

A Study on the Factors that Relate Eating Patterns and Tendency of Vegetable and Fruit Consumption among Japanese University Students

Akihiko Fujino and Miao Miao

Abstract—This study aims to examine the characteristics of dietary behavior among Japanese university students, and thus figure out the factors that affect eating patterns and tendency of fruit and vegetable intake. A cross-sectional survey including 97 university students was conducted in Okayama in 2016. Descriptive statistics is used to show the present situation and characteristics of dietary behavior among Japanese students. Multi-regression analyses were applied to find out the factors that influence dietary patterns. The results indicate that the quantities of vegetable and fruit consumption are differently related to meal time and some other meal ingredient consumption. This finding suggests that the general promotion such as “recommending quantity of fruit and vegetable consumption per person per day” is not the only way to encourage consumers to increase their fruits and vegetable intake. This study’s results would be useful for effective promotion of fruit and vegetable consumption and for enhancing marketing promotion and development of semi-finished products or processed fruits and vegetables.

Index Terms—Consumer behavior, consumption of fruits and vegetables, dietary pattern, marketing promotion.

I. INTRODUCTION

Health is affected by many factors; amongst these diet is one of the most important factors. The health benefits of fruits and vegetables, whole grains, and proteins have been widely studied and acknowledged. However, in recent times, the importance of eating patterns is also emerging as an essential factor for health [1], [2].

From a nutritional point of view, most researchers recommend the consumption of at least 400g of fruits and vegetables per person per day for good health [3]. Compared with people who do not consume vegetables often, those who regularly eat vegetables feel less stressed and irritable, and have less bodily tension related to stress [4]. However, despite these health benefits, it has been observed that many consumers still do not eat healthy. We can observe this fact from consumers’ reduction of vegetables and fruits intake, and changes of eating patterns. Understanding the current situation of dietary patterns can help food producers and distributors to promote marketing strategies effectively for different target markets.

Previously, Japan had a large market for vegetables. In

1988, each Japanese consumer consumed about 120 kg of vegetables per year, which exceeded the U.S. consumption per person per year [5]. Japan’s total wholesale value of vegetables was 2.56 trillion yen (about \$24.90 billion) in 1999 and 2.33 trillion yen (about \$22.67 billion) in 2003 [6]. The high value of Japan’s vegetable consumption shows both high consumption per person and high prices for vegetables [7].

However, Japan’s consumption has declined over the last quarter century, and the total wholesale value of vegetables and fruits in 2015 was 2.26 trillion yen (about \$21.99 billion) [8], which has declined by \$2.93 billion from 1999. The purchase quantity of vegetables has declined from 215 kg per family (more than two family members) in 1988 to 176 kg in 2013. The decline reflects a change in Japan’s dietary behavior.

On the other hand, several studies have revealed changes in attitudes and behavior regarding dietary patterns among young people. Some changes in the dietary behavior that have taken place in Japan include food delivery service, skipping breakfast, and eating snacks between meals [9]. Furthermore, female university students preferred vegetables and cakes, while males had a high intake of processed food after entering university, such as instant noodles and fast food [10].

Recently some studies revealed that dietary patterns are affected by the condition and choice of residency. The Japanese university students living in boarding houses tend to skip meals more frequently and eat fewer meals per week because of lack of cooking knowledge and skills and home management ability [11]. In addition, most female college students who live in dormitories and eat meat more than vegetables, experience languid and do not feel well rested even with sufficient sleep time [12].

Residential status, family mealtimes, and parental style seem to be the important factors that may influence a child’s eating behavior. Furthermore, providing nutritional knowledge and information by parents can improve fruit and vegetable intake [13]. In different life stages, the family form has a strong influence on children’s food consumption of fruits and vegetables, breakfast, and healthy eating in general [14]. These findings suggest that the choice of residency could be a main determinant of dietary patterns among university students.

Apart from the above-mentioned factors, in recent years, some studies have claimed that insufficient time for vegetable preparation is a barrier to intake among young consumers. Reference [15] demonstrated that perceptions of the

Manuscript received December 1, 2016; revised February 21, 2017.

