*Original Article***Baseline dietary intake in the Saku Control Obesity Program (SCOP)**

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Abstract

BACKGROUND: We planned a moderate-intensity lifestyle intervention program for overweight Japanese populations, the Saku Control Obesity Program (SCOP), a clinic-based, open randomized, cross-over trial. The purpose of the present article describes the baseline dietary characteristics of the study subjects.

METHODS: Dietary intake at baseline was assessed using a validated self-administered diet history questionnaire in overweight subjects (mean body mass index: 30.8 kg/m²) in the intervention and the control groups (n = 119 and 116, respectively).

RESULTS: Mean value of energy intakes was not significantly different between the intervention and the control groups (2485 and 2426 kcal/day, respectively). Mean intake of nutrients and foods was generally similar between the groups although higher intake of potassium, calcium, phosphorus, riboflavin, and dairy product and lower intake of pulses and seaweeds in the intervention than in the control groups were observed.

CONCLUSIONS: Mean dietary intake level of energy, nutrients, and foods at baseline was similar between the intervention and the control groups although small significant difference was observed for a few dietary variables. These results suggest the success of randomization in the present study at least regarding dietary intake.

KEY WORDS: dietary intake, semiquantitative questionnaire, epidemiology, intervention, obesity

Introduction

The prevalence of obesity has increased dramatically during the past several decades, especially in industrial countries. The increasing prevalence of obesity is fundamentally derived from increase in energy expenditure and increase in overall energy consumption. Obesity induces multiple metabolic abnormalities that contribute to the pathogenesis of diabetes mellitus and cardiovascular disease and are associated with increased morbidity and mortality risk. In Japan, the prevalence of overweight [body mass index (body weight in kg divided by the square of body height in m; BMI) of ≥ 25 kg/m²] in men and elderly women has increased in the last 20 years. A population approach to control obesity and prevent obesity-associated diseases focusing on middle-aged men and women is urgently needed in Japan. In western countries, many intervention studies to modify overweight or prevent type 2 diabetes mellitus have conducted and the efficacy has been evaluated.

We planned a moderate-intensity lifestyle intervention program for overweight Japanese populations whose dietary habits are markedly different from those in western populations, and examined their effectiveness in the Saku Control Obesity Program (SCOP), a clinic-based, open randomized, cross-over trial. The purpose of the present article describes the baseline dietary characteristics of the study subjects.

Methods**Subjects**

Obese adults (BMI of ≥ 25 kg/m²) were selected for potential subjects from database of comprehensive medical examination for the past 5 years of Saku Central Hospital, Nagano, Japan. Eligibility criteria for this study were: (1) 40–64 years old; and (2) free of type 1 diabetes and irreversible diseases like stroke, cardiovascular disease, and advanced cancer. The eligible persons were invited to this intervention study through telephone or invitation letter and were asked to participate in orientation meeting about research projects. In total, 235 subjects (115 men and 120 women) participated in this study, and randomly assigned to two groups with intervention of physical activity and diet in 2006 or in 2007. A total of 119 and 116 subjects were randomized into the intervention and control group in 2006, respectively. All subjects gave their written informed consent to participate, and all procedures were reviewed and approved by the Review Board of National Institute of Health and Nutrition.

Dietary assessment

Dietary habits were assessed by using a previously validated, self-administered diet history questionnaire (DHQ).¹⁻³⁾ The DHQ structured 16-page questionnaire for assessing dietary habits in the previous month, consisting of the following seven

sections: general dietary behaviors; major cooking methods; consumption frequency and semi-quantitative portion size of selected 121 food and nonalcoholic beverage items; dietary supplements; consumption frequency and amount of 19 staple foods (rice, bread, noodles and other wheat foods) and miso (fermented soybean paste) soup; and open-ended items for foods consumed regularly ($\geq$ once/ week) but not appearing in the DHQ. The food and beverages items and portion sizes in the DHQ were derived mainly from data in the National Nutrition Survey of Japan. Dietary intake, including 150 food and beverage items, energy and dietary fiber, was calculated using an ad hoc computer program for the DHQ, which was based on the food composition table in Japan; information in dietary supplement and from the open-ended section is not used in the calculation. Methods of calculating dietary intake and the validity of the DHQ have been published elsewhere.¹⁻³⁾ Pearson correlation coefficient between DHQ and 3-day dietary records was 0.48 for energy in 48 normal-weight women.¹⁾ DHQ was completed by all subjects just before the baseline health check-up. At the orientation meeting, subjects were directed to complete the DHQ. The questionnaires were checked by dietitians, and missing or illogical answers were obtained or corrected by interview.

Statistical analysis

All statistical analyses were performed for men and women separately, using SAS statistical software, version 8.2 (SAS Institute Inc., Cary, NC, USA). We computed mean daily intakes of energy and some nutrients and foods at baseline by intervention and control groups. Non-paired t test and chi-squared test was performed to examine the differences in baseline dietary characteristics between the two groups. Since food group intakes were generally skewed towards higher values, we chose to use non-parametric statistics. Because most of the food groups correlated with total energy intake, both crude values and energy-adjusted values were used. Energy-adjusted food intake values were calculated as the amount of food consumed divided by 1000 kcal (density model). Measured body weight and body height at the baseline health check-up were used in this report. Body weight at 20 years old was self-reported as part of the DHQ. BMI was calculated as weight (kg) divided by the square of height. Change of body weight from 20 years old were also calculated as current body weight minus body weight at 20 years old. A two-sided P value of <0.05 was consisted statistically significant.

Results

All subjects completed the DHQ at baseline survey. **Table 1** shows basic demographic and dietary behavior characteristics of subjects at baseline. The mean ($\pm$ standard deviation) was as follows: 53.5 ± 6.5 years for age, 30.8 ± 3.3 kg/m² for BMI, 18.8 ± 8.8 kg for change weight from 20 years old. About 60% of subjects had no experience of intentional dietary change. About 80% of subjects had not received dietary counseling from medical doctor, nurse, or dietitian. About 70% of subjects reported themselves very fast or relatively fast eaters. To the question about preference of pork fat, beef fat, and poultry skin, about 40% of subjects answered "dislike or don't eat". Response of questions about rate of eating and fat preference differed statistically significant between sexes ($p < 0.05$).

