

Original Article

Study Design of the Saku Control Obesity Program (SCOP)

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Abstract

BACKGROUND: The increasing number of patients with metabolic syndrome and resultant diabetes mellitus, hypertension, hyperlipidemia, and other lifestyle-related diseases are an urgent focus of the Ministry of Health, Labor and Welfare. Because obesity is a common basis of these diseases, the control of obesity is an important aim.

METHODS: A cognitive-behavioral treatment is being employed in a randomized intervention trial at the Saku Health Dock Center. 976 people whose BMI in upper quintile were identified from the health checkup database, and 235 people participated in the Saku Control Obesity Program (SCOP). Various biomarkers (including lipokines and single nucleotide polymorphism SNPs), physical activity, personality type (measured by the NEO-FFI), and dietary habits and dietary intake behavior (measured by the SQ-DHQ) will be measured to clarify the multiple factors influencing obesity. Each participant will use a diary to record body weight, body fat, number of steps, physical activity energy expenditure (PAEE), and success in achieving the established plan; a dietary record and appropriate equipment are also provided. At 1, 3, 6, 9, and 12 months, each participant will be interviewed by a doctor and dietician and receive individual education regarding physical activity. Follow-up will occur 1 and 2 years after baseline measurements.

RESULTS: A total of 116 men (52.9 ± 6.6 years) and 119 women (54.4 ± 6.5 years) are participating in the study. Average body weight (\pm SD) was 86.4 ± 11.8 kg in males and 75.2 ± 9.5 in females. BMI was 30.4 ± 3.5 in males and 31.1 ± 3.1 in females. Waist and visceral fat area were 101.5 ± 8.7 cm and 159 ± 54 cm² in males and 103.7 ± 8.3 cm and 130 ± 47 cm² in females, respectively. PAEE was 271 ± 127 kcal in males and 246 ± 102 kcal in females. Basal metabolic rate, measured in one-tenth of the participants, was 1659 ± 226 kcal in males and 1477 ± 210 kcal in females.

CONCLUSION: The purpose of this study is to evaluate the effectiveness of a cognitive-behavioral treatment designed to help obese patients lose weight and to maintain their weight losses over time. SCOP has been started with a good participation rate.

KEY WORDS: obesity, intervention trial, epidemiology, health education

Introduction

The increasing number of patients with metabolic syndrome and resultant lifestyle-related diseases is an urgent issue in Japan, as well as many other developed countries.¹⁾ Many serious medical conditions have been linked to obesity, including type 2 diabetes, hypertension, hyperlipidemia, and cardiovascular diseases.²⁾ Obesity is also linked to higher rates of certain types of cancer, including colon, rectal, and prostate in males and breast, uterine, and ovarian in females.³⁾ Because obesity is a

common basis of these diseases, controlling obesity is an important means of prevention.

Although unhealthy diet and physical inactivity can cause or aggravate obesity, the increase in obesity over the past 30 years has been fueled by a complex interplay of environmental, social, economic, and behavioral factors, acting on a background of genetic susceptibility.^{4,5)} The medical community has recognized the extraordinary difficulties in the prevention and treatment of obesity.

Excess abdominal fat is an important and independent risk factor for disease. Research has shown that waist circumference is directly associated with abdominal fat and can be used in the assessment of risks associated with excess weight and obesity.^{6,7)} Men with a waist measurement of more than 85 cm and women with a waist measurement of more than 90 cm may have more health risks than people with smaller waist measurements. In recent years, abdominal computed tomography has become available to determine the amount of abdominal fat directly.

Regular physical activity is a key part of any weight-control effort.^{8,9)} For people who are overweight, increasing physical activity helps them to reduce many of the risks for illnesses associated with obesity. However, the imbalance between caloric intake and expenditure likely differs from one person to another, with genetic, environmental, and other factors all playing a part.¹⁾ Environmental factors include lifestyle behaviors such as what a person eats and his or her level of physical activity. Studies have shown that obese people tend to consume large meals and high-fat foods and place taste and convenience ahead of nutrition. Also, most obese people do not get enough physical exercise.

Obese people may suffer emotionally due to their excessive weight, because they are perceived by others as gluttonous, lazy, or both. As a result, people who are obese often face prejudice or discrimination in social situations. While mediated by underlying personality, feelings of rejection, shame, or depression may occur in obese individuals.¹⁰⁾ In addition to these social influences, behavioral outcomes may have both molecular and environmental influences as well.

High blood pressure, high LDL cholesterol levels, low HDL cholesterol levels, high triglycerides, and high blood glucose are all warning signs of some obesity-associated diseases. Fortunately, people who have a BMI of 30 or greater can improve their health through losing weight.¹¹⁾ A loss of 5–10% of initial body weight can do much to improve health by lowering blood pressure and other risk factors for obesity-related diseases.¹⁻³⁾ In addition, research showed that a 5–7% weight loss brought about by moderate diet and exercise could delay or possibly prevent type 2 diabetes in people at high risk of developing the disease. In a recent study, participants who were overweight and had prediabetes were able to delay or prevent the onset of type 2 diabetes by adopting a low-fat, low-calorie diet and exercising for 30 minutes a day, 5 days a week.¹²⁾

Since 1990 a population-based Japan Public Health Center cohort study, consisting of 40- to 59-year-old residents, has been conducted in Saku.^{13,14)} The purpose of this cohort study was to identify cancer and cardiovascular disease risks, and it represented a novel approach that incorporated biological markers as health screening data and blood storage for future analyses. We selected this area because of a long collaborative history for primary prevention of chronic diseases.

The primary aim of the present study was to reduce the body weight of obese people who have sought weight-loss treatment. To do so, a cognitive-behavioral treatment was implemented as the most promising approach.¹⁵⁾ Compared to a standard behavioral weight loss program, this treatment was specifically designed to target weight reduction and sustained weight loss, as well as improved physical, psychological, and social well-being in participants. This multidisciplinary approach for reducing obesity can be applied by various agencies.

