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〔報　文〕

A Second Look at the Results of New Dietary Education Program to Prevent Type 2 Diabetes Focusing on Dietary Caloric Intake for Alcohol and Fat/Oil

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Abstract

Objective: This report focused on alcohol and fat/oil intake using results of a particular dietary intervention program of randomized controlled trial[1)].

Methods and Materials: Subjects were recruited primarily during an annual health check-up in a health examination center located in the center of Tokyo from February 2000 to January 2001. The examination included an oral glucose tolerance test (OGTT). Eligible subjects were those diagnosed as borderline diabetic. Subjects were randomly assigned to the intervention or control groups. Study subjects were 156 Japanese male workers at high risk for type 2 diabetes, aged 35-70 years. The intervention group, or (New Dietary Education group: NDE) received individualized dietary counseling based on their food frequency questionnaire (FFQW65)[2)] results.

Results: Many NDE subjects successfully managed to maintain a balance of total intake.

The NDE intervention was effective in decreasing caloric intake of alcohol for Japanese male workers at a high risk for type 2 diabetes (% change NDE: -0.088 ± 3.75 vs. control: 0.89 ± 3.0). The intervention group diet produced a lower caloric intake of fat/oil than did the control group diet after one year (% change NDE: -0.035 ± 0.034 vs. control: 0.034 ± 0.0235).

Daily dietary caloric intake for alcohol was decreased in the NDE group compared to the control group and the difference was significant after adjusting for baseline value ($P = 0.049$). Daily dietary caloric intake for fat/oil was decreased in the NDE group compared to the control group but the difference was not significant after adjusting for baseline value ($P = 0.158$).

Conclusion: All the subjects were given specific information about their actual dietary habits through the use of the FFQW65. The program focused on increasing motivation and encouraging the subjects to recognize the need for behavior modification through their own efforts. The improvement seen in alcohol and fat/oil intake in the NDE group might be due to showing individually radar-charted traits or illustrated ideal meals during the intervention.

Key words: randomized controlled trial, dietary intervention, alcohol, fat/oil, prevention of type 2 diabetes

