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A Modified Simple Questionnaire to Estimate Dietary Energy Intake for the Japanese

CHIEMI TARU [1], AKIMITSU TSUTOU [2], and IKUKO MIYAWAKI [1].

[1]*Division of Scientific Development for Practical Nursing, Department of Nursing, Faculty of Health Sciences, Kobe University Graduate School of Health Sciences, Kobe, 654-0142, Japan.*

[2]*Division of Preventive Health Sciences, Department of Community Health Sciences, Faculty of Health Sciences, Kobe University Graduate School of Health Sciences, Kobe, 654-0142, Japan.*

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[Aim] To produce a simple food questionnaire for estimating total energy intake and intake of three major nutrients which medical or health care staff such as nurses can rapidly use for the determination of health guidance for individuals.

[Methods] The study group comprised 116 normal healthy subjects (mean age ± S.D. = 40.0 ± 17.8 years), 76 women and 40 men. Using findings based on our previous research and experiences and the simple food questionnaire (MHW-FQ) that the "Kenkoh Shihyoh Sakutei Iinkai" established by the then Ministry of Health and Welfare developed in 1975, we produced a modified version of the MHW-FQ and named it M-MHW-FQ. The study presented here was conducted for the statistical determination of the usefulness of M-MHW-FQ.

[Results]M-MHW-FQ yielded much better results than MHW-FQ as evidenced by improved correlation coefficients, which ranged between 0.56 and 0.75. The findings showed that, despite its simplicity, M-MHW-FQ yielded relatively accurate results and was satisfactory for the rapid estimation of total energy intake including that of three major nutrients.

[Conclusion] This study provides evidence that our simple questionnaire, M-MHW-FQ, is useful for the rapid estimation of individual total dietary energy intake and nutrient balance. We expect that our questionnaire can make a significant contribution to an improvement in lifestyle-related diseases.

INTRODUCTION

A rapid increase in a population with lifestyle-related diseases and a demographic transition to an aging society in Japan may lead to a collapse of the medical insurance system. Since food intake has become excessive and lack of exercise a common feature of the general Japanese population, prevention of lifestyle-related diseases is extremely difficult. For meals in particular, many types of ready-made food such as food in retort pouches and fast food readily available in Japan. An increase in dietary energy intake, especially animal lipids, associated with rapid economic growth after World War II, is thought to be one of main reasons for changes in Japanese dietary habits (1). Although dietary energy intake has decreased gradually after its peak around 1975, the ratio of caloric intake from lipids to total

Phone: +81-78-796-4693 Fax: + 81-78-796-4693 E-mail: t0417@gold.ocn.ne.jp

dietary energy intake, increased gradually after 1955, when it was less than 10%. The mean ratios have remained between 24.1% and 26.5% during the past 25 years or more, and in 2008 ratio was 24.1% for men and 25.5% for women (1). There is no doubt that these changes in dietary energy intake has caused an increase in various lifestyle-related diseases, such as obesity, type II diabetes mellitus, hypertension, and disorders involving lipid metabolism (2,3). However, when dietary recommendations for the prevention of lifestyle-related diseases are needed during a medical examination, it is difficult for a dietitian to determine rapidly the entire actual food intake of an individual. A questionnaire with which medical or health care staff can easily investigate dietary energy intake for screening is therefore urgently needed.

In recent years, several food frequency questionnaires have been developed (4 -10). However, all these questionnaires are generally difficult to use for health screening, because its actual administration takes a lot of time. To date, there is only one simple food intake frequency questionnaire (MHW-FQ) that the "Kenkoh Shihyoh Sakutei Iinkai (Committee for Development of Guidelines for Health; author's translation)" established by the then Ministry of Health and Welfare developed in 1975, and which could be easily used for screening. Unfortunately, the original version of this questionnaire is no longer available. There is one study, however, of the validity of MHW-FQ, (11). At the time this study was published, the authors had already noticed that, although the MHW-FQ and a regular survey method showed correlation for total daily energy, carbohydrate and protein intakes, the MHW-FQ questionnaire did not have enough items about fat intake. In addition, more than 35 years have passed since the MHW-FQ was developed, and during that time the traditional Japanese dietary pattern has changed considerably (12).