Table 1 Basic characteristics of participants *

	All (n = 235)	Men (n = 116)	Women (n = 119)	P-value***
Age (years)	53.5 $\pm$ 6.5	52.9 $\pm$ 6.6	54.1 $\pm$ 6.4	0.161
Sex (% women)	51.1			
Body height (cm)	161.8 $\pm$ 8.6	168.4 $\pm$ 8.6	155.4 $\pm$ 5.5	<.0001
Body weight (kg)	80.7 $\pm$ 12.1	86.4 $\pm$ 11.8	75.2 $\pm$ 9.5	<.0001
Body mass index (kg/m ²)	30.8 $\pm$ 3.3	30.4 $\pm$ 3.5	31.1 $\pm$ 3.1	0.124
Change of body weight from 20 years old (kg)**	18.8 $\pm$ 8.8	17.8 $\pm$ 8.7	19.7 $\pm$ 9.0	0.102
Intentional of dietary change (%)				
No	60.5	59.5	61.5	0.927
Yes (within 1y)	19.3	20.7	18.0	
Yes (within 3y)	9.0	9.5	8.6	
Yes (more than 3y ago)	11.2	10.3	12.0	
Current dietary counseling (%)				
No	83.0	85.3	80.7	0.341
Yes	17.0	14.7	19.3	
Rate of eating (%)				
Very fast	26.8	34.5	19.3	0.042
Relatively fast	46.8	42.2	51.3	
Medium	19.6	19.8	19.3	
Relatively slow	4.7	2.6	6.7	
Very slow	2.1	0.9	3.4	
Fat preference (%)				
Pork fat and beef fat				
like and usually eat	19.6	28.5	10.9	<.0001
Neither like nor dislike	44.7	49.1	40.3	
dislike and don't eat	35.7	22.4	48.7	
Poultry skin				
like and usually eat	18.7	24.1	13.5	0.004
Neither like nor dislike	40.9	45.7	36.1	
dislike and don't eat	40.4	30.2	50.4	

* Values are mean $\pm$ standard deviation or percent

** Present body weight minus body weight at 20 years old
(n=232; 113 men and 119 women)

*** Significant difference between sexes

Basic demographic and dietary behavior characteristics of subjects at baseline according to quartiles of BMI. Subjects in the higher quartiles of BMI had higher value of current body weight and larger value of body weight change from 20 years old ($p < 0.001$). Significant differences between groups were observed in the body weight change from 20 years old ($p = 0.013$) in both sex combined.

More subjects in the lower quartiles of BMI reported recent intentional dietary changes ($p = 0.017$). Basic demographic and dietary behavior characteristics of men and women according to quartiles of BMI showed that similar relations of BMI with and characteristics were observed in both men and women except for that with rate of eating (**Table 2**).

Mean intakes of food groups were presented in **Table 3** (men and women separately). Mean crude intake of cereals, alcoholic beverages, meats, and eggs was higher in men than in women,

Table 2 Basic characteristics of men and women according to quartile of body mass index (BMI) *

	Quartiles of BMI					Quartiles of BMI				
	Men (n = 116)					Women (n = 119)				
	1 (n = 29)	2 (n = 29)	3 (n = 29)	4 (n = 29)	P-value***	1 (n = 29)	2 (n = 30)	3 (n = 30)	4 (n = 30)	P-value***
Body mass index (kg/m ²)	27.5 ± 0.7	29.1 ± 0.4	30.3 ± 0.4	34.9 ± 4.4		27.8 ± 1.0	29.6 ± 0.4	31.5 ± 0.6	35.4 ± 2.5	
Age (years)	54.1 ± 6.5	53.6 ± 6.2	52.7 ± 6.5	51.1 ± 7.1	0.324	54.0 ± 6.5	55.3 ± 5.8	54.6 ± 6.4	52.3 ± 7.0	0.304
Body height (cm)	168.6 ± 5.2	169.5 ± 6.4	167.7 ± 5.3	167.8 ± 6.2	0.629	155.8 ± 4.9	156.2 ± 5.8	154.6 ± 6.1	154.9 ± 5.3	0.650
Body weight (kg)	78.4 ± 5.2	83.5 ± 6.5	85.2 ± 5.5	98.4 ± 15.6	<.0001	67.6 ± 4.4	72.4 ± 5.7	75.3 ± 6.6	85.2 ± 10.3	<.0001
Change of body weight from 20 years old (kg)**	12.9 ± 5.3	17.4 ± 4.0	16.1 ± 9.4	24.7 ± 9.9	<.0001	13.9 ± 5.8	16.8 ± 5.4	22.2 ± 6.2	25.8 ± 11.7	<.0001
Intentional of dietary change (%)										
No	48.3	62.1	62.1	65.5	0.071	31.0	73.3	72.4	69.0	0.026
Yes (within 1y)	41.4	10.3	20.7	10.3		37.9	16.7	6.9	10.3	
Yes (within 3y)	3.5	13.8	3.5	17.2		13.8	3.3	10.3	6.9	
Yes (more than 3y ago)	6.9	13.8	13.8	6.9		17.2	6.7	10.3	13.8	
Current dietary counseling (%)										
No	72.4	86.2	89.7	93.1	0.126	82.8	83.3	76.7	80.0	0.911
Yes	27.6	13.8	10.3	6.9		17.2	16.7	23.3	20.0	
Rate of eating (%)										
Very fast	20.7	37.9	34.5	44.8	0.413	27.6	16.7	16.7	16.7	0.030
Relatively fast	55.2	34.5	48.3	31.0		31.0	63.3	50.0	60.0	
Medium	24.1	20.7	17.2	17.2		31.0	16.7	23.3	6.7	
Relatively slow	0.0	6.9	0.0	3.5		6.9	3.3	0.0	16.7	
Very slow	0.0	0.0	0.0	3.5		3.5	0.0	10.0	0.0	
Fat preference (%)										
Pork fat and beef fat like and usually eat	13.8	34.5	34.5	31.0	0.445	13.8	3.3	6.7	20.0	0.462
Neither like nor dislike	51.7	48.3	44.8	51.7		34.5	43.3	46.7	36.7	
dislike and don't eat	34.5	17.2	20.7	17.2		51.7	53.3	46.7	43.3	
Poultry skin like and usually eat	13.8	27.6	20.7	34.5	0.354	17.2	6.7	16.7	13.3	0.348
Neither like nor dislike	41.4	51.7	48.3	41.4		34.5	26.7	33.3	50.0	
dislike and don't eat	44.8	20.7	31.0	24.1		48.3	66.7	50.0	36.7	

* Values are mean±standard deviation or percent

** Present body weight minus body weight at 20 years old (n=232; 112 men and 120 women)

*** Significant difference between BMI categories

Table 3 Food group intakes estimated by a self-administered diet history questionnaire (DHQ) by sex *

