Analysis of energy and nutrient intake of Japanese male students with smart cards at university dining commons —protein, fat and carbohydrates—

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学生食堂のスマートカードを利用した日本人男子大学生の エネルギーおよび栄養素摂取量の解析 ～たんぱく質, 脂質, 炭水化物の摂取について～

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本研究では、スマートカードで食事履歴を収集するシステムを用いて、大学生協食堂にて男子大学生が選択した食事のエネルギーや栄養素量の摂取量を分析し、三大栄養素摂取量のバランスを評価することを目的とした。

調査期間は2007年4～6月(57日間)、解析対象者は97人(18～22歳)である。大学生協食堂の利用時間を、8:15～10:59を朝食、11:00～15:59を昼食、16:00～18:59を夕食に3区分し、朝食1,810食、昼食3,571食、夕食2,482食について、エネルギー、たんぱく質、脂質、炭水化物の摂取量を集計した。

男子大学生が選択した食事のエネルギーは、朝食が $686 \pm 170 \text{kcal}$ 、昼食が $944 \pm 180 \text{kcal}$ 、夕食が $869 \pm 226 \text{kcal}$ であった。脂肪エネルギー比率は、朝食が27%、昼食は31%、夕食は31%であった。昼食と夕食は脂肪エネルギー比率の目標値である20%以上30%未満の範囲を超えていた。朝食の時間帯は、エネルギーと脂肪エネルギー比率のバランスがとれた「朝定食」というメニューが提供される。朝食の脂肪エネルギー比率が適正であった理由は、朝食の1,810食のうち79%にあたる1,422食が「朝定食」の選択によるものだということが明らかとなった。

エネルギーと脂肪エネルギー比率のバランスを考えて食事選択できるような食事環境を整えると同時に、大学生には、自らに適した食事選択ができるよう教育することが必要であることが示唆された。

INTRODUCTION

Students who start living independently upon entering

college are in a situation that they need to prepare meals by themselves, thus they are required to be able to self-manage meals. However, according to a survey on students'

practical living conducted by the National Federation of University Co-operative Associations, one of the top items within the category, “dietary issues,” was that “Nutrition of meals is not balanced”¹⁾. It is known that imbalanced meals that contain food high in fat are linked to metabolic syndromes²⁻⁴⁾.

According to the results of the National Health and Nutrition Survey Japan, annual report 2007⁵⁾, the ratio of those who have a risk of developing metabolic syndromes and those who are suspected to have the syndromes is higher among men than women. One out of approximately 10 men in their 20s is a would-be metabolic syndrome patient, and the number jumps to 1 out of approximately 3.5 men in their 30s. In order to prevent lifestyle-related diseases, for men in particular, it is necessary to guide them how to eat meals that fit into their own nutritional needs throughout the college life.

For the purpose of supporting students' diets, the university co-operative dining commons has adopted smart cards called “Meal Cards” that allow students to use the dining commons for one year within the upper limits per day. A smart card has an IC chip embedded in a plastic card of the size of a cash card, which allows recording of information. The “Meal Cards” apply a point-of-sale system: A system that links the central computer and resisters to collect and accumulate data for each product. Using this card through a resister enables long-term monitoring of “on what date, at what time, which menu, at what price, how many and who purchased a meal” without interfering with users and researchers. Meal monitoring using such a smart card has been done elsewhere in office dining commons⁶⁻⁹⁾.

The university co-operative dining commons is operated as a cafeteria. Since selection of the meal menu is left to users themselves, it is unclear if a nutritious balance is met. The objective of this study is to analyze the intake of energy and nutrients from meals chosen by male university students and to evaluate the balance of the three major nutrients' intake, using the system to collect meal history from “Meal Cards.”

METHODS

Ethical Considerations

This study was conducted under the basic principles of the Helsinki Declaration, with a consideration of protecting personal information, respecting privacy, confirming informed consent, and minimizing benefits and adversities to subjects due to the study. The subjects received explanation of the study content and prepared written consents. This study was approved by the Ethical Committee of the Okayama Prefectural University.