This background and our previous research (13, 14) provided the basis for our notion of a food questionnaire which is a modification of the MHW-FQ and provides information about total intake energy and nutrient balance which is fundamental for improving preventive and therapeutic strategies for lifestyle-related diseases.

MATERIALS AND METHODS

1. Subjects

Healthy adult volunteers were recruited from the community where the authors reside and from the university by means of leaflet distribution and word of mouth. As a result, 128 volunteers applied to this study, and 12 of them dropped out during the study.

2. Methods of investigation

1) Preparation of questionnaire

a) MHW-FQ

Seventy healthy people were the subjects of this investigation, for which both MHW-FQ and quantified actual food intake were used. Specifically, actual dietary caloric intake each of the subjects during one day was investigated in conjunction with this questionnaire. The MHW-FQ questionnaire was designed to produce high correlation coefficients for total energy and intake of three major nutrients which were calculated from the answer to the questionnaire and the same items calculated from quantified actual food intake. Energy equivalent to 80 Kcal was expressed as 1 unit.

b) Our questionnaire

We modified MHW-FQ on the basis of the findings of our previous studies (13,14) and our experience and named the modified questionnaire M-MHW-FQ (See Appendix).

(1) In the MHW-FQ, staple food was classified into boiled rice, bread, noodles, and others. In the M-MHW-FQ, on the other hand, boiled rice was sub-classified into ordinary boiled rice, rice with curry, and a big bowl of rice topped with something (such as scrambled eggs with deep-fried breaded pork, beef or prawn tempura). In addition, bread was sub-classified into baked bread such as sliced bread or French loaf, bread used in combination with other food such as hamburger buns or sandwich bread, and sweet rolls. The intake frequency during one week was also investigated (Appendix: 1-5).
(2) As for questions on sweetened drinks, meat, tofu or fermented soybeans and dairy products, the number of choice items increased because of the increase in questions about intake (Appendix: 9,15,16).
(3) As for questions on confectionery, an item of fried confectionery such as chips was added (Appendix: 11).

c) Calculation of total energy and intake of three major nutrients in M-MHW-FQ

Basically the same method for calculating energy intake in MHW-FQ was also used for M-MHW-FQ. For staple food, first the total energy intake for one week was calculated, and then the daily average caloric intake was calculated based on the intake frequency for one week. For staple food, only energy intake of carbohydrates was calculated with the MHW-FQ. For the M-MHW-FQ, however, nutrients contained in staple foods were also considered, and lipid and protein caloric intakes were calculated and added. Total dietary energy intake as well as individual intakes of carbohydrates, proteins, and lipids were calculated from the formula shown in Appendix.

2) Study to validate reliability of M-MHW-FQ

a) Outline of study

(1) Content of investigation

1. MHW-FQ
2. M-MHW-FQ
3. Intake survey over seven days

(2) Collection of data

At first, the 128 volunteers were asked to provide answers to both MHW-FQ and M-MHW-FQ. Afterwards, data of the intake survey over seven days were returned to us by one of the following methods that each volunteer selected: 1) providing a detailed record of meals (food ingredients, net weight, etc.) and photographs of food taken with a disposable camera; 2) providing a summary of food intake and a CD with photographs of meals taken with a digital camera; 3) sending an E-mail with a summary of food intake once a day with an attachment of photographs of meals which were taken with a cellular phone.

b) Ethical concerns

The Ethics Committee of Kobe University approved the protocol for this study. It was explained that even if a volunteer agreed to participate in this investigation, he or she could resign at any time without incurring any disadvantage by doing so. Data were collected from volunteers who had given their written consent to participate in this study. Individual findings, such as dietary intake energy and nutrient balance, were reported back to each volunteer, together with comments by a registered dietitian and a 2GB-USB flash memory as a gift.

d) Method of analysis

Dietary energy was calculated from data of the intake survey over seven days by a registered dietitian using Health Maker Pro 501 for Windows. For MHW-FQ, the energy intake was calculated with the method described in the survey document. For M-MHW-FQ, total energy intake, intake of each of the three major nutrients, and the ratio of lipid caloric intake to total dietary energy intake were calculated. Concurrent validity for M-MHW-FQ was examined by comparing Pearson's product-moment correlation coefficients. One was a comparison between actual daily energy intake data calculated from the intake survey over seven days and data calculated from answers to MHW-FQ , and the other was between actual daily energy intake data calculated from the intake survey over seven days and data calculated from answers to M-MHW-FQ. Data were analyzed by using SPSS software version 16.0 and are presented as mean ± standard deviation (S.D.). P values of less than 0.05 were considered to indicate statistical significance.