Subjects and Methods

A cognitive-behavioral treatment is being employed for a randomized intervention trial in Saku Health Dock Center.⁶⁾ Each year about 7,000 examinees came to the center for health checkups, including an oral glucose tolerance test (OGTT) by 75 g glucose intake. Including all visits, the Saku Health Dock Center database contains approximately 196,000 records. We used the database to select initial examination records, and about 45,000 examinees were identified. For this study, the candidates from recent 5 years was selected with the inclusion criteria of age 40–64 years and a body mass index (BMI: kg/m²) within the upper five percentile (28.3). Exclusion criteria were psychiatric conditions or physical conditions (i.e., significant hepatic or renal dysfunction and significant cardiovascular disease such as heart failure, stroke, and transient ischaemic attacks) that would preclude full participation in the study; current treatment for obesity; current treatments known to affect eating or weight (e.g., medications). A total of 976 people whose BMI was more than 28.3 (upper five percentile) were identified in the health checkup database, and 235 participants were enrolled in the Saku Control Obesity Program (SCOP). The research plan was approved by the Ethical Committee of the National Institute of Health and Nutrition and Saku Central Hospital. Participants received a precise explanation of the study and gave written informed consent.

For two weeks before the baseline survey, every subject wore a uniaxial accelerometer (Lifecorder, Suzuken) all day long, and the calculated physical activity energy expenditure (PAEE) served as the baseline for physical activity training. All participants were randomly divided to two groups: group A will receive intervention in year 1 and be followed up in years 2 and 3; group B will receive intervention in year 2 and be followed up in year 3.

The aim of this study is to reduce body weight 1–2 kg per month. In order to achieve an α error < 0.05 and β error < 0.80, the necessary number of participants in one arm would be 23 if the average group A weight loss was 10 kg from 80 kg and the average group B weight loss was 4 kg, whereas 74 participants would be necessary in each arm if group A lost 10 kg on average and group B lost 5 kg. Thus, the inclusion of more than 100 participants in each arm should provide sufficient statistical power.

At the time of the baseline health checkup, each participant completes a questionnaire regarding health state, smoking and drinking habits, dietary habit, profession, daily life habits, and reproductive history for females. Answers were evaluated by dietitians, who also conduct a baseline interview with each participant.

Various blood and biochemical markers, including lipokines and SNPs, are collected at baseline and at 3, 6, 9, and 12 months during the intervention period. Physical activity is measured continuously by the accelerometer. To clarify the multiple behavioral factors influencing obesity, psychological characteristics are assessed using the NEO-FFI and dietary habits and dietary intake behavior are measured by the SQ-DHQ questionnaire.^{16,17)}

A diary to record body weight, body fat, number of steps, and success in achieving the established plan (e.g., not eating snacks, increase of 3,000 steps/day), as well as a dietary record are given to each participant. Appropriate equipment, such as body weight and body fat scale and accelerometer (Lifecorder), are also provided.

Intervention, including doctor's interview, dietitian's interview, and individual education regarding dietary habit and physical activity, is scheduled at 1, 3, 6, 9, and 12 months from the baseline. Group A will have a follow-up period of 2 years, and group B will be followed up for 1 year. Longer follow-up data will be obtained from Saku Health Dock Center.

Medical outcomes will include anthropometric and metabolic parameters, and psychosocial outcomes will include obesity-specific quality of life, eating improvement, body satisfaction, mood change (POMS), and cognitive disturbance (QOL).

Blood samples (10 ml) are collected at the time of each health checkup at the Saku Health Dock Center. Routine laboratory blood and urine analyses are performed in the Saku Central Hospital. Frozen plasma and 5 ml of whole blood are sent to the National Institute for Health and Nutrition for lipokine measurement and SNPs analysis.¹⁸⁾

Follow-up system

All participants will send their diary each month to the National Institute of Health and Welfare. Dietitians will check the body weight change, physical activity, and meals in the record and send comments to encourage the participants. Any health conditions are described in the diary. Doctors confirm participants' health state at each 3-month checkup.

After each checkup, laboratory data are added to the baseline data. In addition, changes of address are reported to the governing committee office in the National Institute of Health and Nutrition, so that new addresses can be added to the master files.

Health education

Active health education was planned according to the cognitive-behavioral treatment.¹⁵⁾ The method of treatment for each participant depends on his or her level of obesity and overall health condition. Treatment includes a combination of diet, exercise, and behavior modification. Previously overweight and obese individuals are encouraged to get 60 to 90 minutes of exercise a day to sustain weight loss. Details of the methods are described in a separate paper.¹⁹⁾

Data analyses

Basic analyses for the collected questionnaires were done by combining all data obtained at the basal survey. Data-linkage groups were set to link appropriate follow-up data, including the baseline questionnaire, changes of address, incidence of diseases, death, and laboratory data. Each questionnaire was input into an Excel file (Microsoft, Redmond, WA, USA), and all data were combined in an SPSS database (SPSS Ver 14.0, SPSS Inc., Chicago, IL, USA).

Results

Subjects

Since 1986, the number of people who received a health checkup at the Saku Health Dock Center was 44,874 (27,167 males; 17,707 females), with approximately 196,000 total records. To establish a retrospective prospective cohort, a database was made by combining all these annual data. Body weight had been recorded in 44,870 people (27,165 males; 17,705 females) in which the number within the upper five percentile (BMI \geq 28.3) was 2,247 (1,366 males; 881 females). We selected 976 (612 males; 364 females) obese candidates from the cases up to 2000, whose age was from 40 to 64 years.

The plan of SCOP was introduced by a mailing to these 976 people, and an explanatory meeting was held in the auditorium at Saku Central Hospital. The final number of participants was 116 males and 119 females, aged 52.9 ± 6.6 and 54.4 ± 6.5 years, respectively. Average body weight (\pm SD) was 86.4 ± 11.8 kg in males and 75.2 ± 9.5 in females. BMI was 30.4 ± 3.5 in males and 31.1 ± 3.1 in females. Waist and visceral fat area were 101.5 ± 8.7 cm and 159.0 ± 54.1 cm² in males and 103.7 ± 8.3 cm and 129.8 ± 47.0 cm² in females, respectively. PAEE was 271 ± 127 kcal in males and 246 ± 102 kcal in females. Basal metabolic rate, measured in one-tenth of the participants, was 1659 ± 226 kcal in males and 1477 ± 210 kcal in females.