Subjects

S University in S City, Yamaguchi Prefecture, is a single-department university specialized in Economics. The University enrolls 500 students each year, and its male-female ratio is 6:3. Among 157 students who were enrolled in the University and bought the “Meal Cards,” 97 male students were chosen as the study subjects. Ten students who never used the “Meal Cards” between April and June 2007, 26 students whose height, weight and physical activities and levels were unknown, 4 students who did not provide consents to participate in the study, and 20 female students were not included in the subjects (Figure 1).

Research on Fundamental Attributes of the Subjects

On April 6, 2007, we conducted a research on students who purchased the “Meal Cards” regarding their height, weight and fundamental attributes. Height was reported by the students themselves, and weight was measured using digital scales (Innerscan 50 BC-301-SV, Tanita, Tokyo). The subjects also reported their year in school, gender, age, housing arrangement, and physical activities at the time of the study using self-administered questionnaires. With regard to physical activities, the students were asked about “the frequency of regular exercise or part-time jobs requiring long hours in a standing position.” The students chose the answers from “none,” “once or twice a week,”

Figure 1 Extraction method of analysis subjects

“three to five times a week,” and “almost everyday.” Since all the students were commuting, it was determined that none of them would fall into the physical activity level I⁽¹⁰⁾. Exercise or part-time jobs up to twice a week was categorized in the physical activity level II⁽¹⁰⁾, and more than three times a week in level III⁽¹⁰⁾.

The fundamental attributes of the subjects were as follows: Age – 18–22 years old; BMI – 6 students were less than 18.5 kg/m² (6%), 76 students were between 18.5 and 25.0 kg/m² (78%), 15 students were more than 25.0 kg/m² (16%); physical activity levels – 58 students were at level II (60%) and 39 students were at level III (40%).

Energy and Nutrient Content Settings for a Reference in the Evaluation

“Dietary Reference Intakes for Japanese, 2010”⁽¹⁰⁾ states that the estimated energy requirement is 2,650kcal/day for physical activity level II and 3,000kcal/day for level III. The load average was calculated as (2,650kcal/day × 58 subjects + 3,000kcal/day × 39 students) ÷ 97 subjects = 2,790kcal/day/subject. Since 16% of the subjects had BMI 25.0 kg/m² and higher, the target supply energy was decided as 2,500–2,900kcal, which was ±200kcal of 2,700kcal, a slightly lower value than the load average. There are various ways of defining a distribution pattern of the supply energy into three meals. In this study, the supply energy was set at breakfast : lunch : dinner = 1 : 1.5 : 1.5⁽¹¹⁾, equivalent to 650–750kcal for breakfast, 950–1,100kcal for lunch and dinner when rounded off. The percentage energy from protein is not indicated in the Dietary Reference Intakes for Japanese⁽¹⁰⁾. Regarding the percentage energy from fat, more than 20% to less than 30%, an equivalent to the target value for 18–29 years old, was defined as a standard. Regarding the percentage energy from carbohydrates, more than 50% to less than 70%, an equivalent to the target value for 18–29 years old, was defined as a standard.

Outline of University Co-operative Dining Commons

The basic information of the S University co-operative dining commons is shown in Table 1. The hours of operation are set to provide breakfast to dinner as the class hours start at 9:00 and end at 18:00. The upper limit for the “Meal Cards” is JPY1,000 per day. The days of operation in 2007 were 176 days, which is equivalent to JPY176,000 per year if used to the maximum value. Since “Meal Cards” cost JPY140,000 per year, users could use the card to receive an extra JPY36,000 worth of meals per year.

The menu provided at the dining commons is decided

by the Chugoku-Shikoku Regional Association, which is then distributed to the dining commons throughout the Chugoku and Shikoku regions.