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adequacy of intake and insufficient time for vegetable preparation are the main barriers to fruit and vegetable consumption. Reference [16] found that high nutrition intake and healthy body weight benefits are very positive factors for vegetable consumption; however, taste, cost, and difficulty of preparation inhibit vegetable consumption in the USA. Furthermore, it has been found that choices of fruit are influenced much more by their convenience and attractiveness than a long storage life and cost [17]. Therefore, in order to increase consumption of fruits and vegetables, and in order to improve healthy eating patterns, there could be a potential market for fruit and vegetable products with simplified preparation.

Furthermore, substitute products of vegetables and fruits have been gradually and increasingly coming into the spotlight in the form of supplements, vegetable juices, fruit desserts, and so on. In Japan, there is a greater tendency to consume supplements. Reference [18] showed that 66.3% of the Japanese population has followed a diet at some time in their lives and 51.3% have taken supplements for health or weight loss. However, “Good for health” and “Feel insufficient intake of vegetables” are the most important motivating factors for the intake of supplements. In other words, supplements could be considered as a substitute product for daily intake of raw vegetables and fruits in dietary patterns.

Overall, from a health and nutrition standpoint, these studies have pointed out that dietary patterns have been affected by residential status, preferences, cooking skills, ease of preparation, nutritional knowledge, and availability of substitute products.

However, from a marketing perspective, there is lack of research on the link between fruit and vegetable consumption of university students, following residency type (dormitory, apartment, room share, parents’ house, and so on), academic year in university, health condition, self-catering, dietary pattern, and meal time.

On an applied research level, it is important to clarify the current situation and provide evidence to encourage healthy dietary patterns and consumption of fruits and vegetables. In the light of the above, this study aims to highlight the relationship between living conditions, dietary patterns and consumption of fruits and vegetables. Based on this study, the food manufacturers and distributors can develop appropriate marketing strategies to meet the needs of current college students.

Consequently, this study is based on previous research by examining factors that influence dietary patterns. The study explores the characteristics of dietary patterns through a survey of university students’ consumption behavior. This survey shows the differences in dietary requirements, dietary pattern, intake of fruits and vegetables by residency, and gender.

II. DATA AND ANALYSES

A. Data and Methodology

In order to investigate the students’ dietary situations and behavior, a cross-sectional survey was deemed appropriate

given that the study sought to describe the characteristics in dietary pattern, including the number of meals a week, consumption of staple food, protein, vegetables, fruits, desserts, beverages, snacks, and supplements. All quantities of meal ingredients per week were measured by each ingredient unit which was recognizably defined in the questionnaires (For example, one unit of fruit is defined as a kiwi fruit of usual size. And one unit of vegetable is defined as half package of bean sprouts, which is usually around 100g). The survey collected information on respondents’ residential status (living style), health condition (such as bad health condition days per week, sleep condition, and so on), health information interest, self- assessment of present diet status, and interest evaluations for some kind of vegetable products.

The research was conducted at a university in Okayama prefecture of Japan during July 2016, in which four-year college students, around 20 years of age. The sample size of valid responses is 97.

Analyses were conducted using the Statistical Packages for Social Sciences. Descriptive statistics such as frequencies, quantities, and means were used to identify the variables relating to respondents’ demographic profile, intake of vegetables and fruits, and demand for dietary supplements. Multiple regression analysis was adopted to identify variables independently associated with vegetable and fruit consumption.

B. Cross Tabulation

Valid questionnaire data were collected from 97 university students of which 64% were males and 36% were females. Many of the respondents have been living by themselves since joining the university (51%), while the remaining respondents are living with family or have been living in university dorm (49%). The school year of respondents consists of lower (1 and 2: 54%) and upper years (3 and 4: 46%).