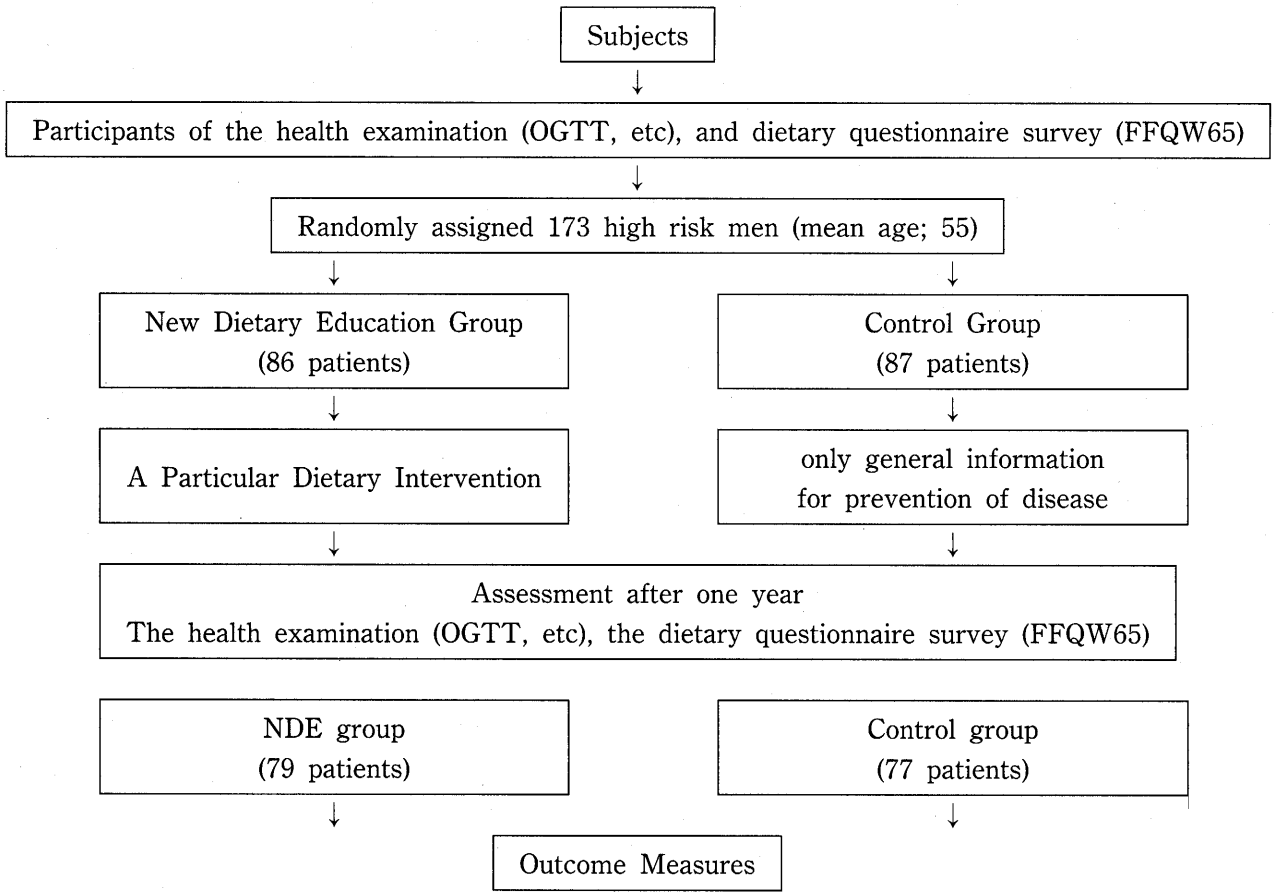
Introduction

Type 2 diabetes is increasing worldwide largely as a result of increasing obesity and sedentary lifestyles. The prevalence of type 2 diabetes has drastically increased with estimates of no fewer than 7,400,000 cases in Japan[3]. To prevent the development of type 2 diabetes, a primary prevention program of dietary education would be greatly beneficial. As we have previously reported, we conducted a randomized controlled trial (RCT) for a new dietary education (NDE) program reducing plasma glucose (PG) levels in Japanese male workers and proving that the NDE can reduce glucose levels by effecting changes in the total caloric intake of subjects at high risk for type 2 diabetes[1]. Excessive dietary caloric intake for alcohol and fat/oil as a relative variance of caloric energy intake was one of the problems among the subjects.

Objective

This study focused on the difference in alcohol and fat/oil intakes of the intervention and control groups using a particular dietary intervention.

Dietary Intervention Design



Primary: the percent change from baseline in 2-h PG value

Secondary: the change from baseline in the absolute value of "overintake/underintake fraction" for total energy

$$\text{overintake/underintake fraction} = \left(\frac{\text{Actual total energy intake}}{\text{RDA (recommended dietary allowance)}} - 1\right) \times 100\ (\%)$$

Goal of the Dietary Education Program

- recognize how to divide total caloric intake between breakfast, lunch and dinner
- know their actual food intake pattern
- recognize how one's eating pattern differs from recommended pattern
- recognize how to choose from food groups; carbohydrate, protein, fat, fiber, vitamin, mineral
- show the need to keep protein energy around 15-20%, fat energy around 20-25%, and carbohydrate energy around 55-60% of the total caloric intake
- to maintain the intake of alcohol at an appropriate level
- to optimize the intake of whole-grain products, vegetables, soybeans, fruits, fish, meat and eggs

Methods and Materials

Subjects were recruited primarily during an annual health check-up in a health examination center located in the center of Tokyo from February 2000 to January 2001. The examination included an oral glucose tolerance test (OGTT) and the dietary questionnaire survey, FFQW65. Eligible subjects were those diagnosed as borderline diabetic. The 156 study subjects were randomly assigned to the intervention (n=79) or control (n=77) groups. They were all Japanese male workers at high risk for type 2 diabetes, aged 35-70 years.