Menu plates at the dining commons include the name, energy, and salt content of the menu items. Protein, fat and carbohydrates are also indicated as 1 point = 80kcal. To calculate the nutritional composition value, the Standard Tables of Food Composition in Japan (Fifth revised and enlarged edition, 2005) was used, except for ready-made products, for which the food composition analysis value was used. The percentage energy from protein for each menu, as well as the percentage energy from fat was calculated using Atwater's conversion factor. The percentage energy from carbohydrates was obtained by subtracting the percentage energy from protein and the percentage energy from fat from 100%.

Outline of the Menu Provided at the University Co-operative Dining Commons

The number of menu items provided each day at the University co-operative dining commons ranged from 70 to 90 items (Table 2). The menu changed every week. A set menu was only available for breakfast; lunch and dinner was provided in the form of an a-la-carte menu. A “self-service counter” is buffet style in which students can serve salad and sides from large serving dishes; the price is calculated by the gram.

Meal Survey Method Using Smart Cards

The period of the meal survey method was from April to June 2007, for 57 days while the dining commons was open for business from Mondays through Fridays. The menu items purchased by a “Meal Card” user at the resister were counted as one meal. The meals were categorized into three periods: Breakfast from 8:15 to 10:59, lunch from 11:00 to 15:59, and dinner from 16:00 to 18:59.

As each menu carries data on energy, protein, fat,

Table 1 Basic information of co-operative dining commons of S University

Expected days of operation	176 days (2007)
Hours of operation	8:15–19:00
Service style	Cafeteria
Number of seats	Approximately 250 seats
Number of users per day	700–900 users Breakfast: 50–60 users Lunch: 500–700 users Dinner: 120–130 users
Year of Meal Card implementation	2005
Limit on Meal Cards *	JPY1,000/day

* Amount exceeding JPY1,000 can be paid by cash or a prepaid card

Table 2 Menu items provided at the co-operative dining commons per day

	Numerics represent the number of items		
	Breakfast (8:15–10:59)	Lunch (11:00–15:59)	Dinner (16:00–18:59)
Morning sets *	2	—	—
Staple foods (rice)	2	2	2
Noodles (udon, buckwheat noodle, ramen)	11	11	11
Rice bowls	4	4	4
Curries	4	4	4
Main dishes	20	20	20
Side dishes	30	30	30
Soups	2	2	2
Deserts	7–9	7–9	7–9
Drinks	4	4	4
Self-service counter **	◎	◎	◎

* Breakfast set: A set of rice, a main dish, a side, soup and nori seaweeds.

** Self-service counter: Sides and salad provided in a buffet style.

Figure 2 Meals used for the analysis

carbohydrates and salt content, a total nutritional value for one meal was calculated using those data. Data regarding salt contents were excluded since the amount of soup and dressing consumed was unknown.

The number of meals used for the analysis was 7,863 meals (82%) out of 9,557 meals; meals with food from the self-service counter, delivered meals, rice-only meals, and desert-only meals that accounted for 1,694 meals (18%) were excluded (Figure 2). Among the number of meals used for the analysis, breakfast accounted for 1,810 meals (2,713 menu items), lunch for 3,571 meals (11,768 menu items), and dinner for 2,482 meals (8,305 menu items). The reason for excluding some items from the analysis was as follows: The contents of the “self-service counter” and “delivered meals” were unknown, therefore the nutritional value was not obtained; “rice-only meals” might indicate that the users had brought in side dishes; and “desert-only meals” were not clearly defined in terms of whether or not they could substitute as meals. The distribution of utilization rate of the dining commons for breakfast, lunch, and dinner per person during the study period is shown in Figure 3. The following formula was

used to calculate the utilization rate of the dining commons per person.

$$\text{Utilization rate of the dining commons per person} = \frac{\text{utilization frequency per breakfast, lunch, and dinner}}{\text{number of days of operation during the study period}} \times 100$$

Peak of the utilization rate of the dining commons per person was 11–20% for breakfast, 81–90% for lunch, and 61–70% for dinner. The number of persons with a utilization rate of the dining commons more than 51% were 32 persons for breakfast (33%), 86 persons for lunch (89%), and 51 persons for dinner (53%).