	Crude model (g/day)			Density model (g/1000kcal)		
	Men (n = 116)	Women (n = 119)	P-value **	Men (n = 116)	Women (n = 119)	P-value **
	Mean ± SD	Mean ± SD		Mean ± SD	Mean ± SD	
Cereals	595.7 ± 218.7	422.7 ± 123.2	<0.001	223.9 ± 63.1	202.8 ± 59.7	<0.001
Nuts	3.4 ± 5.5	3.8 ± 9.0	0.672	1.1 ± 1.4	1.4 ± 3.2	0.328
Potatoes	30.5 ± 24.8	36.6 ± 47.1	0.213	11.2 ± 8.4	15.4 ± 13.4	0.005
Sugars	13.7 ± 8.8	12.7 ± 7.3	0.369	5.2 ± 3.3	5.8 ± 2.7	0.102
Confectionaries	60.3 ± 43.4	96.4 ± 82.6	<0.001	22.5 ± 15.1	40.8 ± 24.4	<0.001
Animal fat	0.5 ± 1.0	0.5 ± 1.1	0.955	0.2 ± 0.4	0.2 ± 0.5	0.510
Vegetable oil	29.2 ± 19.9	29.2 ± 25.8	0.993	10.6 ± 6.5	12.4 ± 7.9	0.055
Pulses	62.1 ± 37.9	60.8 ± 37.8	0.792	23.6 ± 13.9	28.7 ± 17.8	0.014
Fruits	104.6 ± 130.4	140.0 ± 182.8	0.088	40.0 ± 53.4	61.4 ± 78.6	0.015
Green-yellow vegetables	112.9 ± 84.7	130.5 ± 86.2	0.116	42.0 ± 30.1	60.8 ± 36.0	<0.001
Other vegetables	165.6 ± 97.4	189.2 ± 141.5	0.138	63.1 ± 34.7	86.7 ± 44.5	<0.001
Mushrooms	12.1 ± 12.1	17.7 ± 14.6	0.002	4.5 ± 4.2	8.0 ± 6.5	<0.001
Seaweeds	12.5 ± 10.7	19.6 ± 19.0	0.001	4.7 ± 4.1	9.2 ± 7.5	<.0001
Seasonings	20.4 ± 10.9	23.4 ± 20.8	0.168	7.6 ± 3.9	10.5 ± 8.2	<0.001
Alcoholic beverages	322.6 ± 416.2	51.4 ± 120.6	<0.001	111.2 ± 127.0	24.5 ± 63.0	<0.001
Nonalcoholic beverages	982.7 ± 533.6	917.0 ± 608.5	0.380	385.7 ± 254.4	434.1 ± 257.5	0.148
Fish and shellfish	114.3 ± 69.3	99.0 ± 63.1	0.078	41.6 ± 20.4	44.2 ± 21.7	0.336
Meats	83.3 ± 65.0	53.2 ± 42.9	<0.001	29.3 ± 16.8	22.8 ± 13.9	0.001
Eggs	43.0 ± 30.1	32.6 ± 22.1	0.003	16.2 ± 11.3	15.1 ± 10.4	0.465
Dairy products	403.3 ± 180.7	413.3 ± 171.0	0.665	158.4 ± 80.3	197.7 ± 81.5	<0.001
Water	463.3 ± 481.1	439.8 ± 416.9	0.690	180.6 ± 204.9	225.4 ± 251.4	0.136

* Values are expressed as mean±standard deviation

** Significant difference between sexes (analysis of variance)

while mean crude intake of confectionaries, mushrooms, and seaweeds was higher in women than in men ($p<0.05$). When analyzed using energy-adjusted values, intake of cereals, alcoholic beverages, and meats was higher in men, while intake of potatoes, confectionaries, pulses, fruits, green and yellow vegetables, other vegetables, mushrooms, seaweeds, seasonings,

and dairy products was higher in women than in men ($p<0.05$).

Mean intakes of food groups according to the quartiles of BMI showed that there were no statistically significant differences among BMI categories in both crude and density model, except for confectionaries, green-yellow vegetables, alcoholic and nonalcoholic beverages, and fish and shellfish

Table 4 Food group intakes estimated by a self-administered diet history questionnaire (DHQ) according to BMI categories (n=235) * (Crude model: g/day)