The result of group total in Table I-(a) shows that the average frequency of students’ meals in a week was more than 20 (20.7), but the average breakfast times was less than 5 (4.3). The other results in Table I-(a) and Table I-(b) show that there

TABLE I-(A): FREQUENCY OF MEALS PER WEEK (PART 1)
(Average and Standard deviation)

Group	Total	Gender	
		Male	Female
Total	20.7 (5.1)	20.3 (5.4)	21.3 (4.4)
Breakfast (5 am–9 am)	4.3 (2.4)	4.1 (2.4)	4.7 (2.4)
Lunch (11 am–2 pm)	6.5 (1.2)	6.4 (1.4)	6.8 (0.7)
Dinner (5 pm–9 pm)	6.3 (1.6)	6.4 (1.5)	6.1 (1.6)
Others (between the above)	3.5 (2.7)	3.4 (2.9)	3.7 (2.4)

TABLE I-(B): FREQUENCY OF MEALS PER WEEK (PART 2)
(Average and Standard deviation)

Group	Residential status		School year	
	With family, or Dorm	Apart-ment	Lower	Upper
Total	21.4 (4.6)	20.0 (5.5)	20.5 (4.8)	20.9 (5.4)
Breakfast	4.7 (2.4)	3.9 (2.4)	4.8 (2.2)	3.8 (2.5)
Lunch	6.8 (0.7)	6.3 (1.5)	6.6 (1.2)	6.5 (1.2)
Dinner	6.2 (1.8)	6.4 (1.3)	6.1 (1.6)	6.6 (0.8)
Others	3.7 (3.0)	3.3 (2.5)	3.1 (2.6)	4.0 (2.8)

Note: Standard deviations are in parentheses

is no statistically significant difference of every meal times between each group of gender, residential status, and school year.

TABLE II-(A): QUANTITY OF INTAKE FOR EACH MEAL INGREDIENT (PART 1)
(Average and Standard deviation)

Group	Total	Gender	
		Male	Female
Staple food (rice, bread, noodles, and so on)	5.6 (3.8)	6.3 (4.1)	4.4 (2.7)
Protein (meat, fish, tofu, and so on)	4.5 (3.9)	5.0 (4.6)	3.5 (1.8)
Vegetables	3.6 (2.4)	3.6 (2.4)	3.6 (2.4)
Fruits	1.4 (2.5)	1.6 (2.9)	1.1 (1.3)
Desserts	1.5 (2.2)	1.6 (2.6)	1.2 (1.3)
Beverages	6.2 (4.0)	6.1 (3.7)	6.3 (4.6)
Snacks	1.2 (1.3)	1.1 (1.4)	1.4 (1.3)
Supplements	0.6(1.6)	0.7 (1.7)	0.5 (1.3)

TABLE II-(B): QUANTITY OF INTAKE FOR EACH MEAL INGREDIENT (PART 2)
(Average and Standard deviation)

Group	Residential status		School year	
	With family, or Dorm	Apartment	Lower	Upper
Staple food	5.3 (3.0)	5.9 (4.5)	5.4 (3.1)	5.9 (4.5)
Protein	4.2 (3.0)	4.7 (4.7)	4.1 (4.2)	5.0 (3.5)
Vegetables	3.7 (2.4)	3.4 (2.4)	3.7 (2.5)	3.5 (2.2)
Fruits	1.7 (2.8)	1.2 (2.2)	1.7 (2.3)	1.2 (2.7)
Desserts	1.8 (2.7)	1.1 (1.5)	1.6 (1.8)	1.4 (2.6)
Beverages	5.8 (3.6)	6.6 (4.4)	6.3 (3.4)	6.0 (4.6)
Snacks	1.3 (1.4)	1.2 (1.3)	1.4 (1.4)	1.1 (1.2)
Supplements	0.8 (1.9)	0.5 (1.2)	0.3 (0.7)	1.0 (2.1)

Note1: All quantities of meal ingredients per week were measured by each ingredient unit which was defined in the questionnaires.