Analysis of menu chosen by the users

Energy, protein, fat and carbohydrates contained in the meals chosen by the users were calculated for breakfast, lunch and dinner. The percentage energy from protein for breakfast, lunch and dinner, as well as the percentage energy from fat was calculated using Atwater's conversion factor. The percentage energy from carbohydrates was obtained by subtracting the percentage energy from protein and the percentage energy from fat from 100%.

The amount of food eaten from the selected meals, and the amount of dressing used by the students was not recorded.

RESULTS AND DISCUSSION

Characteristics of the Provided Menu

Within the menu that was provided in April 2007, the energy and the percentage energy from fat for each of the nine major groups of meals – the morning set, staple foods (rice), noodles (udon, buckwheat noodles, ramen), rice bowls, curries, main (grilled or simmered dishes), main (deep-fried dishes), side (simmered dishes), and side (salad dishes) – were shown in scattergraphs (Figure 4). Some of the curries exceeded 1,200kcal, while the percentage energy from fat of some main (deep-fried dishes) and side (salad dishes) exceeded 60%.

The energy and percentage energy from fat of nine menu groups were shown in the average $\pm$ SD (Table 3). The results show that, for the morning sets, the energy was 594 ± 65 kcal. The percentage energy from fat was 26 ± 4 %, indicating that the percentage energy from fat of the morning sets was within the appropriate range.

The energy was 404 ± 21 kcal for the staple foods (rice) and 427 ± 118 kcal for the noodles (udon, buckwheat noodle, ramen), indicating approximately 400kcal for both categories. The percentage energy from fat was 8 ± 6 % for the staple foods (rice) and 17 ± 11 % for the noodles (udon, buckwheat noodle, ramen), showing that the percentage energy from fat was lower in the staple foods than in the noodles. The rice bowls and curries were meals combining both the staple foods and the main dishes. The energy was 668 ± 145 kcal for the rice bowls and 926 ± 236 kcal for the curries. The energy of the curries was higher than that of the rice bowls. The percentage energy from fat was 27 ± 9 % for

the rice bowls and 26 ± 7 % for the curries. The averages of the percentage energy from fat in both categories were within the appropriate range. The energy was 182 ± 101 kcal for the main (grilled or simmered dishes) and

Figure 3 The distribution of utilization rate of the dining commons for breakfast, lunch and dinner per person during the study period

Figure 4 The energy and the percentage energy from fat for each of the major groups of meals The menu was provided in April 2007.

Table 3 Characteristics of nutritional values of representative menu groups

Category	Number of Items	Energy * (kcal/item)	Percentage Energy from Fat * (%)
Morning sets	9	594 ± 65	26 ± 4
Staple foods (rice)	13	404 ± 21	8 ± 6
Noodles (udon, buckwheat noodle, ramen)	11	427 ± 118	17 ± 11
Rice bowls	25	668 ± 145	27 ± 9
Curries	9	926 ± 236	26 ± 7
Main (grilled or simmered dishes)	13	182 ± 101	47 ± 11
Main (deep-fried dishes)	21	423 ± 187	54 ± 14
Side (simmered dishes)	9	86 ± 88	27 ± 20
Side (salad dishes)	10	71 ± 36	45 ± 26

* Average value ± standard deviation

The menu was provided in April 2007.

423 ± 187kcal for the main (deep-fried dishes), indicating that the energy from the main (deep-fried dishes) was three times higher than that of the main (grilled or simmered dishes). The percentage energy from fat was 47 ± 11% for the main (grilled and simmered dishes) and 54 ± 14% for the main (deep-fried dishes), both resulting in the ratios as high as 50%. It is suggested that regardless of cooking methods, ingredients for the main dishes such as meat and fish are high in fat content.