They all received individualized dietary counseling based on their FFQW65 results in the following way. We made individual nutritional assessments from the initial result of FFQW65 reorganizing its 65 items into 15 food groups. (A sample shown in **Fig.1-1**) From the assessments, individual charts indicating deficiency rate of various food groups (A sample shown in **Fig.1-2**), deficiency rate of meals (A sample shown in **Fig.1-3**) and PFC (protein, fat and carbohydrate) balance ratios (A sample shown in **Fig.1-4**) were elicited. With critical comments to each subject, these data were sent to all 156 subjects. We also prepared 3 types of illustrated patterns according to the subjects' recommended total caloric intake; 1600 kcal, 1800 kcal and 2000 kcal, respectively, (a 1800 kcal sample shown in **Appendices 1-3**) and together with the information shown in **Fig.1**, a properly chosen sample diet with critical comments was sent to the intervention group only and not to the control group.

Statistical Analyses

Difference between groups for baseline characteristics of the subjects who completed the trial were assessed by the Student's *t* Test and Wilcoxon's rank-sum test. Outcome measures were compared using ANCOVA by adjusting for baseline values. The Spearman correlation coefficient was used for examining the relationship between the percentage changes in the absolute value of "overintake/underintake fraction" including caloric intake by alcohol and fat/oil in the NDE and control groups.

Results

Many NDE subjects successfully managed to maintain a balance of total caloric intake. The NDE intervention was effective in decreasing caloric intake of alcohol for Japanese male workers at a high risk for type 2 diabetes (% change NDE: -0.088 ± 3.75 vs. control: 0.89 ± 3.0). The intervention group diet produced a lower caloric intake of fat/oil than did the control group diet after one year (% change NDE: -0.035 ± 0.034 vs. control: 0.034 ± 0.0235).

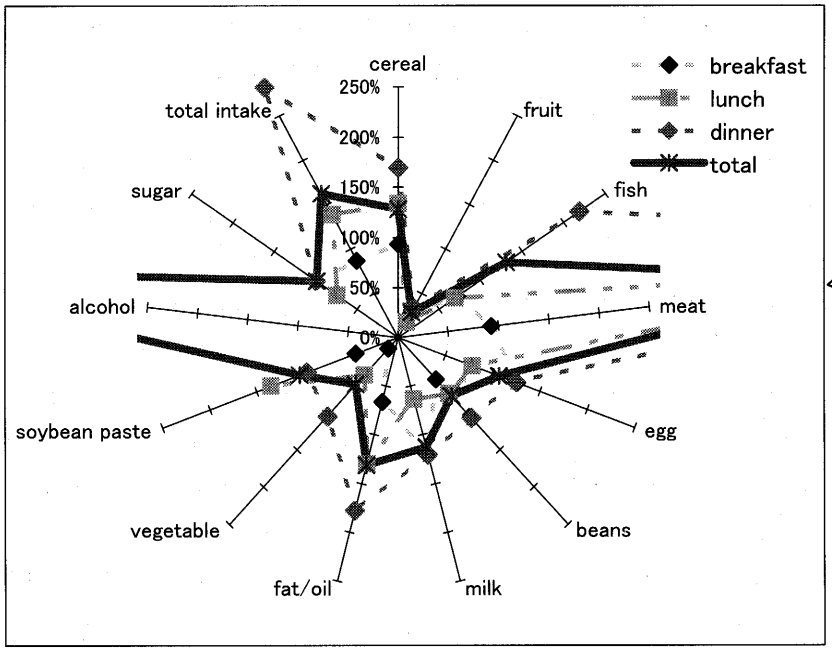
Daily dietary caloric intake for alcohol was

Food group	Estimate energy(kcal)				1840	Sufficiency/deficiency rate			
	breakfast	lunch	dinner	total	goal	breakfast	lunch	dinner	total
cereal	273	391	495	1126	880	93%	133%	169%	128%
fruit	7	5	9	23	80	28%	17%	33%	28%
fish	29	27	87	156	120	71%	69%	218%	130%
meat	25	152	218	381	80	92%	569%	816%	476%
egg	34	21	33	85	80	126%	79%	124%	106%
beans	22	30	43	94	120	56%	75%	108%	78%
milk	45	23	45	126	112	120%	63%	121%	112%
fat/oil	35	69	95	209	160	66%	130%	178%	130%
vegetable	4	13	28	51	80	15%	50%	105%	63%
processed food	2	10	9	38	10				
soybean paste	4	11	8	25	24	45%	135%	97%	105%
alcohol	0	0	218	226	40				564%
confectionery	18	93	176	242	20				
sugar	8	6	8	24	24	98%	74%	99%	98%
beverage	40	44	19	92	10				
total intake	533	852	1733	2986	1840	87%	139%	283%	162%

Your deficiency rate is 162% of your caloric goal.