Note2: Standard deviations are in parentheses

TABLE III: PERCENTAGE OF FOOD ITEMS CONSUMED ON A TYPICAL DAY
(PERCENTAGE OF ALL RESPONDENTS)

Meal Time	Day Total	Break-fast	Lunch	Dinner	Others
Staple food	100%	86%	97%	91%	28%
Protein	97%	60%	81%	90%	23%
Vegetables	98%	48%	73%	90%	21%
Fruits	49%	29%	21%	26%	30%
Desserts	62%	28%	22%	29%	36%
Beverages	93%	84%	90%	88%	71%
Snacks	63%	13%	23%	12%	55%
Supplements	24%	12%	7%	14%	9%

TABLE IV: THE LIST OF INGREDIENTS FOR A TYPICAL DAY
(Percentage of All and Gender Groups)

Meal Timing	Day Total	Break-fast	Lunch	Dinner	Others
Protein All	97%	60%	81%	90%	23%
Male	97%	58%	77%	90%	26%
Female	97%	63%	89%	89%	17%
Vegetables All	98%	48%	73%	90%	21%
Male	98%	47%	69%	92%	23%
Female	97%	51%	80%	86%	17%
Fruits All	49%	29%	21%	26%	30%
Male	45%	27%	19%	26%	29%
Female	57%	31%	23%	26%	31%
Desserts All	62%	28%	22%	29%	36%
Male	60%	27%	21%	27%	35%
Female	66%	29%	23%	31%	37%

Snacks	All	63%	13%	23%	12%	55%
	Male	55%	10%	18%	10%	50%
	Female	77%	20%	31%	17%	63%

TABLE V: RELATIVELY HIGHER RELATIONS^a BETWEEN VARIABLES
(Correlation Coefficient and Variance Inflation Factor)

Set of Variables	C.C. ^b	V.I.F. ^c
1. Quantity of Fruit Consumption	0.85	3.62
2. Quantity of Dessert Consumption		
1. Quantity of Staple Food Consumption	0.71	2.00
2. Quantity of Protein Consumption		
1. Taking Fruits at Breakfast Time	0.69	1.90
2. Taking Fruits at Lunch Time		
1. Quantity of Protein Consumption	0.65	1.72
2. Quantity of Vegetable Consumption		

^a Correlation Coefficient > 0.64

^b Correlation Coefficient

^c Variable Inflation Factor

Dietary pattern and meal ingredient consumption were measured by questions which required the respondents to describe what they often eat for meals (three regular meals and others: snacking time, between the three meals) per day and the quantities of each food per meal. The differences of dietary patterns between different gender groups are shown in Tables I and II. Based on these data, we find no obvious distinctions on the frequency of having a meal and the quantities of each ingredient per meal except staple food and protein between the genders.

Table II-(a) shows that many consumption of ingredients are higher for males than for females. However, for beverages and snacks, consumption by females is much higher than that by males, and the standard deviation of beverages is higher in the female group than in the male group.

From previous research, we can see that entering university is like a turning point for students who are forced to manage lives by themselves. Moreover, we can suppose that their dietary patterns are affected by living conditions and choice of residency. However, Table II-(b) shows that there is no obvious distinction in vegetable consumption between the students living with families and those living by themselves. For fruit consumption, the respondents living by themselves consume less fruits than those living with families. It may be supposed that one of the reasons is the high price of fruits in Japan.

Table III indicates that the characteristics of eating behavior on each ingredient for meals. For a typical day, staple food, protein, and vegetables are consumed by most of the respondents. Moreover, beverages are almost consumed by 93% of the respondents. Whereas fruits are only consumed by less than half of the respondents (49%). Table III shows that the quantities of staple food and beverages are consumed equally for three regular meals, while protein and vegetables are usually consumed during lunch and dinner. Furthermore, fruits are consumed less for three meals than during snacking time. This implies that the eating behavior of students is related to their meal time, which could be considered in food marketing approaches. For example, providing a new way of eating fruits for three meals and simplifying the preparation of vegetables for breakfast could be useful approaches for manufacturers and retailers.

Table IV shows the differences of each ingredient consumption for meals per day between males and females (except staple food and beverages, which are usually consumed for three meals). As the result suggests, vegetables are obviously consumed during lunch and dinner by both males and females. However, there is no clear difference of fruit consumption for meals between males and females.