The energy of the side (simmered dishes) was 86 ± 88kcal while that of the side (salad dishes) was 71 ± 36kcal, both indicating approximately 80kcal. The percentage energy from fat of the side (simmered dishes) was 27 ± 20% and that of the side (salad dishes) was 45 ± 26%. The percentage energy from fat was higher in the side (salad dishes). The side (salad dishes) was divided into two groups, one less than 20% and the other more than 50% percentage energy from fat (Figure 4). Since the salad included a type in which dressing was added later and another that was marinated in mayonnaise, it is speculated that the latter was high in the percentage energy from fat.

Energy, Protein, Fat and Carbohydrates of Breakfast, Lunch and Dinner

The results of an analysis on energy, protein, fat and carbohydrates of breakfast, lunch and dinner chosen by the users are shown in Table 4.

Although the set target energy was 650–750kcal for breakfast, 950–1,100kcal for lunch and dinner, values between 50th percentile and 75th percentile were considered equivalent to the targeted energy for all three meals (Table 4). Values above 90th percentile were considered to have exceeded the set target energy (Table 4). As no additional research was done outside the university dining commons, it was not possible to evaluate the intake from the other sources when the energy intake was lower than

the set target energy. However, the maximum value would mean that the energy intake could be higher, not lower, if the subjects had additional sources. Therefore, it can be considered that approximately 10% of the male university students were possibly taking in higher energy amounts than the set target energy amounts.

The average protein values ± SD were 23.5 ± 7.5g for breakfast, 31.8 ± 7.2g for lunch, and 28.0 ± 8.0g for dinner. The average of the percentage energy from protein was 14% for breakfast, 13% for lunch, and 13% for dinner (Table 4). “Dietary Reference Intakes for Japanese, 2010”¹⁰⁾ does not indicate a target protein intake. However, considering that the Reference does show the range of the percentage energy from fat and carbohydrates, approximately 15% –within the range from more than 10% to less than 20%– is considered appropriate. Therefore, it can be said that the protein intake from the meals chosen by the male students presented no problem in terms of insufficiency/excess of the protein.

The average fat values ± SD were 20.4 ± 7.6g for breakfast, 32.3 ± 8.5g for lunch, and 29.9 ± 10.5g for dinner (Table 4). The average of the percentage energy from fat was 27% for breakfast, 31% for lunch, and 31% for dinner. The target value of the percentage energy from fat indicated in the Dietary Reference Intakes for Japanese¹⁰⁾ ranges from more than 20% to less than 30%. As for breakfast, the range between the 90th percentile of values and the maximum value exceeded the target value, while in lunch and dinner, the range between the 50th percentile of values to the maximum value exceeded the target value (Table 4).

The average carbohydrates values ± SD were 100.6 ± 25.4g for breakfast, 131.9 ± 24.5g for lunch, and 121.5 ± 29.6g for dinner. The average of the percentage energy from carbohydrates was 60% for breakfast, 56% for lunch, and 56% for dinner (Table 4). These numbers fell between

Table 4 Energy, Protein, Fat, and Carbohydrates intake status for breakfast, lunch and dinner