RESULTS

Among the 128 volunteers, 12 who did not submit data were excluded from the analysis, so that food intake records provided by 116 volunteers (76 women and 40 men) were analyzed. The characteristics of the volunteers are shown in Table I. The mean age ±S.D. of volunteers was 40.0 ± 17.8 years old, and their mean body mass index ±S.D. was 21.6 ± 2.5, which was within normal range. The mean daily caloric intake±S.D. calculated from intake records for seven days was 1793.8 ± 349.6 kcal.

Table I. Characteristics of subjects and results of 7-day intake survey

	minimum	maximal	mean value	standard deviate
Age	20	80	40.0	17.8
Body height (cm)	145	181	162.3	7.2
Body weight (kg)	43	82	57.1	9.0
Body mass index (BMI)	16.9	28.0	21.6	2.5
Total energy intake (Kcal)	775.0	2653.0	1793.8	349.6
Protein intake (g)	27.6	144.9	64.5	16.4
Carbohydrate intake (g)	100.8	450.8	251.5	58.3
Lipid intake (g)	26.0	108.0	58.3	12.7
Lipid intake / total energy(%)	15.9	40.1	29.5	4.4

Coefficients of correlation between mean daily intake data calculated from intake records for seven days and from MHW-FQ were calculated. All results are summarized in Fig. 1. For mean daily caloric intake the coefficient of correlation was 0.53 ($p < 0.001$) for MHW-FQ, while a much higher coefficient of correlation of 0.75 ($p < 0.001$) was obtained for M-MHW-FQ. For mean daily protein, carbohydrate, and lipid intakes, coefficients of correlation were 0.45 ($p < 0.001$), 0.46 ($p < 0.001$), and 0.51 ($p < 0.001$), respectively, for MHW-FQ. However, higher corresponding coefficients of correlation of 0.62 ($p < 0.001$), 0.64 ($p < 0.001$), and 0.56 ($p < 0.001$) were obtained for M-MHW-FQ. The most notable feature was that, for the ratio of lipid caloric to total caloric intake, a high coefficient of correlation of 0.53 ($p < 0.001$) was obtained for M-MHW-FQ but of only 0.34 ($p < 0.01$) for MHW-FQ.