	Men				Women			
	1 (n=29)	2 (n=29)	3 (n=29)	4 (n=29)	1 (n=29)	2 (n=30)	3 (n=30)	4 (n=30)
Cereals	594.0 ± 303.2	624.8 ± 188.2	588.9 ± 191.8	575.3 ± 175.9	442.9 ± 182.6	424.2 ± 61.3	426.2 ± 118.8	398.1 ± 103.1
Nuts	3.6 ± 7.0	3.0 ± 2.9	2.1 ± 2.4	4.7 ± 7.5	3.8 ± 6.5	3.7 ± 6.1	6.7 ± 15.4	1.0 ± 1.4
Potatoes	23.3 ± 19.5	34.4 ± 23.3	29.6 ± 23.8	34.6 ± 30.7	38.5 ± 32.7	32.5 ± 17.9	43.7 ± 80.1	31.7 ± 33.6
Sugars	11.7 ± 6.3	16.6 ± 11.5	13.1 ± 9.6	13.3 ± 6.6	14.9 ± 7.5	11.7 ± 5.4	13.9 ± 9.9	10.5 ± 4.6
Confectionaries	47.2 ± 33.1**	76.5 ± 50.7	61.8 ± 50.2	55.6 ± 32.9	113.3 ± 77.1	112.1 ± 106.7	96.7 ± 87.2	63.9 ± 37.7
Animal fat	0.7 ± 1.2	0.6 ± 1.0	0.3 ± 0.7	0.4 ± 0.8	0.5 ± 0.8	0.5 ± 1.1	0.8 ± 1.7	0.3 ± 0.4
Vegetable oil	25.4 ± 17.2	30.3 ± 18.7	27.6 ± 14.4	33.6 ± 27.1	33.6 ± 23.6	27.7 ± 18.7	29.0 ± 30.2	26.6 ± 29.9
Pulses	52.4 ± 27.7	63.4 ± 28.5	65.4 ± 53.4	67.2 ± 36.3	64.7 ± 42.8	60.8 ± 31.1	58.7 ± 44.1	59.0 ± 33.1
Fruits	105.0 ± 131.9	81.9 ± 62.1	110.8 ± 185.4	120.7 ± 115.8	173.4 ± 168.0	117.4 ± 134.6	111.5 ± 99.8	158.9 ± 278.9
Green-yellow vegetables	90.8 ± 52.7	103.3 ± 60.9	120.0 ± 107.5	137.5 ± 100.7	166.2 ± 100.7	134.0 ± 87.0	119.4 ± 94.0	103.5 ± 43.3**
Other vegetables	159.8 ± 89.5	164.4 ± 105.0	170.3 ± 114.6	168.0 ± 82.1	191.9 ± 108.7	177.6 ± 68.4	211.7 ± 241.6	175.5 ± 78.4
Mushrooms	10.5 ± 9.2	8.5 ± 8.4	12.0 ± 12.2	17.5 ± 15.7	18.4 ± 15.5	19.1 ± 12.5	16.6 ± 17.5	16.6 ± 13.1
Seaweeds	12.1 ± 11.2	10.2 ± 8.7	12.8 ± 12.0	14.8 ± 10.7	21.8 ± 15.7	18.7 ± 13.4	24.4 ± 29.3	13.5 ± 11.1
Seasonings	18.3 ± 10.2	21.6 ± 9.8	20.1 ± 11.9	21.6 ± 11.8	19.0 ± 11.5	23.3 ± 23.0	26.0 ± 23.2	25.1 ± 23.1
Alcoholic beverages	264.8 ± 303.6	344.7 ± 426.9	325.7 ± 403.4	355.1 ± 518.7	106.1 ± 184.8	25.6 ± 76.7**	40.1 ± 99.3	35.4 ± 79.9
Nonalcoholic beverages	887.4 ± 463.6	1018.6 ± 481.2	915.5 ± 626.4	1109.4 ± 546.3	774.8 ± 426.8	1074.9 ± 486.7	1072.4 ± 953.8	741.4 ± 285.1
Fish and shellfish	96.1 ± 43.0	111.2 ± 64.6	106.0 ± 62.0	143.9 ± 92.2**	113.5 ± 78.1	93.8 ± 46.0	94.5 ± 67.5	94.7 ± 57.9
Meats	79.8 ± 71.0	79.8 ± 37.1	72.9 ± 55.8	100.8 ± 85.8	60.5 ± 43.7	53.6 ± 32.1	49.8 ± 49.8	49.2 ± 45.4
Eggs	40.5 ± 24.4	42.6 ± 26.9	51.5 ± 37.3	37.4 ± 29.8	33.9 ± 21.4	27.3 ± 21.3	35.6 ± 21.9	33.6 ± 24.0
Dairy products	429.4 ± 216.2	370.6 ± 155.9	411.3 ± 180.9	402.1 ± 168.8	470.0 ± 220.3	386.2 ± 143.4	421.3 ± 173.7	377.6 ± 126.8
Water	394.7 ± 451.3	523.6 ± 487.7	424.9 ± 462.5	510.0 ± 531.8	368.1 ± 293.9	279.2 ± 246.4	607.9 ± 501.6	501.7 ± 496.3

BMI; Body mass Index

* Values are expressed as mean±standard deviation

** Significant difference compared with the lowest BMI category between BMI categories (Dunnett's t-test) p<0.05

*** Significant difference between BMI categories (analysis of variance)

Table 5 Food group intakes estimated by a self-administered diet history questionnaire (DHQ) according to BMI categories (Density model: g/1000 kcal)

	Men				Women			
	1 (n=29)	2 (n=29)	3 (n=29)	4 (n=29)	1 (n=29)	2 (n=29)	3 (n=29)	4 (n=29)
Cereals	231.6 ± 64.2	224.7 ± 52.8	221.4 ± 57.3	218.1 ± 77.6	183.0 ± 56.9	208.3 ± 56.1	207.5 ± 76.5	211.7 ± 43.1
Nuts	1.2 ± 1.5	1.1 ± 1.0	0.8 ± 0.9	1.4 ± 2.1	1.2 ± 1.7	1.5 ± 2.2	2.5 ± 5.6	0.5 ± 0.7
Potatoes	9.5 ± 7.9	12.2 ± 8.1	11.2 ± 8.9	12.0 ± 8.9	14.6 ± 10.9	15.4 ± 9.1	16.3 ± 18.9	15.2 ± 13.4
Sugars	4.9 ± 2.7	6.1 ± 4.5	4.9 ± 3.2	4.8 ± 2.0	6.1 ± 3.2	5.4 ± 1.7	6.1 ± 3.0	5.6 ± 2.8
Confectionaries	18.7 ± 12.6	27.4 ± 15.7	23.8 ± 19.4	20.2 ± 10.7	42.7 ± 18.2	46.9 ± 29.9	39.6 ± 23.5	34.0 ± 23.8
Animal fat	0.3 ± 0.5	0.2 ± 0.3	0.1 ± 0.2	0.1 ± 0.3	0.2 ± 0.2	0.2 ± 0.5	0.4 ± 0.9	0.1 ± 0.2
Vegetable oil	10.6 ± 9.3	10.7 ± 6.0	10.4 ± 5.1	10.6 ± 5.0	13.6 ± 9.3	12.6 ± 6.6	11.2 ± 7.0	12.1 ± 8.8
Pulses	22.2 ± 12.4	23.6 ± 12.7	24.1 ± 17.5	24.5 ± 12.8	25.8 ± 12.8	29.3 ± 16.1	27.8 ± 21.4	31.9 ± 19.9
Fruits	45.9 ± 56.8	29.1 ± 21.9	45.1 ± 82.4	39.9 ± 31.9	66.0 ± 43.1	49.8 ± 39.3	47.2 ± 35.6	82.9 ± 140.2
Green and yellow vegetables	39.5 ± 27.7	36.3 ± 20.9	45.7 ± 41.6	46.5 ± 26.7	67.5 ± 37.2	62.4 ± 39.5	54.2 ± 35.2	59.2 ± 32.3
Other vegetables	69.0 ± 40.7	58.9 ± 29.6	63.9 ± 40.2	60.7 ± 27.0	76.1 ± 29.9	84.9 ± 34.6	91.5 ± 62.6	94.1 ± 43.3
Mushrooms	4.6 ± 4.5	3.0 ± 2.8	4.3 ± 4.0	6.1 ± 5.0	7.2 ± 6.1	9.2 ± 6.3	7.2 ± 7.3	8.4 ± 6.3
Seaweeds	5.0 ± 4.7	3.5 ± 2.6	4.9 ± 4.6	5.5 ± 4.2	9.2 ± 7.1	9.3 ± 6.9	10.6 ± 9.0	7.6 ± 6.9
Seasonings	7.5 ± 4.6	7.7 ± 2.9	7.8 ± 4.8	7.4 ± 3.0	7.4 ± 3.0	10.7 ± 9.2	11.6 ± 9.7	12.3 ± 8.3
Alcoholic beverages	104.5 ± 117.6	118.4 ± 133.6	116.0 ± 137.3	106.0 ± 124.7	49.3 ± 106.3	12.0 ± 33.8	17.2 ± 37.4	20.3 ± 42.6
Nonalcoholic beverages	389.2 ± 283.6	373.3 ± 177.1	350.6 ± 255.2	429.5 ± 292.3	334.8 ± 217.3	505.1 ± 213.5**	469.3 ± 307.7	423.9 ± 259.8
Fish and shellfish	39.7 ± 18.1	39.0 ± 21.9	39.6 ± 18.4	48.0 ± 22.6	44.6 ± 24.6	43.0 ± 17.7	42.3 ± 24.8	47.1 ± 19.5
Meats	29.8 ± 19.2	28.6 ± 12.4	26.4 ± 13.9	32.5 ± 20.5	23.7 ± 13.2	23.9 ± 11.7	20.4 ± 14.5	23.2 ± 16.3
Eggs	17.2 ± 11.2	15.3 ± 9.4	19.4 ± 13.9	12.7 ± 9.7	14.3 ± 8.9	12.7 ± 10.0	16.2 ± 9.2	17.3 ± 12.9
Dairy products	176.5 ± 81.5	135.1 ± 56.8	168.2 ± 103.8	153.6 ± 69.4	197.9 ± 89.6	185.1 ± 72.6	197.2 ± 74.4	210.5 ± 90.3
Water	165.2 ± 193.9	201.2 ± 204.4	158.8 ± 167.9	197.4 ± 251.9	156.3 ± 142.7	142.1 ± 137.3	305.0 ± 285.6	296.1 ± 336.9