	Breakfast ^{*1} (n=86)	Lunch ^{*2} (n=97)	Dinner ^{*3} (n=93)		Breakfast ^{*1} (n=86)	Lunch ^{*2} (n=97)	Dinner ^{*3} (n=93)
Energy (kcal)							
Average	686	944	869	Average	23.5	31.8	28.0
Standard deviation	170	180	226	Standard deviation	7.5	7.2	8.0
Minimum value	244	480	338	Minimum value	4.4	14.8	11.7
10th percentile of values	559	734	563	10th percentile of values	18.9	23.7	18.4
25th percentile of values	595	828	742	25th percentile of values	20.2	26.2	23.2
50th percentile of values	638	942	867	50th percentile of values	22.1	31.0	27.8
75th percentile of values	708	1060	1002	75th percentile of values	24.1	36.8	31.7
90th percentile of values	959	1164	1155	90th percentile of values	32.2	42.1	37.5
Maximum value	1247	1393	1541	Maximum value	50.6	50.0	56.0
Protein (g)				Percentage energy from protein (%)			
Average				Average	27	31	31
Standard deviation				Standard deviation	6	5	5
Minimum value				Minimum value	4	11	8
10th percentile of values				10th percentile of values	12	12	11
25th percentile of values				25th percentile of values	13	12	12
50th percentile of values				50th percentile of values	14	13	13
75th percentile of values				75th percentile of values	14	14	14
90th percentile of values				90th percentile of values	16	15	15
Maximum value				Maximum value	20	18	15
Fat (g)				Percentage energy from fat (%)			
Average	20.4	32.3	29.9	Average	27	31	31
Standard deviation	7.6	8.5	10.5	Standard deviation	6	5	5
Minimum value	3.8	11.8	6.1	Minimum value	5	14	16
10th percentile of values	14.7	22.7	16.4	10th percentile of values	21	24	25
25th percentile of values	16.9	26.8	23.0	25th percentile of values	24	28	28
50th percentile of values	19.0	32.4	29.0	50th percentile of values	27	31	31
75th percentile of values	21.7	37.7	36.4	75th percentile of values	29	34	33
90th percentile of values	30.1	42.1	39.7	90th percentile of values	31	35	36
Maximum value	49.5	55.3	69.0	Maximum value	56	48	40
Carbohydrates (g)				Distribution rate of the percentage energy from fat (%)			
Average	100.6	131.9	121.5	Less than 20%	19	6	11
Standard deviation	26.4	24.5	29.6	More than 20%, less than 30%	68	35	36
Minimum value	21.5	69.4	54.8	More than 30%	13	59	53
10th percentile of values	85.0	100.6	83.7	Average	60	56	56
25th percentile of values	89.1	119.1	105.0	Standard deviation	7	5	5
50th percentile of values	92.5	129.9	120.6	Minimum value	36	37	45
75th percentile of values	107.9	148.3	142.1	10th percentile of values	55	51	50
90th percentile of values	133.2	165.1	161.4	25th percentile of values	58	53	54
Maximum value	194.1	193.3	205.5	50th percentile of values	59	56	56
				75th percentile of values	61	59	59
				90th percentile of values	65	61	63
				Maximum value	91	69	70

*1 Meals provided during 8:15–10:59

*2 Meals provided during 11:00–15:59

*3 Meals provided during 16:00–18:59

50–70%, within the target range set by the Dietary Reference Intakes for Japanese¹⁰⁾. The range between the 10th and 90th percentile of values for breakfast, and between the 10th percentile of values to the maximum value for lunch and dinner were considered to be close to the target value. It was speculated that 90% of the male students were taking appropriate amount of carbohydrates.

In a study on providing healthy menus for office food services, energy per meal was given as 600–700kcal, thus it is determined that the representative value of 650kcal is realistic for setting a standard in planning energy supply⁹⁾. In order to maintain the energy around 650kcal including both main and side dishes, it is suggested that a main dish should provide 200–300kcal and a side 50–150kcal⁹⁾. If a standard for one meal is set at 800kcal for a male university student, it is preferable to provide 400kcal for a staple food, 250–350kcal for a main, and 50–150kcal for a side. However, some menus at the university dining commons contained more than 1,000kcal just for one dish. This can be problematic in terms of improving a meal environment. If a student chooses a high-energy rice bowl (668 ± 145 kcal) or curry (926 ± 236 kcal) with a high-energy main (deep-fried dish: 423 ± 187 kcal) and/or salad marinated in mayonnaise, the total energy can naturally become high.