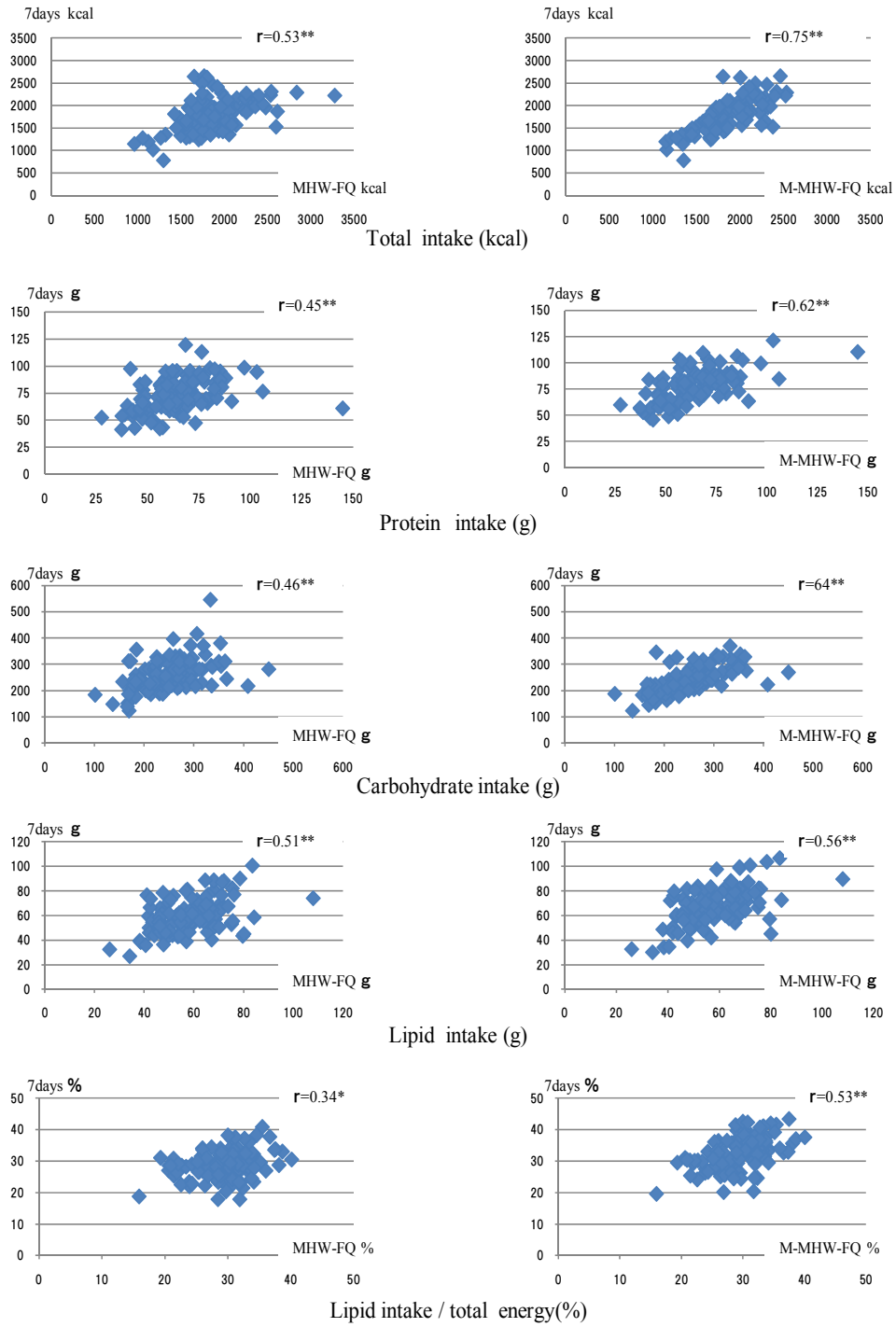

Fig. 1. Concurrent validity between consequence from intake survey for seven days and data calculated from answers to MHW-FQ and M-MHW-FQ
p=0.01>* p=0.001>**

DISCUSSION

The need for effective preventive measures against lifestyle-related diseases is one of the most important health problems facing Japan. For prevention, education for maintaining a healthy lifestyle is essential. For more efficient screening for lifestyle-related diseases, nurses as well as dietitians should investigate energy intake (including dietary habits and actual food intake) to select subjects who may need health guidance and to intervene in their dietary lifestyle where necessary.

This paper introduced a simple method for the rapid estimation not only of the mean daily caloric intake but also of intake of carbohydrates, proteins and lipids for adults. The findings of our study indicate that M-MHW-FQ performs much more effectively than MHW-FQ. The main reasons we made the modified version are that 1) the estimation of the subject's daily dietary intake using conventional food questionnaires is difficult due to changes in dietary habits of the Japanese, and 2) a questionnaire by which co-medical such as nurse can easily and rapidly estimate patient's daily food intake for each patient education is necessary.