C. Regression Analysis

The quantity of ingredient consumption per meal is related to many factors. The meal time is considered as one of the factors affecting the quantities of vegetables and fruits consumption. Multiple regression analysis was adopted to identify variables independently associated with vegetables

and fruits consumption. Because of the constraint of sample size, all respondents' answers were applied for every analysis model.

In order to avoid the multicollinearity problem, each variable was checked for its relation with the others before use in the analysis models. Table V shows the variable pairs with relatively higher relation. As the highest Variance Inflation Factor (a multicollinearity check index, probability of multicollinearity is higher when this is larger than 10), there is no variable pair that should not be used for multi-regression analysis.

TABLE VI: MULTIPLE REGRESSION RESULTS FOR VEGETABLE AND FRUIT CONSUMPTION

Model Dependent variable	Model-11: Quantity of Vegetable Consumption				Model-12: Quantity of Fruit Consumption			
Result	R : 0.80 R ² :0.63 Aj R ² : 0.61 Std Er : 1.49 Observ : 97				R : 0.91 R ² :0.83 Aj R ² : 0.83 Std Er : 1.04 Observ : 97			
Independent variables	Std Coeff	Std Er	t Stat	P-value	Std Coeff	Std Er	t Stat	P-value
Intercept	3.58***	0.15	23.60	0.00	1.45***	0.11	13.73	0.00
Body Condition Index	-0.43**	0.16	-2.78	0.01	----	----	----	----
Taking at Breakfast Time (5 am–9 am)	0.64***	0.17	3.82	0.00	----	----	----	----
Taking at Lunch Time (11 am–2 pm)	0.65***	0.17	3.93	0.00	----	----	----	----
Taking at Dinner Time (5 pm–9 pm)	----	----	----	----	0.59***	0.12	4.82	0.00
Taking between the 3 Min Meal Times	----	----	----	----	0.47***	0.12	3.89	0.00
Quantity of Protein Consumption	1.31***	0.18	7.45	0.00	----	----	----	----
Quantity of Beverage Consumption	-0.30*	0.16	-1.84	0.07	----	----	----	----
Quantity of Vegetable Consumption					0.35***	0.12	2.92	0.00
Quantity of Fruit Consumption	----	----	----	----				
Quantity of Dessert Consumption	----	----	----	----	1.50***	0.13	11.25	0.00

Note1: “*, **, ***” indicates significance at the 90%, 95%, and 99% level, respectively.

Note2: All quantity of meal ingredients were measured by each ingredient unit which was recognizably defined in the questionnaires.

TABLE VII: MULTIPLE REGRESSION RESULTS FOR INTEREST IN ONE-DISH-SIZE VEGETABLE PACKS

Model Dependent Variable	Model-21 Interest in Processed Mixed Vegetables One-dish Salad Pack				Model-22 Interest in Processed Mixed Vegetables One-dish Cooking Pack			
Result	R : 0.43 R ² :0.19 Aj R ² : 0.15 Std Er : 1.02 Observ : 97				R : 0.36 R ² :0.13 Aj R ² : 0.11 Std Er : 1.06 Observ : 97			
Independent variables	Std Coeff	Std Er	t Stat	P-value	Std Coeff	Std Er	t Stat	P-value
Intercept	3.52***	0.10	33.84	0.00	3.40***	0.11	31.60	0.00
Gender (male=1, female=2)	0.27**	0.11	2.58	0.01	----	----	----	----
Health Information Interest (5grade evaluation: high=5,low=1)	0.21*	0.11	1.94	0.06	----	----	----	----
Meal Satisfaction after Coming to University (5grade evaluation: up=5,down=1)	----	----	----	----	-0.26**	0.11	-2.39	0.02
Quantity of Beverage Consumption	-0.23**	0.10	-2.17	0.03	----	----	----	----
Quantity of Vegetable Consumption	0.28**	0.11	2.62	0.01	0.31***	0.11	2.88	0.00

Note1: “*, **, ***” indicates significance at the 90%, 95%, and 99% level, respectively.

Note2: All quantity of meal ingredients were measured by each ingredient unit which was recognizably defined in the questionnaires.