BMI; Body mass Index

* Values are expressed as mean±standard deviation

** Significant difference compared with the lowest BMI category between BMI categories (Dunnett's t-test) p<0.05

*** Significant difference between BMI categories (analysis of variance)

(Tables 4,5).

Mean daily energy and nutrient intakes were presented in **Table 6** (men and women separately). Higher mean intakes in men than in women were observed for total energy (p<0.001), protein, alcohol, and several micronutrients in crude model (p<0.05). In contrast, intake of most nutrients was higher in women than in men (p<0.05).

Energy and nutrient intakes according to the quartiles of BMI were shown in both crude model and energy density model

(**Tables 7,8**). Except for energy-adjusted sodium intake in both sex combined, there were no statistically significant differences among BMI categories.

Energy and nutrient intakes by randomized groups showed that mean energy intakes were 2485±854 and 2426±826 kcal/day in intervention and control groups, respectively, and no statistically significant differences was observed between two groups. Higher intake of potassium, calcium, phosphorus, and riboflavin in the intervention than in the control groups was

Table 6 Energy and nutrient intakes estimated by a self-administered diet history questionnaire (DHQ) by sex *

		Crude model			Density model		
		Men (n=116)	Women (n=119)	P-value **	Men (n=116)	Women (n=119)	P-value **
Energy	kcal /day	2709 ± 791	2209 ± 813	<0.001			
Protein	g/day	96.0 ± 30.0	84.9 ± 30.5	0.005	% energy	14.3 ± 2.4	15.5 ± 2.4
Fat	g/day	76.0 ± 33.2	70.5 ± 37.1	0.236	% energy	24.9 ± 7.0	27.8 ± 6.0
Total fatty acid	g/day	66.8 ± 29.4	61.1 ± 33.2	0.163	% energy	21.9 ± 6.3	24.0 ± 5.5
Saturated fatty acid	g/day	20.9 ± 8.9	19.7 ± 10.0	0.320	% energy	6.9 ± 2.0	7.8 ± 1.7
Monounsaturated fatty acid	g/day	27.6 ± 13.4	24.8 ± 14.7	0.132	% energy	9.0 ± 3.0	9.6 ± 2.8
Polyunsaturated fatty acid	g/day	18.0 ± 7.9	16.3 ± 9.1	0.134	% energy	5.9 ± 1.7	6.4 ± 1.7
Cholesterol	mg/day	429 ± 182	358 ± 174	0.003	mg/1000 kcal	158 ± 55	160 ± 53
Alcohol	g/day	32.5 ± 44.8	2.4 ± 5.8	<0.001	% energy	7.7 ± 9.5	0.7 ± 1.8
Sodium	mg/day	5488 ± 1964	5459 ± 2326	0.917	mg/1000 kcal	2044 ± 526	2493 ± 630
Potassium	mg/day	3318 ± 924	3235 ± 1228	0.556	mg/1000 kcal	1253 ± 258	1486 ± 305
Calcium	mg/day	904 ± 260	943 ± 312	0.292	mg/1000 kcal	347 ± 104	442 ± 112
Magnesium	mg/day	359 ± 99	331 ± 119	0.054	mg/1000 kcal	136 ± 28	152 ± 28
Phosphorus	mg/day	1529 ± 430	1392 ± 479	0.022	mg/1000 kcal	574 ± 104	639 ± 103
Iron	mg/day	8.8 ± 2.7	8.5 ± 3.5	0.436	mg/1000 kcal	3.3 ± 0.8	3.9 ± 0.9
Zinc	mg/day	11.0 ± 3.3	9.4 ± 3.3	0.000	mg/1000 kcal	4.1 ± 0.6	4.3 ± 0.5
Copper	mg/day	1.4 ± 0.4	1.3 ± 0.5	0.023	mg/1000 kcal	0.5 ± 0.1	0.6 ± 0.1
Retinol	µg/day	482 ± 549	368 ± 430	0.078	µg/1000 kcal	180 ± 193	159 ± 134
Carotene	µg/day	3009 ± 2001	3966 ± 2652	0.002	µg/1000 kcal	1129 ± 680	1823 ± 1070
Vitamin D	µg/day	12.0 ± 6.8	11.1 ± 6.7	0.305	µg/1000 kcal	4.4 ± 2.1	5.0 ± 2.5
Thiamin	mg/day	1.2 ± 0.4	1.1 ± 0.5	0.012	mg/1000 kcal	0.4 ± 0.1	0.5 ± 0.1
Riboflavin	mg/day	2.1 ± 0.6	2.0 ± 0.7	0.119	mg/1000 kcal	0.8 ± 0.2	0.9 ± 0.2
Niacin	mg/day	23.3 ± 9.4	18.6 ± 8.3	<0.001	mg/1000 kcal	8.6 ± 2.4	8.4 ± 2.1
Vitamin C	mg/day	117 ± 63	127 ± 88	0.311	mg/1000 kcal	45 ± 23	57 ± 31
Soluble dietary fiber	g/day	3.5 ± 1.5	3.7 ± 1.8	0.269	g/1000 kcal	1.3 ± 0.5	1.7 ± 0.6
Insoluble dietary fiber	g/day	10.5 ± 3.7	11.0 ± 4.9	0.316	g/1000 kcal	4.0 ± 1.2	5.1 ± 1.5
Total dietary fiber	g/day	14.4 ± 5.1	15.5 ± 7.1	0.189	g/1000 kcal	5.5 ± 1.6	7.1 ± 2.2