Food frequency questionnaires have been generally considered to be effective for examining long-term energy intake in order to prevent lifestyle-related diseases. For example, in a study by Date et al. using a food list with 122 single food items, the Pearson correlation coefficient between total energy-adjusted nutrient intake assessed from Date's questionnaire and intake assessed from actual dietary records was 0.65 (4). In a study by Yamaoka et al. using a questionnaire with 65 food items, the Pearson correlation coefficient between total caloric intake assessed from Yamaoka's questionnaire and that assessed from actual dietary records was 0.64 (8). Similarly, the Pearson correlation coefficient for lipid intake was 0.64 for a study by Egami et al. using a 97-item simple food frequency questionnaire (7). High concurrent validity of 0.65 was also attained in a study by Yamaoka et al. using a questionnaire listing 65 food items (8). However, it could take one hour or more for a subject and a staff member to complete the investigation because those questionnaires contain so many questions that the completion of the questionnaire may become burdensome for the subject.

The time required for completing the answers for M-MHW-FQ was approximately five minutes, which shows that it was simple and easy. The coefficient of correlation for total intake energy was 0.75, which means high concurrent validity was verified. Moreover, coefficients of correlation for lipid intake and Lipid intake / total energy were 0.56 and 0.53, respectively, which can be rated as relatively good (10).

From improvement in dyslipidemia and also the antiatherogenic action, an increase in intake of n-3 polyunsaturated fatty acids (α-linolenic acid: labiate oil, Perilla frutescens oil, linseed oil; EPA: sardine, mackerel, saury; DHA: tuna, bonito, yellow tail) and monounsaturated fatty acid (oleic acid: olive oil, rapeseed oil, nuts, avocado), and a reduction in intake of saturated fatty acid (lauric and myristic acid: coconut oil, palm oil; palmitic and stearic acid: dairy products, beef, pork) are generally recommended. In another instance of prevention of lifestyle-related diseases, it has been reported that intensive lifestyle intervention can reduce diabetes incidence in high-risk adults (15). On the other hand, a low-carbohydrate, high-protein diet resulted in the development of aortic atherosclerosis in animal models (16), and a very recent study has reported identification of a significant association between rice intake and an increased risk of type 2 diabetes in women (17). The most important conclusion to be drawn from these findings is that excess intake of lipid and/or total dietary energy is associated with lifestyle-related diseases. Japan has now arrived at the stage where considerations of quality as well as of quantity of the three major

nutrients has become necessary. Drawback or problem is that numbers of food items and questions in our M-MHW-FQ are less than those in other authors' questionnaires (7, 8, 9). However, time required for estimation is approximately one tenth. Compared with MHW-FQ, there are many food items and questions in our M-MHW-FQ. And also, our M-MHW-FQ has the virtue of being high from the viewpoint of concurrent validity. Our findings suggest that the M-MHW-FQ, which appears to be effective for checking dietary profiles rapidly and easily, can be useful for preventing lifestyle-related diseases or provide guidance for someone who is suffering from a lifestyle-related disease.

CONCLUSION

The food questionnaire (M-MHW-FQ) was developed by using MHW-FQ and our previous research findings. This study was conducted to evaluate M-MHW-FQ statistically. M-MHW-FQ was found to perform much more efficiently than MHW-FQ. Our findings show that, despite its simplicity, M-MHW-FQ yields relatively accurate results and is effective for the rapid estimation by medical care staff such as nurses of food caloric intake including the three major nutrients on an individual basis.

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Appendix 1

Food Intake Frequency Questionnaire (M-MHW-FQ)

Please answer the following questions based on your recent dietary habits. For the first five questions, please fill in the blanks【 】 with an appropriate number and after that, select the option which you think is the closest to your case, and replace the letter with the indicated value. If necessary, you may calculate your average daily quantity from your weekly intake.

1. On average, how many bowls of rice do you eat per day?
(If applicable, please count one "onigiri" as one bowl of rice)
Breakfast:【 】bowl(s) per day,【 】days per week
Lunch:【 】bowl(s) per day,【 】days per week
Dinner:【 】bowl(s) per day,【 】days per week

Breakfast, B =【 bowl(s) per day】×【 days per week 】
Lunch, L =【 bowl(s) per day 】×【 days per week 】
Dinner, D =【 bowl(s) per day 】×【 days per week 】
3 (B+L+D)÷7 = Point【 A 】

2. On average, how many dishes of curry-rice or other rice bowl dishes (Japanese "donburi") do you eat per week?

【 】dishes and/or bowls per week =D

4.5D÷7= Point 【 B 】

3. How often do you eat bread or breadstuffs?
a) For example, how often do you eat a slice of bread or French bread? *(Please do not count a croissant as bread but as a sweet bread—see question #3e)*

【 】slices per day = S,
【 】days per week = D
【 】slices per week = SD

2SD÷7 = Point 【 C 】

b) Do you use butter or margarine on your bread?