Fat/oil, alcohol and meat intake is too high.
There is a deficiency in fruit and vegetable intake.

Fig.1-1 A sample of nutrition assessment



You have trouble eating breakfast.
Balanced meals are best.
Fat intake is a little high.

Fig.1-2 Radar chart of sufficiency/deficiency rate of various food groups

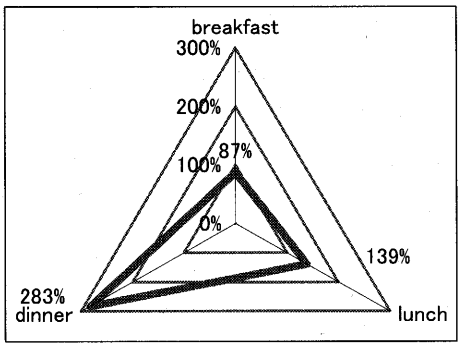
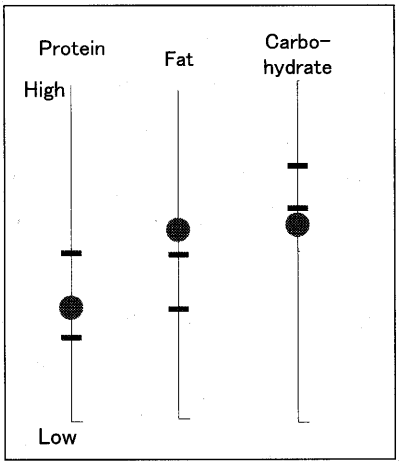


Fig.1-3 Sufficiency/deficiency rate of meals



●(between two bars) shows the right balance

Fig.1-4 PFC balance ratio

decreased in the NDE group compared to the control group and the difference was significant after adjusting for baseline value (P=0.049).

Daily dietary caloric intake for fat/oil was decreased in the NDE group compared to the control group but the difference was not significant after adjusting for baseline value (P=0.158). **(Table 1, Fig.2)**

These results were shown to reduce the level of alcohol and fat/oil intakes effecting changes in the total caloric intake of subjects.

Conclusion and Discussion

This clinical randomized controlled trial has shown that a high-risk group of Japanese male workers at risk for type 2 diabetes can be motivated to make comprehensive changes in dietary behavior for at least a year outside hospital.

This result shows that NDE intervention has the potential to positively improve dietary consumption behaviors of individuals in high risk groups for type 2 diabetes. Caloric intake for alcohol and fat/oil was decreased in the NDE group. Our study assessed the effectiveness of NDE in reducing plasma glucose levels in Japanese male workers at high risk for type 2 diabetes by correcting total caloric intake through adequate instruction[1].

Information was obtained using of the semi-quantitative food frequency questionnaire that included a list of 65 food items for each meal (FFQW65). The FFQW65 classifies food into 15 groups; cereal, fruit, fish, meat, egg, beans, milk, fats and oil, vegetable, processed food, soybeans paste, alcohol, confectionery, sugar, and beverage.

The FFQW65 is a self-administered semi-quantitative food frequency questionnaire consisting of 65 food items for each meal, with colored illustrations showing portion sizes. From the responses, caloric intake for each meal was estimated according to food groups corresponding to the JDS (Japanese Diabetes Society) food exchange book[4]. Relatively high validity (correlation coefficient: r=0.64) and reproducibility (r=0.76) for daily caloric intake were obtained[2]. The subjects were given specific information about actual dietary habits through the use of FFQW65. The program focused on increasing motivation and encouraging the subjects to recognize the need for behavior modification through their own efforts. The radar chart of "ratio of actual-to-RDA" for total caloric intake by meals and illustrations of portions might have helped the subjects modify their food intake pattern through recognition of their own dietary problems. The NDE program provided by dietitians using the FFQW65[1] resulted in significant improvements and benefit to subjects at high risk for type 2 diabetes.