At the baseline survey, the prevalence of hypertension was 70.0% in males and 68.1% in females, diabetes mellitus was 40.5% in males and 40.3% in females, and dyslipidemia was 62.1% in males and 45.4% in females. The prevalence of metabolic syndrome was 62.9% in males and 51.3% in females. Other baseline data are described elsewhere.²⁰⁾ Some of them are summarized in Table 1 (Table 1).

Table 1 Basic Characteristics of the Subjects

Measurement	Men (n = 116)	Women (n = 119)
Age (years)	52.9 \pm 6.6	54.4 \pm 6.5
Height (cm)	168.4 \pm 5.8	155.4 \pm 5.5 *
Weight (kg)	86.4 \pm 11.8	75.2 \pm 9.5 *
BMI (kg/m ²)	30.4 \pm 3.5	31.1 \pm 3.1
Waist circumference (cm)	101.5 \pm 8.7	103.7 \pm 8.3 *
Visceral fat area (cm ²)	159 \pm 54.1	129.8 \pm 47.0 *
Numbr of steps	7601 \pm 3300	8015 \pm 3127
PAEE (kcal)	271 \pm 127	246 \pm 102 *
Adjusted PAEE (METs \cdot h/wk)	3.02 \pm 1.43	3.15 \pm 1.35

PAEE, physical-activity-related energy expenditure; METs, metabolic equivalents; PA, physical activity

Discussion

Life expectancy is rapidly increasing in Japan, and it has become a national concern how to build a vivid society for aged people. Since the 1980s, the leading causes of deaths have changed from infectious diseases to chronic noncommunicable diseases, such as cancer and cardiovascular diseases, and the past decade has seen an epidemic increase of obesity and diabetes mellitus in Japan.⁵⁾ Scientific data, however, are insufficient to make appropriate guidelines for disease prevention. Because cancer and cardiovascular diseases share common causal factors, comprehensive guidelines are needed to prevent both types of diseases. Obesity has risen to epidemic levels in Japan as well as in the United States and other developed countries, causing devastating and costly health problems and reduced life expectancy.^{1,2,5)} Multiple factors contribute to obesity, ranging from inherent biological traits relevant to body weight that differ between individuals to environmental and socioeconomic factors.

Community-based strategies to increase physical activity levels through the Healthy Japan 21 campaign have not succeeded, according to the midterm analysis, suggesting that psychological and genetic factors should be combined with health education.²¹⁾ A psychological approach has not been employed previously in an obesity intervention study in Japan. In this intervention trial, a cognitive-behavioral treatment is being employed, including nonfamily social support and individually adapted health behavior changes.¹⁹⁾ A support team consisting doctors, dietitians, physical instructors, and nurses work with

participants on dietary and exercise plans as well as an appropriate goal weight. Each participant receives an individualized dietary plan, and a healthy lifestyle guide is included in the diary, which also has a full description of how to use the plan.

In the U.S. Weight Watchers program, the initial focus is on a 10% reduction in body weight.²²⁾ Once the participants reach that goal, they receive instruction and encouragement for continued weight loss. Once they reach their proper, healthy weight, the focus moves to maintenance. The importance of behavior changes for losing weight and keeping it off has been widely recognized. Changing one's lifestyle requires more than choosing different foods and adding more physical activity to the daily routine. It also involves changing a person's approach to eating and activity, which means changing how one thinks, feels, and acts. Research has demonstrated that several tools and tips are effective in helping enact these changes. For instance, people hoping to lose weight should motivate themselves, make lifestyle changes a priority, have a plan, set small goals, and surround themselves with good examples, such as real-life stories, healthy and simple recipes, exercise tips, and interesting facts about fitness. They should avoid food triggers, keep a record, focus on the positive, and try not to give up.

We noted a high prevalence of hypertension, hyperlipidemia, and type 2 diabetes mellitus among the obese people in this

study. Most participants with these conditions did not recognize that they were ill, and many felt that prescription drugs alone could alleviate these conditions. However, discussions with doctors about the disease history and explanation of abdominal computed tomography results served as a good motivation for participants to lose weight and add more physical activity to their daily routines.

People who are obese may be able to reverse an earlier metabolic syndrome by adopting a healthy lifestyle and losing weight. Dietary restriction or exercise alone, without weight loss, does not appear to be enough to improve cardiovascular function.²³⁾ Most studies set a tentative goal of 5% reduction of body weight. In contrast, the goal of the SCOP trial is for each participant to lose 10 kg, and improvement of health is expected.

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Original Article

Anthropometric and Clinical Findings in Obese Japanese: The Saku Control Obesity Program (SCOP)Akemi Morita¹⁾, Yumi Ohmori¹⁾, Nozomu Suzuki¹⁾, Nori Ide²⁾, Masahiro Morioka²⁾, Naomi Aiba¹⁾, Satoshi Sasaki¹⁾, Motohiko Miyachi¹⁾, Mitsuhiro Noda³⁾, Shaw Watanabe¹⁾ for SCOP Group

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Abstract

BACKGROUND: Japan has entered the epidemic of obesity. To clarify the contributing factors to the development of metabolic syndrome triggered by visceral fat obesity and to investigate the effectiveness of a weight-loss program, we launched a new intervention program for obese people.

METHODS: Japanese subjects with high body mass index (BMI > 28.3 kg/m²) were selected for a weight-loss program from those who had undergone a medical checkup at the Saku Central Hospital. The baseline anthropometric and clinical findings of the participants were analyzed.

RESULTS: At baseline, 235 subjects (116 men and 119 women) participated in this program. The mean weight, waist circumference, and visceral fat area were 86.4 ± 11.8 kg, 101.5 ± 8.7 cm, and 159.0 ± 54.1 cm² in men and 75.2 ± 9.5 kg, 103.7 ± 8.3 cm, and 129.8 ± 47.0 cm² in women, respectively. Using the Japanese diagnostic criteria, the prevalence of metabolic syndrome was 62.9% in men and 51.3% in women. Leptin, c-peptide, and insulin levels tended to increase with increasing numbers of metabolic risk factors in men. In women, c-peptide and free fatty acid levels tended to increase with increasing numbers of these factors, but adiponectin decreased dose-dependently with increasing numbers of factors.

CONCLUSIONS: More than half the subjects were found to meet the criteria for metabolic syndrome. Immediate intervention to lose weight and to improve other risk factors of metabolic syndrome is necessary in such seriously obese people.