☐ No. Point: (0)
☐ Yes, I do. I use an *average* amount of butter or margarine on my bread. Point: (0.5)
☐ Yes, I do. I use a *more than average* amount of butter or margarine on my bread. Point: (1)

Point 【 D 】

c) Do you use jam, marmalade or honey on your bread?

☐ No. Point: (0)
☐ Yes, I use an *average* amount of jam, marmalade or honey on my bread. Point: (0.5)
☐ Yes, I use a *more than average* amount of jam, marmalade or honey on my bread. Point: (1)

Point 【 E 】

d) On average, how often and how many hamburgers or sandwiches do you eat?

【 】per day = N,
【 】days per week = D
【 】per week = ND

3.5ND÷7 = Point 【 F 】

e) On average, how many sweet breads do you eat per week? *(Please include sweet rolls, croissants, doughnuts or other pastries as sweet bread)*
【 】per day = N,
【 】days per week = D
【 】per week = ND

3.5ND÷7 = Point 【 G 】

4. On average, how often do you eat noodles or pasta?
(This would include but not be limited to; ramen noodles, chow mein noodles (Japanese yakisoba), wheat flour noodles (Japanese udon), buckwheat noodles (Japanese soba), spaghetti, egg noodles etc.)

【 】bowls or dishes per week = B

4B÷7 = Point 【 H 】

5. On average, how much cereal grain, not referred to above, do you consume per week? *(This would include but not be limited to; flour, oatmeal, corn, cornflakes, quinoa, millet, etc.)*

【 】cups or servings per week = C

2C÷7 = Point 【 I 】

6. On average, how many regular potatoes or sweet potatoes day do you eat per day? *(Please regard an average amount of potatoes (about 50 grams) about the same as a large-sized egg)*

☐ I eat less than an average amount or I hardly eat them. Point: (0)
☐ I eat an average amount. Point: (0.5)
☐ I eat more than an average amount. Point: (1)

Point 【 J 】

7. On average, how much sugar do you add to your food per day?

☐ I hardly use sugar. Point: (0)
☐ I use a small amount of sugar. Point: (0.5)
☐ I use an average amount of sugar. Point(0.7)
☐ I use a more than average amount of sugar. Point: (1)

Point 【 K 】

8. On average, how many small spoonfuls of sugar do you consume in your coffee and/or tea each day?

☐ I don't drink coffee or tea. Point: (0)
☐ I don't add sugar to my coffee and/or tea. Point: (0)
☐ I consume (S) spoonfuls of sugar.
Points: (0.3 point per spoonful)

0.3S=Point 【 L 】

9. On average, how often do you consume artificially sweetened beverages? *(This would include but not be limited to; canned coffee, carbonated drinks, energy drinks or soft drinks, etc.)*

☐ I rarely consume them. Point: (0)
☐ I sometimes consume them. Point: (0.5)
☐ I consume at least one can or bottle (200 ml) per day. Point(1)
☐ I consume at least two cans and or bottles (bottles of 2 and over) per day. (1 point per can and or bottle)

Point 【 M 】

Appendix 2

10. On average, how often do you consume confectioneries or snack foods?

- ☐ I hardly consume them. Point: (0)
- ☐ I sometimes consume them. Point: (0.5)
- ☐ I consume them every day. Point: (1)

Point 【 N 】

11. If applicable, what kind of confectioneries or snack foods do you most frequently consume?

- ☐ Japanese-style confectioneries. Point: (0)
- ☐ Western-style cakes or pastries. Point: (1)
- ☐ Chips or other fried snack foods. Point: (1)
- ☐ I frequently consume all of above. Point(1.5)
- ☐ I'm not sure which answer to choose. Point(0.5)