Based on the following knowledge we were able to design and compile the illustrations in Appendices 1-3. Definition of calorie, basal metabolic rate, physical activity level, estimated energy requirement as estimated by FFQW65. Cooking method, kinds of food and timing of meals affect dietary caloric intake. The structural feature of each of the following lipids: cholesterol, fatty acids (including saturated, mono-, polyunsaturated, omega-6 and omega-3; short-, medium, long-chain). Alcohol is a high caloric food and the Food and Agriculture Organization of the United Nations calculates[5] that energy from alcohol in humans is 7 kcal for 1 gram ethanol. It is easy to gain calories with alcohol and fat/oil and difficult to lose calories with exercise.

The NDE was shown to reduce caloric intake for alcohol and fat/oil in the intervention group at

Table 1 The result of data analysis on change from baseline in the absolute value of "overintake/underintake fraction" for energy intake by "alcohol" and "fat/oil"

	Alcohol		Fat/Oil	
	Control	Dietary intervention	Control	Dietary intervention
% change	0.89	−0.088	0.034	−0.035
SD	3	3.75	0.235	0.323
SE	0.34	0.42	0.03	0.04
N	77	79	77	79

SD: standard deviation SE: standard error N: number

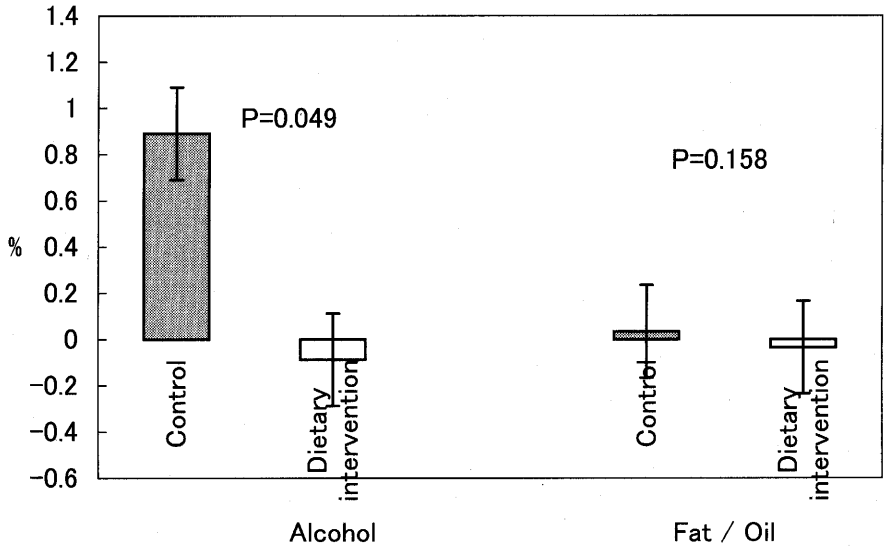


Fig. 2 Change from baseline in the absolute value of "overintake/underintake fraction" for energy intake by "alcohol" and "fat/oil"

high risk for type 2 diabetes. Many subjects tended to eat and drink a great deal late at night. Changing this habit of excess caloric intake at night during the NDE might have reduced the risk for diabetes. Unfortunately, subjects had great difficulty adhering to dietary instructions concerning the recommendations for meals. However, the decrease was remarkable for alcohol intake. Dietary modifications are the cornerstone of expert consensus and recommendations for the prevention and treatment of diabetes mellitus (American Diabetes Association)[6]. Clinical trials of dietary changes for risk-factor management have focused on a combination of diet and lifestyle modifications[7]. In a randomized controlled trial by Ornish et al.,[8] 28 patients were assigned to an experimental group (low-fat vegetarian diet, stopping smoking, stress management training, and moderate exercise). It reports that the comprehensive lifestyle changes may be able to bring about regression of even severe atherosclerosis after only 1 year, without use of lipid-lowering drugs. Other aspects of lifestyle, especially diet, may confound the reported effects of alcohol intake on insulin resistance. Longer

and larger studies are required to determine the efficacy of lifestyle for type 2 diabetes in high risk group.

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*Appendices 1-3 are shown on pp.39-41.