* Values are expressed as mean±standard deviation

** Significant difference between sexes (analysis of variance)

Table 7 Energy and nutrient intakes estimated by a self-administered diet history questionnaire (DHQ) by BMI categories * (Crude model)

		Men n=116				Women n=119			
		1 (n=29)	2 (n=29)	3 (n=29)	4 (n=29)	1 (n=29)	2 (n=30)	3 (n=30)	4 (n=30)
Energy	kcal /day	2522 ± 871	2791 ± 596	2653 ± 630	2870 ± 994	2494 ± 961	2170 ± 618	2242 ± 916	1941 ± 648**
Protein	g/day	90.4 ± 27.9	95.6 ± 24.3	93.6 ± 28.5	104.7 ± 37.3	94.4 ± 37.0	82.5 ± 22.0	85.1 ± 33.0	77.9 ± 27.1
Fat	g/day	69.4 ± 30.9	77.6 ± 24.4	72.4 ± 26.9	84.6 ± 45.9	80.5 ± 37.0	69.4 ± 29.2	72.5 ± 46.6	60.1 ± 31.9
Total fatty acid	g/day	61.3 ± 27.7	67.9 ± 21.4	63.7 ± 24.0	74.5 ± 40.6	69.5 ± 31.9	60.1 ± 26.0	62.8 ± 42.5	52.4 ± 29.3
Saturated fatty acid	g/day	19.8 ± 9.3	21.2 ± 6.7	19.9 ± 8.0	22.7 ± 11.1	22.3 ± 10.6	20.0 ± 9.9	20.5 ± 11.5	16.0 ± 6.9**
Monounsaturated fatty acid	g/day	25.1 ± 12.4	28.1 ± 9.5	25.9 ± 10.3	31.2 ± 18.9	28.4 ± 13.7	24.1 ± 11.4	25.5 ± 19.0	21.3 ± 13.4
Polyunsaturated fatty acid	g/day	16.1 ± 6.4	18.0 ± 5.8	17.6 ± 6.4	20.2 ± 11.4	18.5 ± 8.4	15.7 ± 6.1	16.5 ± 12.1	14.6 ± 8.7
Cholesterol	mg/day	395 ± 149	427 ± 154	444 ± 191	447 ± 228	401 ± 179	335 ± 147	371 ± 196	325 ± 169
Alcohol	g/day	26.7 ± 34.7	28.3 ± 33.1	33.4 ± 41.8	41.6 ± 63.7	5.3 ± 9.7	1.0 ± 3.0**	1.5 ± 3.7**	1.6 ± 3.7**
Sodium	mg/day	4856 ± 1591	5670 ± 1619	5175 ± 1659	6252 ± 2605	5733 ± 2220	5531 ± 1745	5585 ± 3109	4995 ± 2054
Potassium	mg/day	3121 ± 738	3263 ± 844	3294 ± 942	3594 ± 1114	3632 ± 1385	3173 ± 890	3220 ± 1601	2927 ± 816
Calcium	mg/day	894 ± 277	872 ± 231	925 ± 291	925 ± 245	1057 ± 364	923 ± 262	955 ± 376	841 ± 183**
Magnesium	mg/day	333 ± 76	355 ± 90	366 ± 109	381 ± 115	374 ± 142	327 ± 89	331 ± 146	294 ± 76**
Phosphorus	mg/day	1456 ± 410	1502 ± 371	1533 ± 418	1626 ± 513	1559 ± 565	1363 ± 366	1405 ± 562	1246 ± 352**
Iron	mg/day	8.0 ± 1.9	8.9 ± 2.2	9.0 ± 2.7	9.4 ± 3.5	9.5 ± 4.3	8.4 ± 2.5	8.6 ± 4.2	7.7 ± 2.4
Zinc	mg/day	10.5 ± 3.8	11.2 ± 2.6	10.9 ± 2.9	11.6 ± 3.9	10.5 ± 4.1	9.2 ± 2.2	9.5 ± 3.7	8.4 ± 2.6**
Copper	mg/day	1.3 ± 0.4	1.5 ± 0.4	1.4 ± 0.4	1.5 ± 0.5	1.4 ± 0.6	1.3 ± 0.3	1.3 ± 0.6	1.2 ± 0.4
Retinol	µg/day	549 ± 863	448 ± 353	507 ± 432	423 ± 416	360 ± 262	349 ± 282	470 ± 735	292 ± 216
Carotene	µg/day	2681 ± 1537	2815 ± 1568	3037 ± 2478	3505 ± 2253	4703 ± 2699	4166 ± 2476	3697 ± 3437	3323 ± 1600
Vitamin D	µg/day	10.9 ± 5.2	11.6 ± 6.6	11.2 ± 6.2	14.3 ± 8.7	12.4 ± 7.4	10.4 ± 5.2	11.2 ± 8.4	10.3 ± 5.7
Thiamin	mg/day	1.2 ± 0.4	1.1 ± 0.3	1.2 ± 0.4	1.4 ± 0.5	1.2 ± 0.6	1.1 ± 0.3	1.0 ± 0.5	0.9 ± 0.4
Riboflavin	mg/day	2.0 ± 0.5	2.1 ± 0.5	2.1 ± 0.5	2.3 ± 0.6	2.1 ± 0.8	2.0 ± 0.5	2.0 ± 0.8	1.8 ± 0.5
Niacin	mg/day	22.0 ± 7.8	22.4 ± 7.5	22.3 ± 8.5	26.4 ± 12.7	20.8 ± 9.1	18.7 ± 6.8	18.6 ± 9.5	16.5 ± 7.5
Vitamin C	mg/day	101 ± 44	112 ± 52	110 ± 61	146 ± 83 **	138 ± 96	127 ± 66	123 ± 105	122 ± 85
Soluble dietary fiber	g/day	3.2 ± 1.1	3.4 ± 1.2	3.5 ± 1.7	3.8 ± 1.7	4.2 ± 2.2	3.6 ± 1.3	3.8 ± 2.5	3.3 ± 1.0
Insoluble dietary fiber	g/day	9.8 ± 2.3	10.3 ± 3.2	10.6 ± 4.4	11.1 ± 4.4	12.4 ± 6.0	10.9 ± 3.3	11.3 ± 6.5	9.7 ± 2.8
Total dietary fiber	g/day	13.4 ± 3.5	14.2 ± 4.3	14.7 ± 6.1	15.5 ± 6.2	17.4 ± 8.2	15.2 ± 4.7	15.9 ± 9.8	13.5 ± 4.0