Point 【 O 】

12. On average, how much fruit do you consume per day? (Please regard one medium-sized apple as one serving of fruit)

- ☐ I don't eat fruit. Point: (0)
- ☐ I eat about one-half serving. Point: (0.5)
- ☐ I eat one full serving. Point: (1)
- ☐ I eat more than one full serving. Point (1 point per fruit)

Point 【 P 】

13. On average, how many eggs do you consume per day?

- ☐ I don't eat eggs. Point: (0)
- ☐ I sometimes eat eggs. Point: (0.5)
- ☐ I eat approximately 1 egg. Point: (1)
- ☐ I eat more than 1 egg. Point:(1 point per egg)

Point 【 Q 】

14. On average, how much fish do you consume per day? (Please regard one 70-gram piece of fish—or approximately 7 slices of raw sashimi—as one serving of fish)

- ☐ I don't eat fish. Point: (0)
- ☐ I sometimes eat fish. Point: (0.5)
- ☐ I eat approximately 1 piece of fish. Point: (1)
- ☐ I eat approximately 2 pieces of fish. Point:(2)

Point 【 R 】

15. On average, how much meat do you consume per day? (Please regard 2 or 3 slices of ham, 3 Vienna Sausages, one grilled chicken shish kebab or one helping of meat and potato dish (Japanese "Nikujyaga") as one 50-gram serving of meat)

- ☐ I don't eat meat. Point: (0)
- ☐ I eat approximately 50 grams of meat. Point: (1)
- ☐ I eat approximately 100 grams of meat. Point: (2)
- ☐ I eat approximately 150 grams of meat. Point:(3)
- ☐ I eat approximately 200 grams of meat Point:(4)
- ☐ I eat approximately 250 grams of meat Point:(5)

Point 【 S 】

16. On average, how much bean curd (tofu) or fermented soybeans (natto) do you eat per day? *(Please regard one package of natto the same as one package of tofu)*

- ☐ I don't eat either of them. Point: (0)
- ☐ I sometimes eat them. Point:(0.5)
- ☐ I eat approximately 1/2 package. Point: (1)
- ☐ I eat approximately 1 package. Point: (2)
- ☐ I eat approximately 1.5 packages. Point:(3)
- ☐ I eat approximately 2 packages. Point:(4)

Point 【 T 】

17. On average, how much dairy do you consume per day? *(Please regard one package of ice cream, one slice of pizza or a package of yogurt, one bottle (180 milliliters) of milk as one serving of dairy)*

- ☐ I don't consume dairy products. Point: (0)
- ☐ I consume less than one serving of dairy. Point:(0.5)
- ☐ I consume one serving of dairy. Point: (1.5)
- ☐ I consume more than one serving of dairy (1.5 point per serving)

Point 【 U 】

18. On average, how many servings of stir-fried food, fried food, salad dressing or mayonnaise do you eat per day?

- ☐ Less than one serving. Point: (0)
- ☐ At least one serving. Point: (1)
- ☐ At least two servings. Point: (2)
- ☐ At least three servings. Point:(3)
- ☐ At least four servings. Point:(4)

Point 【 V 】

19. Do you prefer lean or fatty meats?

- ☐ I prefer lean meat. Point: (0)
- ☐ I can't decide. Point:(0.5)
- ☐ I prefer fatty meat. Point: (1)

Point 【 W 】

20. Do you eat vegetables every day?

- ☐ No, I hardly eat vegetables. Point: (0)
- ☐ Yes, I eat a few vegetables. Point:(0.5)
- ☐ Yes, I usually eat vegetables. Point: (1)
- ☐ Yes, I eat a lot of vegetables. Point: (1.5)

Point 【 X 】

<The way to calculate dietary intake>

Total energy intake (kcal) = Total score (A to X) ×80

Protein intake (g) = 2 (A＋B+C+F+G+H+I+J+N) + 9 (Q+R+S+T) + 4 V+ 5 X

Carbohydrate intake (g) =18 (A＋B+C+F+G+H+I+J+N) +20 (E+K+L+M+P) + 6 V + 13 X

Lipid intake (g) = 9 (D+O+V+W) + 5 (Q+R+S+T+U) + 3 (F+G) + X