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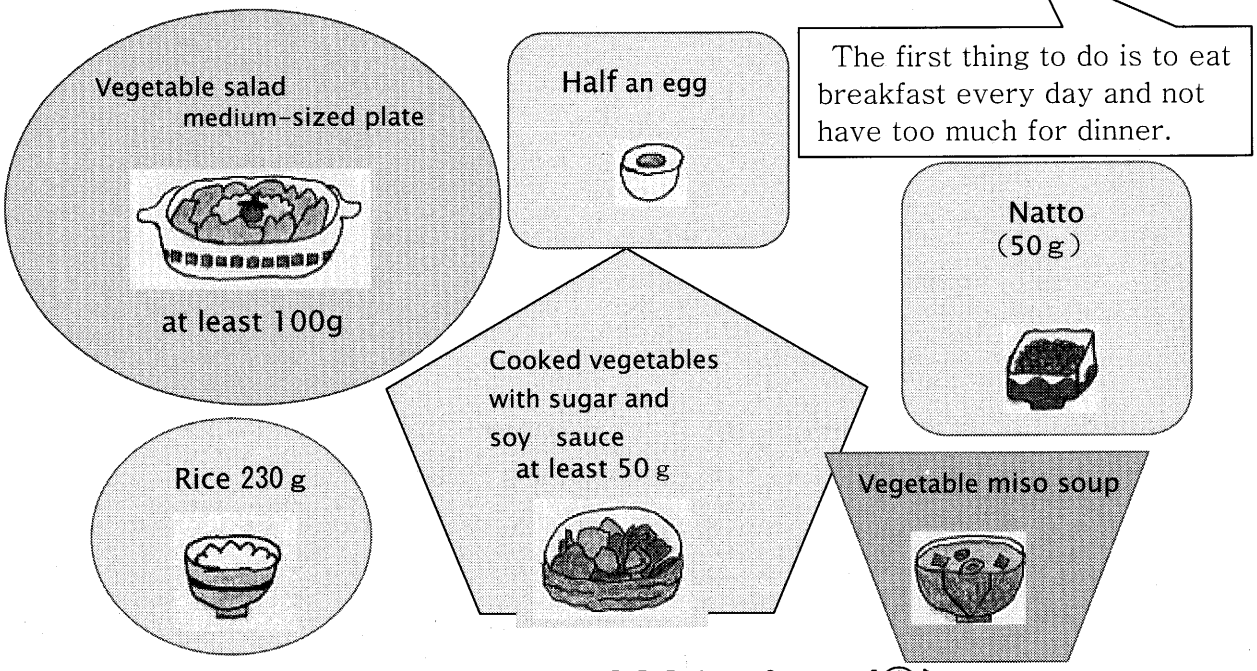
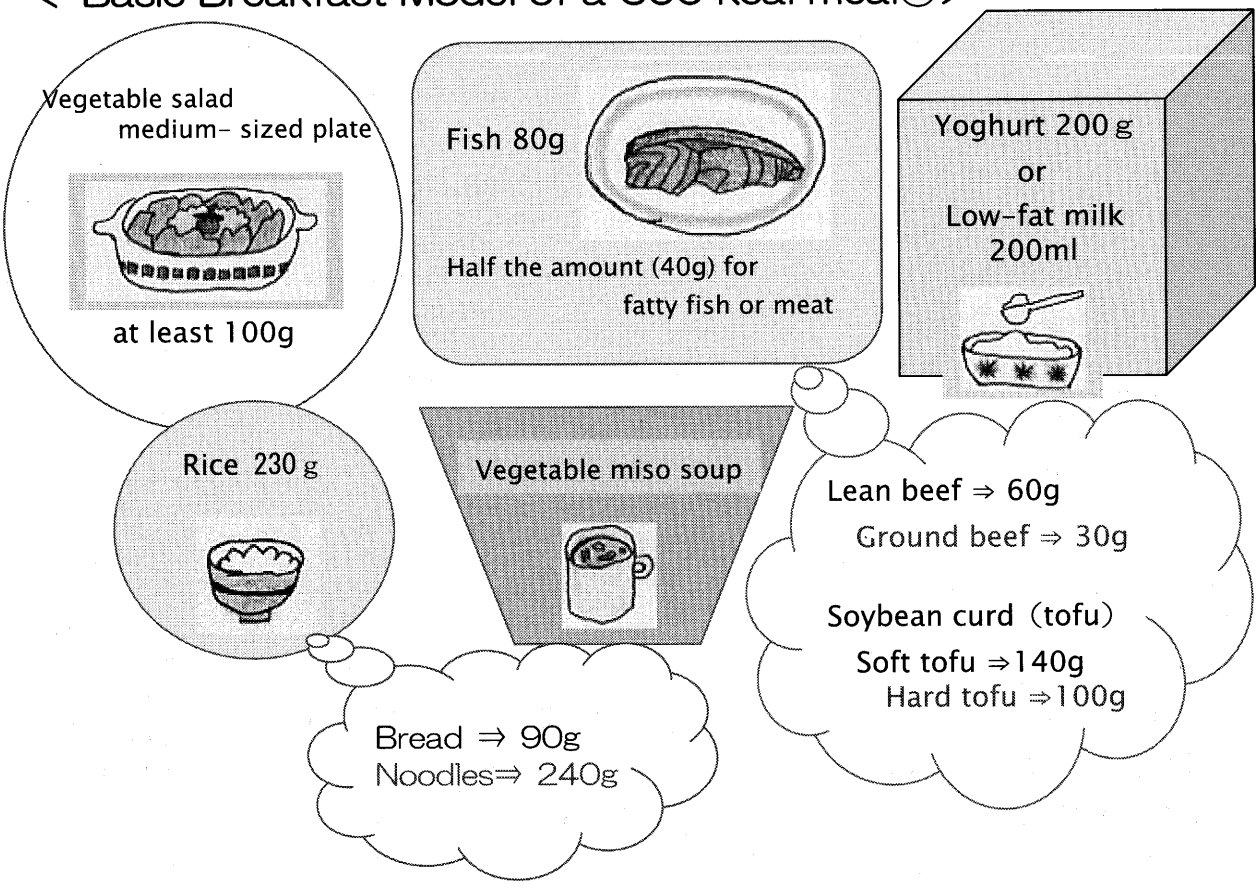
～1800kcal Sample for Total Daily Caloric Intake～