KEY WORDS: obesity, metabolic syndrome, visceral fat area, adipocytokine**Introduction**

Japan has entered the escalating epidemic of obesity.¹⁾ Obesity may trigger many serious illnesses, including type 2 diabetes and cardiovascular diseases. In particular, visceral fat obesity is thought to be associated with many metabolic disorders.

The metabolic syndrome is an important cluster of metabolic abnormalities linked with insulin resistance and cardiovascular diseases.^{2,3)} Insulin resistance had long been considered to have a central role in the development of metabolic disorders⁴⁾; however, several clinical studies have demonstrated intra-abdominal visceral fat accumulation to have a crucial, direct role in this development.^{5,6)} According to the new definition released by the Japanese examination committee for the criteria of metabolic syndrome, the presence of abdominal obesity is necessary for the diagnosis.⁷⁾

Recently, it has been shown that adipocytes secrete several proteins called adipocytokines, including adiponectin, leptin, and tumor necrosis factor- α (TNF- α); these may be related to the development of obesity-mediated adverse effects in glucose and lipid metabolism.⁸⁾ Thus, along with weight reduction in obese patients, changes in the concentrations of biochemical

parameters including these adipocytokines should be surveyed.

To prevent the development of metabolic syndrome, weight reduction in obese patients is clearly necessary.⁹⁾ However, it is not well understood how much reduction is appropriate and which method of weight control is the most effective for prevention of metabolic syndrome. In addition, it is unclear whether visceral fat can be reduced effectively by modification of diet and exercise habits.

To clarify the contributing factors to the development of metabolic and cardiovascular disorders and to investigate the effectiveness of a weight-loss program, we launched a new intervention program for obese people.¹⁰⁾ In this report, we present anthropometric and biochemical data, as well as major clinical findings, of all subjects at baseline.

Methods

Japanese obese subjects were selected from people who had undergone a medical checkup in the Saku Central Hospital. They were aged 40–64 years with a body mass index (BMI: kg/m²) greater than 28.3 (the upper 5 percentile of all examinees) and had come for medical checkup since 2000. They were asked to participate in an intervention program for weight loss, the Saku Control Obesity Program (SCOP). The details of the subjects and methods of this program are presented the previous report.¹⁰⁾ The participants had an anthropometric and clinical examination (height, weight, body fat percentage, waist circumference, visceral fat area, and biochemical markers of blood and urine) and were assessed for present illness, physical activity level, and dietary habits at the start of this program.

The height (cm) and weight (kg) of the subjects were measured with an automatic scale (Tanita, BF-220, Tokyo, Japan). Percentage body fat was evaluated by the bioelectric impedance method with the same scale. The BMI was calculated as the weight (kg) divided by the squared height (m²). Visceral and subcutaneous fat areas were assessed by a computed tomography scan at the level of the umbilicus, with the subjects in the supine position, and calculated using commercially available software (Fat Scan; N2 System Corp., Osaka, Japan).

Adipocytokines (i.e., leptin, TNF- α , adiponectin, and free fatty acid), c-peptide, and insulin levels were examined using the laboratory testing services provided by SRL Inc. (Tokyo, Japan). Leptin (ng/mL) was measured by a radioimmunoassay (Human Leptin RIA Kit, LINCO Research, St. Charles, MO, USA) with a sensitivity of 0.5 ng/mL. TNF- α (pg/mL) was measured by an enzyme-linked immunoassay (ELISA; Quantikine TNF- α HS Immunoassay Kit, R&D Systems Inc., Minneapolis, MN, USA) with a sensitivity of 0.12 pg/ml. High-molecular-weight form adiponectin (μ g/mL) was determined using ELISA (Fujirebio Inc., Tokyo, Japan) with a detection limit of 0.18 μ g/ml. Free fatty acid (mEq/L) was determined using an enzymatic assay (NEFA-SS 'Eiken', Eiken Chemical Co. Ltd., Tokyo, Japan) with a sensitivity of 0.005 mEq/L. C-peptide (ng/mL) was measured by a chemiluminescent enzyme immunoassay (CLEIA) (Lumipulse Presto C-peptide, Fujirebio Inc.) with a minimal detection limit of 0.1 ng/mL. Insulin (μ IU/mL) was measured using CLEIA (Lumipulse Presto Insulin, Fujirebio Inc.) with a minimal detection limit of 0.3 μ IU/mL. Other biochemical markers were examined in the clinical laboratory of the Saku Central Hospital.

Comparisons of the mean values of anthropometric and biochemical markers between sexes and between the groups stratified by the number of metabolic risk factors were tested using Student's *t*-test and analysis of variance (ANOVA), respectively. The associations of adipocytokines and insulin resistance markers with anthropometric and other biochemical markers for metabolic syndrome were examined using Pearson's correlation. Statistical significance was set at $p < 0.05$ for all analyses. All statistical analyses were performed using the SPSS[®] system for personal computers (Release 14.0.1, SPSS Japan, Inc., Tokyo, Japan).

Results

Among the 917 people with BMI > 28.3 kg/m², 235 subjects (116 men and 119 women) participated in this program. *Table 1* shows the basic characteristics of the subjects grouped by sex at baseline. Men were taller, heavier, and had greater visceral fat area than women, but women had significantly greater waist circumferences than men. In terms of clinical and biochemical markers, men showed significantly higher triglyceride and uric acid levels than women. In contrast, total cholesterol, HDL cholesterol, and LDL cholesterol were higher in women than in men.