Percentage Energy from Fat in Menu Chosen by the Subjects

It is clear that an increase in fat intake from food is linked to a weight gain¹²⁾. As the percentage energy from fat in lunch and dinner exceeded the target value, which was less than 30%, the distribution rate of the percentage energy from fat was calculated. The ratio that the percentage energy from fat was more than 30% was 13% for breakfast, and more than 50% for lunch and dinner (Table 4). The ratio that the percentage energy from fat was within the appropriate range, from more than 20% to less than 30%, was 68% for breakfast but approximately 35% for lunch and dinner (Table 4).

When examining the reason the percentage energy from fat in breakfast was low, 1,422 meals out of 1,810 meals (79%) were the “morning sets” (Table 5). As shown in table 3, the energy of the “morning sets” was 594 ± 65 kcal, and the percentage energy from fat was $26 \pm 4\%$, falling within the target range. In addition, the “morning sets” included rice, a main dish, a side dish, miso soup, and nori seaweeds, providing a balanced diet in terms of meal composition and nutritional values. It can be said that because many users chose the balanced meals (morning sets), the overall result for percentage energy from fat was low.

The average of the percentage energy from fat in the main (grilled or simmered dishes), the main (deep-fried dishes) and the side (salad dishes) exceeded 40%. As the percentage energy from fat of some rice bowls and curries exceeded 30%, it is possible that the percentage energy from fat could become high if the menu items with high fat-energy rates were combined with other menu items. When choosing meals at the university dining commons, it is recommended that the staple foods (rice) of $8 \pm 6\%$ fat-energy rate is to be combined with the main dish of 40–50% and the side of 20–30% to achieve the total percentage energy from fat of 20–30%.

There are also reports on the fact that a large portion size can increase an energy intake¹³⁾ and that it is effective to control portion sizes for weight reduction¹⁴⁾.

It is necessary for the university dining commons to: 1. provide nutritionally-balanced (in terms of energy and percentage energy from fat) set menus for lunch and dinner; 2. propose model combinations of menu items; 3. make portion sizes smaller for high-energy menus; and 4. show percentage energy from fat on menu plates. While organizing the meal environment, it is also important to educate university students regarding target energy and percentage energy from fat and how to choose menu items.

Limit of the Study

This study was limited to meals purchased at the university dining commons with “Meal Cards”. In addition, since the amount of food eaten from the selected meals, and the amount of dressing used by the students was not surveyed, the amount of food consumed was not understood accurately. Furthermore, regarding persons who had a utilization rate of the dining commons which was more than 51%, 32 persons (33%) were present for breakfast, and 51 persons (53%) were present for dinner. Due to the low value for breakfast and dinner, a survey of all meals, regarding the personal habits and the amount of food eaten in one day, is needed. Furthermore, the study did not include the “self-service counter” for the analysis since it was unknown how much food was consumed at the bar. To understand the meal contents at the “self-service counter” is an issue for a future study.

Since the “Meal Cards” are expensive, costing JPY140,000 per year, it is most likely that parents with a strong interest in their children’s dietary needs purchase the cards. This

Table 5 Ratio of morning sets in breakfast

Number of meals for breakfast	1,810 (meals)
Number of morning sets	1,422 (meals)
Ratio of morning sets	79 (%)

study targeted only students with a meal card and did not include the meal selection of all male university students. Therefore, in order to determine the meal selection status of male students in general, it is necessary to also survey the meals of male students who do not carry a meal card.

In order to understand the appropriateness of meals of individuals, it is necessary to check height and weight to monitor whether BMI falls into a normal weight category between equal or more than 18.5 kg/m² to less than 25.0 kg/m². Organizing a system in which height and weight data from wellness check-up results can be utilized in co-operation with a nurse's office is also important.