BMI; Body mass Index

* Values are expressed as mean±standard deviation

** Significant difference compared with the lowest BMI category between BMI categories (Dunnett's t-test) p<0.05

*** Significant difference between BMI categories (analysis of variance)

Table 8 Energy and nutrient intakes estimated by a self-administered diet history questionnaire (DHQ) by BMI categories * (Density model)

		Men n=116				Women n=119			
		1 (n=29)	2 (n=29)	3 (n=29)	4 (n=29)	1 (n=29)	2 (n=30)	3 (n=30)	4 (n=30)
Energy									
Protein	% energy	14.6 ± 2.4	13.7 ± 2.1	14.2 ± 2.5	14.7 ± 2.5	15.2 ± 2.7	15.3 ± 1.6	15.5 ± 3.0	16.1 ± 2.3
Fat	% energy	25.0 ± 8.6	24.8 ± 5.5	24.6 ± 7.0	25.4 ± 7.0	28.5 ± 6.9	28.0 ± 5.0	27.7 ± 6.1	26.8 ± 6.0
Total fatty acid	% energy	22.1 ± 7.8	21.7 ± 5.0	21.6 ± 6.2	22.3 ± 6.3	24.7 ± 6.3	24.3 ± 4.7	23.7 ± 5.7	23.3 ± 5.5
Saturated fatty acid	% energy	7.1 ± 1.9	6.8 ± 1.6	6.8 ± 2.5	7.0 ± 2.1	7.9 ± 1.9	8.0 ± 1.8	8.0 ± 1.7	7.4 ± 1.5
Monounsaturated fatty acid	% energy	9.0 ± 3.9	9.0 ± 2.4	8.8 ± 2.6	9.2 ± 3.0	10.1 ± 3.1	9.7 ± 2.4	9.5 ± 2.9	9.3 ± 2.8
Polyunsaturated fatty acid	% energy	5.9 ± 2.3	5.8 ± 1.3	6.0 ± 1.5	6.0 ± 1.8	6.6 ± 1.9	6.5 ± 1.5	6.2 ± 1.7	6.4 ± 1.8
Cholesterol	mg/1000 kcal	161 ± 60	152 ± 46	168 ± 61	151 ± 54	161 ± 45	152 ± 51	164 ± 55	165 ± 60
Alcohol	% energy	7.2 ± 8.4	7.2 ± 8.7	8.4 ± 10.1	8.1 ± 10.9	1.5 ± 2.9	0.3 ± 0.9**	0.5 ± 1.0	0.7 ± 1.4
Sodium	mg/1000 kcal	2010 ± 677	2038 ± 423	1942 ± 422	2187 ± 537	2305 ± 432	2581 ± 624	2505 ± 861	2575 ± 505
Potassium	mg/1000 kcal	1295 ± 293	1172 ± 210	1264 ± 308	1282 ± 199	1475 ± 343	1478 ± 242	1437 ± 354	1554 ± 271
Calcium	mg/1000 kcal	371 ± 108	315 ± 73	363 ± 136	340 ± 84	434 ± 115	433 ± 89	441 ± 123	460 ± 121
Magnesium	mg/1000 kcal	139 ± 33	128 ± 21	140 ± 34	136 ± 23	152 ± 29	152 ± 26	149 ± 34	156 ± 25
Phosphorus	mg/1000 kcal	594 ± 114	539 ± 82	587 ± 123	576 ± 90	630 ± 107	633 ± 73	637 ± 133	657 ± 92
Iron	mg/1000 kcal	3.4 ± 0.9	3.2 ± 0.5	3.4 ± 0.8	3.3 ± 0.8	3.8 ± 0.9	3.9 ± 0.8	3.9 ± 1.1	4.0 ± 0.7
Zinc	mg/1000 kcal	4.2 ± 0.6	4.0 ± 0.4	4.2 ± 0.6	4.1 ± 0.8	4.2 ± 0.6	4.3 ± 0.4	4.3 ± 0.6	4.4 ± 0.5
Copper	mg/1000 kcal	0.5 ± 0.1	0.5 ± 0.1	0.5 ± 0.1	0.5 ± 0.1	0.6 ± 0.1	0.6 ± 0.1	0.6 ± 0.1	0.6 ± 0.1
Retinol	μg/1000 kcal	205 ± 250	158 ± 118	211 ± 228	147 ± 144	139 ± 66	154 ± 106	192 ± 214	150 ± 98
Carotene	μg/1000 kcal	1162 ± 725	979 ± 478	1148 ± 865	1227 ± 602	1872 ± 936	1992 ± 1172	1619 ± 1249	1810 ± 897
Vitamin D	μg/1000 kcal	4.5 ± 2.3	4.1 ± 2.2	4.2 ± 1.8	4.7 ± 2.0	5.0 ± 2.2	4.7 ± 1.9	5.0 ± 3.7	5.3 ± 2.0
Thiamin	mg/1000 kcal	0.5 ± 0.1	0.4 ± 0.1	0.4 ± 0.1	0.5 ± 0.1	0.5 ± 0.1	0.5 ± 0.1	0.5 ± 0.1	0.5 ± 0.1
Riboflavin	mg/1000 kcal	0.8 ± 0.2	0.8 ± 0.2	0.8 ± 0.2	0.8 ± 0.2	0.9 ± 0.2	0.9 ± 0.2	0.9 ± 0.2	1.0 ± 0.2
Niacin	mg/1000 kcal	9.0 ± 2.8	8.0 ± 2.0	8.3 ± 2.1	9.1 ± 2.4	8.5 ± 2.5	8.6 ± 1.9	8.1 ± 2.1	8.4 ± 2.0
Vitamin C	mg/1000 kcal	43 ± 20	41 ± 19	43 ± 25	52 ± 27	53 ± 22	59 ± 26	53 ± 28	65 ± 42
Soluble dietary fiber	g/1000 kcal	1.4 ± 0.6	1.2 ± 0.4	1.3 ± 0.6	1.3 ± 0.5	1.7 ± 0.5	1.7 ± 0.5	1.7 ± 0.8	1.8 ± 0.4
Insoluble dietary fiber	g/1000 kcal	4.2 ± 1.4	3.7 ± 0.8	4.0 ± 1.4	4.0 ± 1.0	4.9 ± 1.4	5.1 ± 1.4	5.1 ± 2.0	5.1 ± 1.1
Total dietary fiber	g/1000 kcal	5.7 ± 2.0	5.1 ± 1.1	5.5 ± 1.9	5.5 ± 1.5	6.9 ± 2.0	7.2 ± 1.9	7.2 ± 3.0	7.2 ± 1.7