Breakfast 600kcal, Lunch 650kcal, Dinner 550kcal

< Basic Breakfast Model of a 600 kcal meal ①>



< Basic Breakfast Model of a 600 kcal meal②>



<Basic Lunch Model of a 650 kcal meal①>

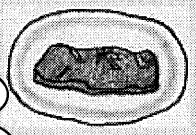
Vegetable salad
medium-sized

at least 100g

Cooked vegetables with sugar and soy sauce
at least 50 g

Lean meat 60g

Half the amount (30g) for fatty meat



Rice 250 g

If it's fried,e.g. tempura, it's best not to eat too much.
Let's eat more for breakfast or lunch rather than dinner. Let's use only two teaspoons of oil in total.

Buckwheat noodles⇒ 280g
Noodles⇒ 350g

<Basic Lunch Model of a 650 kcal meal②>

Udon with meat and vegetables
300g

Vegetable salad
medium-sized

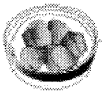
at least100g

You could add canned tuna, ham, or prawns.

Fruit

one

Tofu



Cooked Potato (100g)

There's a vitamin and protein deficiency when you choose to eat noodles.
Eat it with tofu, tuna salad, fruit and milk.

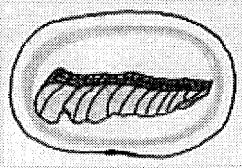
< Basic Dinner Model of a 550 kcal meal>

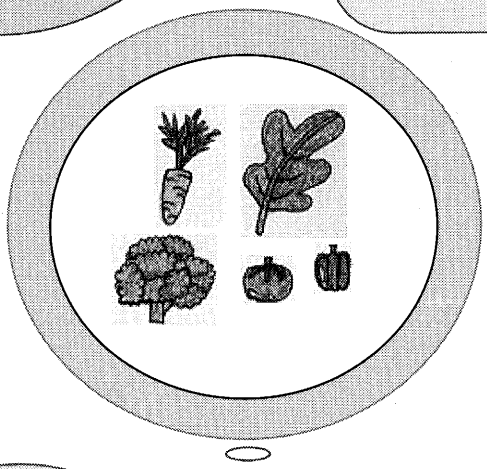
Eat dinner by about 8:00 p.m.

Vegetable salad
medium-sized

at least 100g

Fish 80g
Half the amount (40g) for fatty fish.





Rice 195 g

Vegetable miso soup

Have one more dish full of green vegetables.