Table 1 Basic Characteristics of the Subjects

	Men (n = 116)	Women (n = 119)
Age (years)	52.9 \pm 6.6	54.4 \pm 6.5
Height (cm)	168.4 \pm 5.8	155.4 \pm 5.5 *
Weight (kg)	86.4 \pm 11.8	75.2 \pm 9.5 *
BMI (kg/m ²)	30.4 \pm 3.5	31.1 \pm 3.1
Waist circumference (cm)	101.5 \pm 8.7	103.7 \pm 8.3 *
Visceral fat area (cm ²)	159.0 \pm 54.1	129.8 \pm 47.0 *
Systolic blood pressure (mmHg)	132 \pm 15	136 \pm 18
Diastolic blood pressure (mmHg)	82 \pm 13	83 \pm 12
Total cholesterol (mg/dL)	204 \pm 28	216 \pm 39 *
HDL cholesterol (mg/dL)	50 \pm 10	56 \pm 12 *
LDL cholesterol (mg/dL)	122 \pm 27	131 \pm 34 *
Triglyceride (mg/dL)	175 \pm 120	148 \pm 78 *
Fasting glucose (mg/dL)	112 \pm 25	112 \pm 26
HbA1c (%)	5.9 \pm 1.1	5.9 \pm 1.1
Uric acid (mg/dL)	6.6 \pm 1.3	5.3 \pm 1.0 *
C-reactive protein (mg/dL)	0.17 \pm 0.28	0.18 \pm 0.17
Free fatty acid (mEq/L)	0.51 \pm 0.19	0.57 \pm 0.21 *
Leptin (ng/mL)	8.2 \pm 5.6	21.3 \pm 11.2 *
Tumor necrosis factor- α (pg/mL)	1.6 \pm 2.9	1.2 \pm 0.4
Adiponectin (μ g/mL)	2.8 \pm 1.8	5.5 \pm 3.1 *
C-peptide (ng/mL)	2.86 \pm 1.25	2.54 \pm 0.92 *
Insulin (μ IU/mL)	12.11 \pm 9.97	11.11 \pm 5.91

Values are mean \pm SD.

*: Significant difference between men and women ($p < 0.05$).

Figure 1 shows the distribution of visceral fat area stratified for BMI and sex. Despite the fact that we selected subjects with BMI > 28.3 at the last medical checkup, 53 subjects (22.6%) had BMIs \leq 28.3. However, all subjects were classified as obese (BMI > 25). In terms of the waist circumference, all subjects (except four women) met the criteria of the central obesity defined in the Japanese diagnostic criteria of metabolic syndrome (men: \geq 85 cm, women: \geq 90 cm). The prevalence of subjects with visceral fat area less than 100 cm² was 19.1% (men: 8.6%, women: 29.4%). One-fifth of the women with a BMI \geq 30 had a visceral fat area less than 100.

Using the Japanese diagnostic criteria, the prevalence of metabolic syndrome in men and women was 62.9% and 51.3%, respectively (*Figure 2*). *Figure 2* also presents the prevalence of subjects with high blood pressure, dyslipidemia, and high blood glucose using the cut-off points defined in the Japanese diagnostic criteria of metabolic syndrome. Less than 30% of male and female subjects were diagnosed with diabetes mellitus, based on the Japan Diabetes Society criteria.

Among the adipocytokines, leptin levels exhibited a significantly positive correlation with anthropometric obesity parameters in both men and women (*Table 2*). In women, adiponectin levels were significantly correlated with four components of the metabolic syndrome criteria. In men, however,

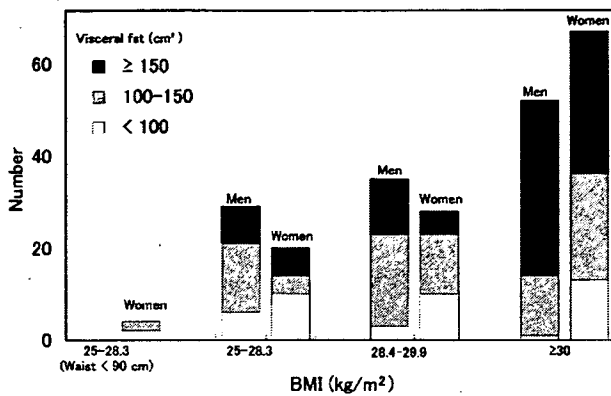


Fig. 1. Distribution of all subjects classified according to BMI and visceral fat area. All men had a waist circumferences ≥ 85 cm; with the exception of four subjects (left), all women had waist circumference ≥ 90 cm.

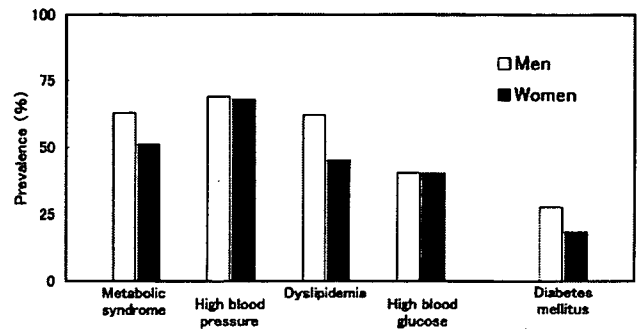


Fig. 2. Prevalence of metabolic syndrome and each metabolic abnormality. The cut-off values defining metabolic abnormalities were established at 130/85 mmHg for high blood pressure; ≥ 150 mg/dL triglyceride and/or < 40 mg/dL HDL cholesterol for dyslipidemia; and 110 mg/dL for high blood glucose; or patients being treated for hypertension, dyslipidemia, and/or diabetes, all according to Japanese diagnostic criteria for metabolic syndrome. A 75-g oral glucose tolerance test was used to calculate the prevalence of diabetes mellitus based on 1999 Japan Diabetes Society criteria.

Table 2 Pearson's correlations between components of metabolic syndrome and adipocytokines and other plasma biochemical markers in relation to metabolic disorder

	C-reactive protein	Free fatty acid	Leptin	Tumor necrosis factor- α	Adiponectin	C-peptide	Insulin
Men (n=116)							
Weight	0.381 *	0.082	0.646 *	-0.064	-0.043	0.193 *	0.165
BMI	0.402 *	0.114	0.740 *	-0.041	-0.060	0.285 *	0.247 *
Waist circumference	0.389 *	0.120	0.763 *	-0.094	-0.022	0.186 *	0.123
Visceral fat area	0.088	0.058	0.511 *	-0.092	-0.020	0.228 *	0.164
Systolic blood pressure	0.126	0.071	0.070	-0.124	-0.096	0.039	0.050
Diastolic blood pressure	0.016	0.163	0.062	-0.166	-0.006	-0.031	-0.053
HDL cholesterol	-0.061	0.142	0.033	-0.044	0.132	-0.117	-0.122
Triglyceride	-0.077	0.334 *	0.026	-0.049	-0.198 *	0.186 *	0.078
Fasting glucose	0.012	0.153	0.120	-0.095	-0.133	0.078	0.115
Women (n=118)							
Weight	0.104	-0.068	0.488 *	0.000	-0.007	0.492 *	0.474 *
BMI	0.062	0.139	0.549 *	0.079	0.068	0.447 *	0.478 *
Waist circumference	0.151	-0.074	0.468 *	0.062	0.082	0.416 *	0.366 *
Visceral fat area	0.167	0.158	0.286 *	0.293 *	-0.053	0.325 *	0.341 *
Systolic blood pressure	0.052	0.100	0.061	0.075	-0.134	0.046	0.080
Diastolic blood pressure	0.048	0.056	0.109	-0.065	-0.232 *	0.253 *	0.285 *
HDL cholesterol	-0.056	0.015	0.051	-0.153	0.352 *	-0.208 *	-0.133
Triglyceride	0.129	0.051	0.051	0.172	-0.288 *	0.359 *	0.315 *
Fasting glucose	0.176	0.293 *	0.102	0.184 *	-0.225 *	0.088	0.074

