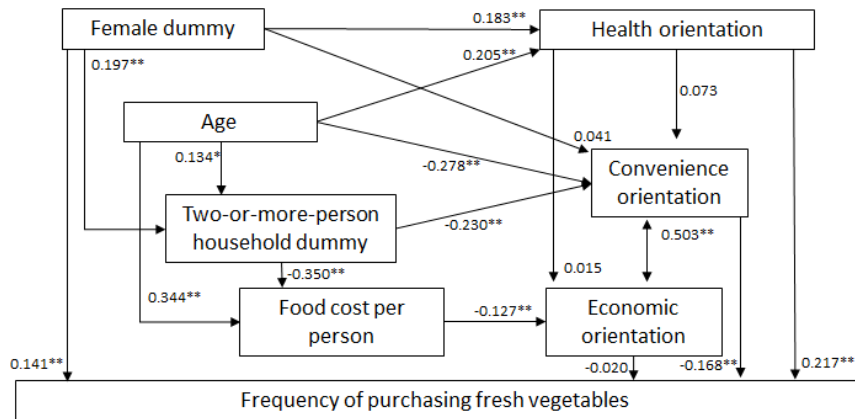
R 3.3.3 is used for this estimation.



#### IV. Estimation results

The results of estimation are shown in Charts 1 and 2. Fitness of Chart 1 explaining the purchasing behavior regarding fresh vegetables was mostly good, as expressed with CFI=0.892, RMSEA=0.090, GFI=0.988, and AGFI=0.955, though CFI was below 0.9. Fitness of Chart 2 explaining the purchasing behavior regarding cut vegetables was good, as expressed with CFI=0.916, RMSEA=0.076, GFI=0.991, and AGFI=0.966. The results of Hypotheses 1 through 10 presented in Section 2 are summarized as follows.

First, for Hypothesis 1, the tendency that as people get old, the food cost per person becomes higher, resulting in weaker “economic orientation” was confirmed in Charts 1 and 2. Hypothesis 2: older people are more strongly health-oriented and less convenience-oriented, was also proven. As for Hypothesis 3, positive effects on health orientation were confirmed while no effects were confirmed on convenience orientation. Hypothesis 4: two-or-more-person households are less convenience-oriented and with less food cost per person, was confirmed. Hypothesis 5: women and older people are often in two-or-more-person households, was also proven true. Regarding Hypothesis 6, no significant results to support the hypothesis were obtained. Regarding Hypothesis 7, effects of health orientation and convenience orientation were proven to be true while the effect of economic orientation was not confirmed. For Hypothesis 8, a positive effect on the frequency of purchasing fresh vegetables was confirmed from the female dummy. Regarding Hypothesis 9,



Note: \*\*, \*, and + represent statistical significance at the 1% level, 5% level and 10% level, respectively. Standardized coefficients are employed. The same applies to Chart2.

Chart1 Frequency of Purchasing Fresh Vegetables

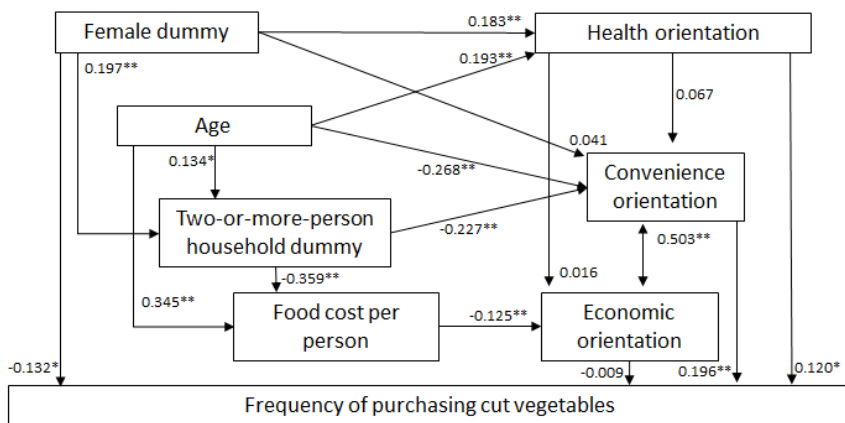


Chart2 Frequency of Purchasing Cut Vegetables

positive effects of health orientation and convenience orientation on the frequency of purchasing cut vegetables were proven to be true while the effects of economic orientation were not confirmed. Regarding Hypothesis 10, the female dummy was found to have negative effects on the frequency of purchasing cut vegetables. As for the frequency of purchasing cut vegetables, it was found that where the effects of health orientation and convenience orientation are assumed to be fixed, men, who have fewer opportunities to cook, tend to purchase cut vegetables more frequently than women.

## V. Discussion

Based on the analysis so far, we were able to examine the models explaining the frequencies of purchasing fresh vegetables and cut vegetables, respectively. As explained earlier, path analysis is a technique with which a series of causal connections in which consumer attributes influence their food orientation and their food orientation determines their purchasing behavior can be verified. This section provides an overview of a series of causal connections from consumer attributes to food orientation, leading to purchasing behavior, which is a task of this paper. At the same time, this section compares the effects of food orientation on fresh vegetables and cut vegetables, respectively, and concludes this paper by presenting implications for the expansion of vegetable consumption in the future.

First, regarding age, we were able to confirm the causal connections that older people purchase fresh vegetables rather frequently because they are strongly health-oriented and weakly convenience-oriented. This indicates differences in consumption behavior among age groups are influenced by health orientation and convenience orientation. We were also able to demonstrate that women are more strongly health-oriented and purchase fresh vegetables more frequently than men, and that two-or-more-person households are less convenience-oriented and therefore purchase fresh vegetables more frequently.

Examinations of the effects of these factors on the frequency of purchasing cut vegetables showed that health orientation had positive effects as in the case of fresh vegetables while convenience orientation was also found to have positive effects on the purchasing frequency. This confirmed that cut vegetables are positioned as a product that matches the recent convenience-oriented trend.

As described so far, this paper demonstrated the effects of “food orientation” as the reason that the frequencies of purchasing fresh vegetables and cut vegetables vary depending on consumer attributes, such as age. The frequency of purchasing fresh vegetables is influenced positively by health orientation and negatively by convenience orientation. Based on this knowledge, encouraging young people, in particular, to be more conscious about their health and to get rid of “convenience orientation” to start cooking by themselves, may be useful to increase consumption of fresh vegetables. It was also confirmed that cut vegetables are positioned as a product that matches the recent convenience-oriented trend. Promoting development of products of this kind may also be effective in boosting vegetable intake.

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