The following independent variables are considered: the quantities of eight ingredients of food, intake of vegetables and fruits for the three regular meals and snacking time, body condition index, health information interest, satisfaction for regular meals after entering university, gender, choice of residency, and school year.

Multi-regression analyses show that the quantities of

vegetable and fruit consumption are related to the other ingredients' consumption (Table VI). Model-11 shows that the vegetables consumption is affected by body condition index, eating breakfast and lunch, and intake of protein and beverages. In particular, eating breakfast and lunch and protein consumption are positively related to vegetable consumption, whereas beverage consumption and body

condition index are negatively related to vegetable consumption. Model-12 shows that eating dinner and snacking time, intake of vegetable and dessert are positively related to fruit consumption.

In the questionnaires, there were questions about interest in substitute products of raw vegetables, which are “one-dish size favorite vegetables salad pack” and “one-dish size favorite vegetables cooking pack.” In Table VII, Model-21 shows the result of the salad pack. Interest in the salad pack is positively related to females, health information interest, and quantity of vegetable consumption, and negatively related to quantity of beverage consumption. In Model-22, interest in the cooking pack is positively related to quantity of vegetable consumption. Furthermore, students who are not satisfied with usual meal after coming to university have more interest in the cooking pack.

III. FINDINGS AND DISCUSSION

A. Findings

This study showed that there is no obvious distinction for eating behavior, which including frequency of having a meal and quantities of each food per meal except staple food and protein between male and female university students in Japan.

Compared to previous studies, our findings indicated that the living conditions and residential status are not related to vegetable and fruit consumption directly. Furthermore, no obvious distinction was found for vegetable consumption between the students living with families and those living by themselves. In other words, changes in living style could not be considered as a factor that influences consumption of vegetables and fruits.

Through the multiple regression analysis, the independent variables were identified, which affected eating patterns and consumption of vegetables and fruits. The results showed that eating breakfast and lunch and intake of protein are positively related to vegetable consumption, whereas eating dinner and snacking time and intake of vegetables and desserts are positively related to fruit consumption. That being said, the meal time is an important driver for increasing consumption of vegetables and fruits.

B. Discussion

It is important to clarify the current situation and provide evidence to encourage healthy dietary patterns and consumption of vegetables and fruits. This research highlights the factors that affect the consumption of vegetables and fruits among young consumers.

Eight independent variables are identified: the quantities of each ingredient, intake of vegetables and fruits for meal time, body condition index, health information interest, satisfaction for regular meals after entering university, gender, choice of residency, and school year.

However, from a marketing perspective, it is important to discuss other factors which influence the intake of vegetables and fruits, such as the price, change of preferences, the distribution process, and the availability of substitute products. In particular, the substitute products of vegetables and fruits have been gradually coming into the spotlight more

and more in the form of supplements, vegetable juices, fruit desserts, and so on.

IV. CONCLUSION

Japan’s consumption of vegetables and fruits has declined over the last quarter century. The data showed us that since 1988, the purchase quantity of vegetables has declined. We can observe a decline in the purchase quantity of fruits as well.

There are various studies detailing numerous changes in lifestyle and behavioral patterns regarding how Japanese consumers eat throughout the week. Some studies discussed the barriers to intake vegetables and fruits, such as the long preparation time for cooking, the taste not being easily satisfactory, the high purchase cost, and a short storage life.

The result of this study indicates that the consumption of vegetables and fruits is different depending upon the meal of the day and the consumption of other ingredients with the meal. Furthermore, we investigated the consumption of supplements as a substitute for vegetables and fruits. However, because the data are insufficient we could not accurately measure its effect.

These findings suggest that vegetable and fruit intake could be increased throughout the day, especially for meals with normally low vegetable and fruit consumption.

The general promotion of “As average vegetable and fruit consumption is not enough, please take more vegetables and fruits every day!” which simply emphasizes eating more vegetables and fruits throughout the day should be replaced with more specific promotions to encourage people to eat more vegetables and fruits at specific meal times.

This study’s findings have useful implications for effective promotion of vegetable and fruit consumption, enhancing marketing promotion, and developing semi-finished products or processed vegetables and fruits.

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