CONCLUSIONS

Results from this study showed that the reason for the appropriate energy and percentage fat energy in the breakfast chosen by male university students was due to the selection of the "morning sets".

For the prevention of lifestyle-related diseases, providing a food environment where meals with balanced energy and percentage fat energy can be selected and dietary education so students can make appropriate health choices is needed.

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REFERENCES

- 1) National Federation of University Co-operative Associations, Japan: Campus life data 2008 (In Japanese). National Federation of University Co-operative Associations, Japan, Tokyo (2009)
- 2) Esmailzadeh, A., Kimiagar, M., Mehrabi, Y., Azadbakht, L., Hu, F. B., & Willett, W. C.: Dietary patterns, insulin resistance, and prevalence of the metabolic syndrome in women. *Am. J. Clin. Nutr.*, 85, 910–918 (2007)
- 3) Lutsey, P. L., Steffen, L. M., & Stevens, J.: Dietary intake and the development of metabolic syndrome. The atherosclerosis risk in communities study. *Circulation*, 117, 754–761 (2008)
- 4) DiBello, J. R., McGarvey, S. T., Kraft, P., Goldberg, R., Campos, H., Quested, C., Laumoli, T. S., & Baylin, A.: Dietary patterns are associated with metabolic syndrome in adult Samoans. *J. Nutr.*, 139, (10), 1933–1943 (2009)
- 5) Ministry of Health, Labour and Welfare Japan: National health and nutrition survey Japan, annual report 2007 (In Japanese). Daiichi Shuppan Publishers, Tokyo (2010)
- 6) Lambert, N., Plumb, J., Looise, B., Johnson, I. T., Harvey, I. weeler, C., Robinson, M., & Rolfe, P.: Using smart card technology to monitor the eating habits of children in a school dining commons: 1. Developing and validating the methodology. *J. Hum. Nutr. Diet.*, 18, 243–254 (2005a)
- 7) Lambert, N., Plumb, J., Looise, B., Johnson, I. T., Harvey, I. weeler, C., Robinson, M., & Rolfe, P.: Using smart card technology to monitor the eating habits of children in a school dining commons: 2. The nutrient contents of all meals chosen by a group of 8- to 11-year-old boys over 78 days. *J. Hum. Nutr. Diet.*, 18, 255–265 (2005b)
- 8) Zenitani, S., Nishiuchi, H., & Kikuchi, T.: Smart-card-based automatic meal record system intervention tool for analysis using data mining approach. *Nutr. Res.*, 30, 261–270 (2010)
- 9) Tomizawa, M., Suto, M., Kimura, M., Hirano, M., Ishikawa, T., & Ishida, H.: Energy level of a healthy menu provided at a worksite dining commons (In Japanese). *Jpn. J. Nutr. Diet.*, 68, (4), 270–275 (2010)
- 10) Ministry of Health, Labour and Welfare Japan: Dietary Reference Intakes for Japanese, 2010 (In Japanese). Daiichi Shuppan Publishers, Tokyo (2009)
- 11) Tomioka, K. Theory and practice of menu planning (In Japanese). In Akabane, M. (Eds.): *Manual of menu planning 7th edition*. Ishiyaku Shuppan Publishers, Tokyo, pp. 9–94 (2006)
- 12) Schutz, V., Garrow J. S.: Energy and substrate balance, and weight regulation. In Garrow, J.S., James, W.P.T., & Ralph, A. (Eds.): *Human Nutrition and Dietetics 10th edition*. Churchill Livingstone, London, pp. 137–148 (2000)
- 13) Rolls, B. J., Morris, E., L., & Roe, L. S.: Portion size of food affects energy intake in normal-weight and overweight men and women. *Am. J. Clin. Nutr.*, 76, 1207–1213 (2002)
- 14) Clark, A., Franklin, J., Pratt, I., McGrine, M.: Overweight and obesity – use of portion control in management. *Aust. Fam. Physician*, 39 (6), 407–411 (2010)