BMI; Body mass Index

* Values are expressed as mean±standard deviation

** Significant difference compared with the lowest BMI category between BMI categories (Dunnett's t-test) p<0.05

*** Significant difference between BMI categories (analysis of variance)

Table 9 Food group intakes estimated by a self-administered diet history questionnaire (DHQ) by group *

	Density model (g/1000kcal)			Density model (g/1000kcal)		
	Intervention group (n=59)	Control group (n=57)	P-value **	Intervention group (n=60)	Control group (n=59)	P-value **
	Mean ± SD	Mean ± SD		Mean ± SD	Mean ± SD	
Cereals	227.5 ± 55.7	220.3 ± 70.2	0.541	197.1 ± 57.9	208.5 ± 61.4	0.300
Nuts	1.0 ± 1.2	1.3 ± 1.6	0.307	1.1 ± 1.6	1.8 ± 4.2	0.279
Potatoes	10.6 ± 8.5	11.8 ± 8.3	0.444	14.5 ± 15.0	16.3 ± 11.7	0.465
Sugars	4.9 ± 3.0	5.5 ± 3.5	0.339	5.8 ± 2.9	5.9 ± 2.5	0.829
Confectionaries	20.5 ± 15.0	24.7 ± 15.1	0.134	43.7 ± 23.4	37.9 ± 25.2	0.192
Animal fat	0.2 ± 0.4	0.2 ± 0.3	0.601	0.2 ± 0.4	0.3 ± 0.7	0.600
Vegetable oil	9.8 ± 4.3	11.3 ± 8.1	0.225	13.6 ± 8.9	11.2 ± 6.7	0.094
Pulses	22.7 ± 15.2	24.5 ± 12.4	0.472	25.5 ± 14.4	32.0 ± 20.4	0.048
Fruits	45.9 ± 69.7	33.9 ± 27.3	0.225	51.6 ± 43.2	71.4 ± 102.3	0.174
Green and yellow vegetables	42.1 ± 34.3	41.9 ± 25.3	0.967	57.1 ± 36.1	64.5 ± 35.9	0.263
Other vegetables	62.3 ± 37.3	64.0 ± 32.0	0.788	81.9 ± 46.6	91.7 ± 42.0	0.232
Mushrooms	4.7 ± 4.4	4.3 ± 4.0	0.627	7.6 ± 6.1	8.4 ± 6.9	0.516
Seaweeds	4.5 ± 4.7	5.0 ± 3.6	0.534	7.8 ± 7.1	10.6 ± 7.7	0.040
Seasonings	7.5 ± 3.7	7.6 ± 4.0	0.886	9.6 ± 7.8	11.4 ± 8.5	0.244
Alcoholic beverages	92.8 ± 101.4	130.3 ± 147.4	0.115	19.5 ± 57.0	29.6 ± 68.6	0.381
Nonalcoholic beverages	369.0 ± 214.8	402.9 ± 290.7	0.477	399.1 ± 222.3	469.7 ± 286.5	0.136
Fish and shellfish	39.8 ± 18.3	43.5 ± 22.4	0.333	43.4 ± 20.8	45.1 ± 22.7	0.671
Meats	28.7 ± 13.7	30.0 ± 19.6	0.665	22.9 ± 15.1	22.7 ± 12.8	0.924
Eggs	17.2 ± 11.9	15.0 ± 10.7	0.292	15.1 ± 10.2	15.1 ± 10.7	0.981
Dairy products	203.1 ± 61.2	112.0 ± 71.2	<0.001	237.6 ± 72.7	157.1 ± 69.4	<0.001
Water	168.0 ± 167.7	193.8 ± 238.3	0.503	209.8 ± 222.0	241.3 ± 279.3	0.497

* Values are expressed as mean±standard deviation

** Significant difference between randomized groups (analysis of variance)

observed in both crude and density models. Similar differences between the two groups were observed when men and women analyzed separately.

Food intake by randomized group. In crude models, only dairy product intake was higher in the intervention than in the

control groups, while energy-adjusted intake of dairy product was higher and that of pulses and seaweeds was lower in the intervention than in the control groups (p<0.05). Apparently similar differences between the two groups were observed when men and women analyzed separately (*Table 9*).

Discussion

The importance of health counseling aimed at lifestyle modification has long been emphasized for preventing and/or treating lifestyle-related diseases. Several lifestyle intervention methods have therefore been developed and used in Japan to promote healthier lifestyles. However, few intervention methods have been examined their effectiveness by using appropriate study designs. We therefore planned a moderate-intensity weight-control intervention program, and examined their effectiveness.

We evaluated the baseline dietary characteristics by validated self-administered DHQ.¹⁻³⁾ In a validation study, mean energy intake estimated from DHQ was comparable with that estimated from 3-day dietary records in 47 normal-weight women (1752 vs 1739 kcal/day).¹⁾ Because our mean estimate of energy intake in overweight men and women (2709 and 2209 kcal/day, respectively) was higher than that estimated from 16-day weighed dietary records (2366 and 1864 kcal/day, respectively) in normal weight men and women ($n = 92$ and 91 , respectively),⁴⁾ mean energy intake obtained in the present study seems to be generally reasonable. However, given that underreporting of energy intake by subjects with higher BMI is quite common even in Japanese people when using self-reported dietary assessment methods,^{4,5)} and BMI-dependent dietary underreporting seems to be canceled by using energy-adjusted values⁶⁾, energy-adjusted rather than crude values of nutrient and food intakes may be somewhat reliable.

In conclusion, mean dietary intake level of energy, nutrients, and foods at baseline was similar between the intervention and the control groups although small significant difference was observed for a few dietary variables. These results suggest the success of randomization in the present study at least regarding dietary intake.

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