*: Significant correlation ($p < 0.05$)

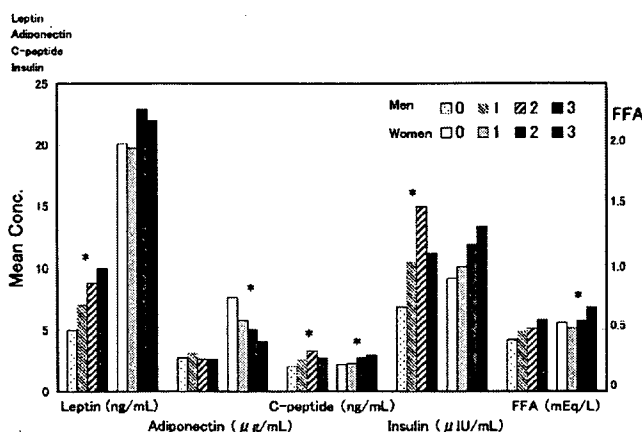


Fig. 3. Association between adipocytokines and the number of the risk factors: high blood pressure ($\geq 130/85$ mmHg); high triglyceride (≥ 150 mg/dL) and/or low HDL cholesterol (< 40 mg/dL); high blood glucose (≥ 110 mg/dL); or under treatment for hypertension, dyslipidemia, and/or diabetes, according to metabolic syndrome criteria. FFA, free fatty acid.

* Significant difference in the number of the risk factors among groups (analysis of variance [ANOVA], $p < 0.05$).

a significant but smaller correlation was seen only for triglyceride level. C-peptide level in both men and women and insulin level in women was significantly correlated with most parameters of metabolic syndrome.

Figure 3 illustrates the association of adipocytokines and markers of insulin resistance with the number of risk factors comprising metabolic syndrome criteria. In men, leptin, c-peptide, and insulin levels tended to show a graded increase with increasing numbers of the risk factors. In women, c-peptide and free fatty acid levels tended to increase with increasing numbers of the risk factors, but adiponectin decreased dose-dependently with increasing numbers of these factors.

Discussion

In our obese subjects, the prevalence of metabolic syndrome using the Japanese criteria was 62.9% in men and 51.3% in women. These values are notably lower in both men and women compared to the prevalence calculated using the International Diabetes Federation definition¹¹⁾ based on waist circumference for Japanese (men: 77.6%, women: 72.3%), whereas only the values for women are lower using the American Heart Association/National Heart, Lung, and Blood Institute definition (men: 51.7%, women: 72.3%).¹²⁾ When using the visceral fat area for the criteria of central obesity, the prevalence of metabolic syndrome was lower than that using the waist circumference. Based on these results, the cut-off value of waist circumference, which was equivalent to 100 cm² of the visceral fat area, was estimated to be greater than 90 cm. However, the cut-off values of waist circumference in women are lower than those in men for all the criteria of metabolic syndrome in Caucasians and Asians, except for the Japanese criteria. In addition, some studies reported the optimal cut-off point of waist circumference to predict the risk of metabolic syndrome for Japanese women to be less than 85 cm.^{13,14)} Considering that women tend to accumulate more subcutaneous fat than visceral fat,¹⁵⁾ other predictors that may play a key role in the development of metabolic disorders in obese women must be determined.

The prevalence of metabolic syndrome defined by Japanese criteria in our obese subjects was much higher than the estimated prevalence in the general population according to the National Health and Nutrition Survey.¹⁾ Our subjects had more risk factors than those who had the same waist circumference in the general population.¹⁾ People with serious obesity, such as our subjects, are a high-risk population in which intervention is necessary to prevent the development of metabolic syndrome.

Adipocytes are present within fat tissues and are capable of releasing numerous vasoactive factors leading to cardiovascular morbidity in obese individuals.¹⁶⁾ It is well known that leptin levels are strongly correlated with fat mass and decrease with weight reduction, and we found significant correlations between leptin levels and anthropometric obesity markers. Adiponectin usually decreases with greater insulin resistance and is lower in people with coronary heart disease than those without this disease. In our study, adiponectin was associated with the risk of metabolic syndrome only in women. The reason for this difference between men and women was unclear, although the balance of the risk for insulin resistance and cardiovascular diseases that our subjects had might be different between men and women.

In conclusion, more than half of our subjects with very high BMI met the criteria for metabolic syndrome. Immediate intervention to encourage weight loss and to improve other risk factors of metabolic syndrome is necessary for these seriously obese people.

Acknowledgments

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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: 30.8kg/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 considered 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	
Yes (within 1y)	19.3	20.7	18.0	
Yes (within 3y)	9.0	9.5	8.6	0.927
Yes (more than 3y ago)	11.2	10.3	12.0	
Current dietary counseling (%)				
No	83.0	85.3	80.7	
Yes	17.0	14.7	19.3	0.341
Rate of eating (%)				
Very fast	26.8	34.5	19.3	
Relatively fast	46.8	42.2	51.3	
Medium	19.6	19.8	19.3	0.042
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	
Neither like nor dislike	44.7	49.1	40.3	<.0001
dislike and don't eat	35.7	22.4	48.7	
Poultry skin like and usually eat	18.7	24.1	13.5	
Neither like nor dislike	40.9	45.7	36.1	0.004
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,

Baseline dietary intake in the Saku Control Obesity Program

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		31.0	73.3	72.4	69.0	
Yes (within 1y)	41.4	10.3	20.7	10.3	0.071	37.9	16.7	6.9	10.3	0.026
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		27.6	16.7	16.7	16.7	
Relatively fast	55.2	34.5	48.3	31.0	0.413	31.0	63.3	50.0	60.0	0.030
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	<.0001	223.9 ± 63.1	202.8 ± 59.7	<.0001
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	<.0001	22.5 ± 15.1	40.8 ± 24.4	<.0001
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	<.0001
Other vegetables	165.6 ± 97.4	189.2 ± 141.5	0.138	63.1 ± 34.7	86.7 ± 44.5	<.0001
Mushrooms	12.1 ± 12.1	17.7 ± 14.6	0.002	4.5 ± 4.2	8.0 ± 6.5	<.0001
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	<.0001
Alcoholic beverages	322.6 ± 416.2	51.4 ± 120.6	<.0001	111.2 ± 127.0	24.5 ± 63.0	<.0001
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	<.0001	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	<.0001
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

Baseline dietary intake in the Saku Control Obesity Program

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.

Acknowledgments

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Original Article

Nutritional Education and Exercise Treatment Based on Cognitive Behavioral Treatment in the Saku Control Obesity Program (SCOP)Naomi Aiba¹⁾, Shaw Watanabe¹⁾, Akemi Morita²⁾, Naomi Suda¹⁾, Hiroko Taguchi¹⁾,
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Abstract

BACKGROUND: Long-term weight loss is difficult to maintain, but recently cognitive behavioral therapy has been shown to be effective for long-term weight loss and maintenance.

METHODS: The 119 participants, who had been assigned to program to lose weight, were interviewed by dietitians regarding their motivation for weight loss and psychological status and self-corrected problems with their eating activities and exercises, following recognition of problems, discussing solutions, and devising personal dietary plans and exercise plan to loose weight at 1.0-2.0 kg per month.

RESULTS: In women, the prevalence of motivation to resolve the situation ($n = 44$, 84.6%) was significantly higher than that of men ($n = 33$, 67.3%; $p < 0.05$). In men, awareness of the need to keep healthy by oneself was significantly associated with the motivation to resolve the situation ($p = 0.002$) and the availability of support from others ($p = 0.004$). Thirty problems and 29 dietary goals were set by participants. The percentages of intake of alcohol ($p < 0.05$) and intake of sweets ($p < 0.01$) as the problems and decrease of intake in specified foods ($p < 0.01$) and snacks ($p = 0.05$) as dietary goals were significantly different between men and women. Women with BMI over 31 kg/m² set fewer additional steps as exercise goals than those with BMI under 29 kg/m² ($p < 0.05$).

CONCLUSIONS: The characters of subjects such as psychological status and the problems and the target recognized by participants were different between gender and the degree of obesity.

KEY WORDS: cognitive behavioral treatment, health education, obesity, baseline data

Introduction

Obesity is increasing in prevalence in Japan, and it represents a major risk not only for metabolic syndromes, such as type 2 diabetes, ischemic heart disease, hypertension, gout, and dyslipidemias, but also some cancers.¹⁾ Loss of 10% of starting weight is thought to be associated with amelioration of risk factors such as hypertension, hypercholesterolemia, and hyperglycemia.²⁾ Traditional dietary treatment of obesity consists of an energy-reduced diet prescribed by dietitians to achieve weight loss in a short period.³⁾ Long term evaluations of obesity interventions indicate that weight loss accomplished through changes in diet and physical activity is rarely maintained.⁴⁾

Since Stuart first applied behavior therapy to weight loss in the obese,⁵⁾ more than 100 papers have been published in the field. The goal of behavioral treatment is for participants themselves to choose to reduce caloric intake and increase energy expenditures based on alternatives provided by professionals, such as the dietitians.

Recently, cognitive behavioral treatment has been applied to weight loss in the obese. Cognitive behavioral treatment (therapy) is a methodology for systematically modifying eating and activity habits, other behaviors, or negative thoughts that appear to contribute to obesity using a combination of self-monitoring, goal setting, stimulus control, cognitive restructuring, stress management, and social support. The cognitive behavioral treatment can be applied in an individual or group setting to achieve a long-term change in eating and physical activity behaviors. Studies suggest that frequent contact between

professionals and patients is necessary to achieve the weight loss. Several studies in a group setting showed that the treatments, typically delivered in 15-26 weekly 30- to 60-min group sessions consisting of fewer than 10 patients, produced a mean post-treatment weight loss of approximately 8.5 kg a 1 year.^{4-6,10)} However, long-term evaluations of interventions indicated that maintenance of weight loss is difficult.¹¹⁻¹³⁾ The U.S. Institute of Medicine defined success as a weight loss of 5% of body weight maintained for 1 or more years.¹³⁾ These results suggested that intensive intervention (weekly group sessions) is successful for weight loss up to 1 year, but long-term adherence to the weight-loss plan cannot be facilitated by these programs. Perri and Corsica evaluated several specific maintenance strategies to achieve better long-term outcomes, including a problem-solving model, relapse prevention training, motivation, and extended behavioral therapy.¹²⁾ However, a truly effective intervention treatment for obesity has not yet been established. Renjilian reported the benefits of group treatment as cost-effectiveness and greater weight loss in patients at the end of the program.¹⁵⁾ In the case of intensive intervention, such as weekly sessions for 6 months, individual treatment is more expensive than the group approach.

In this baseline survey, we clarified the characteristics of the psychological status of subjects and the problems and dietary goals that the subjects had realized and set at the first meeting in Saku Control Obesity Program (SCOP), because there were few reports about the problems and targets that the participants made; so far.

Methods

The study is a randomized controlled trial comparing the effect of 1-year behavioral treatment and exercise versus a control group conducted at the Saku General Hospital Human Dock Center. Details of the aim and design of the study are described in other paper written by Watanabe et al.^{16,17)}

Participants

235 participants (116 males, 119 females) out of 976 people, who had received the regular medical checkup, were finally recruited through the Saku General Hospital Human Dock Center. Inclusion criteria were age 40–64 years, at body mass index (BMI) over 28.3kg/m² within top fifth percentile, stated with desire to lose weight, and no serious medical condition. A total of 119 participants (59 men, 60 women) attended the first group session, and 116 participants (57 men, 59 women) were placed on a waiting list control group for a second session. All participants provided written informed consent, and the ethical committees of the National Institute of Health and Nutrition and the Saku General Hospital approved the study.

Interventions

Dietitians interviewed participants about their motivation for losing weight and to assess psychological status by considering the following: benefits to losing weight, probability of losing weight, level of motivation to resolve the situation, availability of support from others, level of awareness of the need to keep healthy by oneself, obstacles to executing the plans, and the amount of stress felt.

Using a behavioral management treatment, teams of health professionals, including doctors, registered dietitians, and physical activity instructors, conducted a weight-loss intervention that focused on self-management of diet, exercise, and individually set behavior goals. Participants had a brief interview with doctors followed by an individual session for 30–45 min with dietitians and a group session with physical activity instructors; if necessary, participants also received individual instruction in physical activity.

Various strategies were used to modify participants' behaviors, including self-monitoring, problem solving, goal setting, cognitive restructuring, stress management, stimulus control, and social support. Following recognition of the specific dietary problems, participants were expected to self-correct problems with their eating activity and exercise, choose a solution, implement a plan, and evaluate the outcome. During the individual sessions with dietitians every 3 months, participants evaluate their ability to self-monitor weight, physical activity (number of steps per day), accomplishment of the dietary and exercise plan, and daily diet activity. The dietitians provide positive feedback to participants for their progress in weight loss and engaged participants in problem solving to deal with obstacles. Then the dietitians help participant to recognize any dietary problems and to make plans for the following month. Between these face-to-face sessions, participants report their progress for the previous month and their new plans for the following month by mailing records to the dietitians in the months when they have no meeting with dietitians. When the reports are sent from the participants, dietitians and physical activity instructors send back their comments to the participants within 1 week.

The goal of weight loss was set at 1.0–2.0 kg per month, with a final goal of 10 kg lost by the end of the program. Nutritional education focused on individual dietary behaviors as clarified by monitoring participants' dietary records, especially fat intake, amount of grains, cooking methods, snacking, eating out, skipping meals, and alcohol intake. Each month, participants are also required to make their exercise plans with 1,000 more steps per day into the actual steps last month, with aim at the final goal of 10,000 steps per day by the end of the program.

Data Analysis

Data were analyzed using the Statistical Package for Social Sciences® (SPSS/PC, version 12.0, SPSS Inc., Japan). Differences between men and women with regard to psychological status, problem-solving strategies, and goal setting were analyzed using chi-square tests. Analysis of variance was used to examine differences between initial goals for exercise with regard to BMI.

Results

In this baseline survey, the data collected from 119 participants in first intervention group were analyzed for psychological characteristics and the data from 117 participants except 2 dropout participants were analyzed for problems and dietary and exercise goals.

The prevalence of motivation to resolve the situation in women was significantly higher than that of men ($p < 0.05$; *Table 1*). Compared to women, more men expected support from others ($p < 0.05$), particularly their wives. More women were aware of obstacles to executing their weight-loss plans, although the prevalence of seeing benefits to losing weight, probability of losing weight, awareness of the need to keep healthy by oneself, and stress were not different between men and women.

Table 1 Sample characteristics of psychological status

Variables	levels	Men		Women		p value *
		n	%	n	%	
Benefits to lose weight	High	46	85.2	51	91.1	0.34
	Low	8	14.8	5	8.9	
Probability to lose weight	High	32	61.5	28	53.8	0.43
	Low	20	38.5	24	46.2	
Motivation to resolve the situation	High	33	67.3	44	84.6	0.04
	Low	16	32.7	8	15.4	
Availability of support from others	High	32	66.7	22	45.8	0.04
	Low	16	33.3	26	54.2	
Awareness of necessity to keep healthy by oneself	High	37	84.1	39	76.5	0.35
	Low	7	15.9	12	23.5	
Obstacles to executing plans	Yes	20	45.5	30	66.7	0.06
	No	22	50.0	15	33.3	
Feel stress	Yes	31	77.5	35	71.4	0.52
	No	9	16.7	14	28.6	

* Results of chi-square tests to examine the distribution of psychological status with men and women.

Table 2 Association of awareness of necessity to keep healthy by oneself and other psychological variables

Variables		Awareness of necessity to keep healthy by oneself									
		Men				p value *	Women				
		High		Low			High		Low		
n	%	n	%	n	%	n	%	p value *			
Benefits to lose weight	High	32	72.7	6	13.6	0.96	39	76.5	7	13.7	<0.001
	Low	5	11.4	1	2.3		0	0.0	5	9.8	
Probability to lose weight	High	22	50.0	3	6.8	0.60	24	50.0	2	4.2	<0.01
	Low	15	34.1	4	9.1		12	25.0	10	20.8	
Motivation to resolve the situation	High	27	62.8	1	2.3	<0.01	35	72.9	6	12.5	<0.01
	Low	9	20.9	6	14.0		2	4.2	5	10.4	
Availability of support from others	High	26	60.5	1	2.3	<0.01	18	40.9	2	4.5	0.12
	Low	10	23.3	6	14.0		17	38.6	7	15.9	
Obstacles to executing plans	Yes	18	47.4	2	5.3	0.54	7	17.1	6	14.6	0.03
	No	15	39.5	3	7.9		24	58.5	4	9.8	
Feel stress	Yes	7	20.0	0	0.0	0.23	8	18.6	2	4.7	0.64
	No	23	65.7	5	14.3		24	55.8	9	20.9	

* Results of chi-square tests to examine the distribution of psychological status

Table 3 Recognition of problems related to diet

Classification	Contents	Men		Women		Classification	Contents	Men		Women	
		n	%	n	%			n	%	n	%
Behaviors for diet						Meal contents					
Behavior as a cause of eating too much	Eat fast	24	40.7	28	47.5	Eat specified foods too much	Eat too few vegetables	14	23.7	10	16.9
	Eat much at supper	7	11.9	4	6.8		Take much fat or fatty food	18	30.5	16	27.1
Time of eating	Eat much	9	15.3	9	15.3	Take much salt or salty food	7	11.9	7	12.1	
	Can not leave food	2	3.4	7	11.9	Eat grains too much	7	11.9	6	10.3	
	Eat continuously for long time	0	0.0	1	1.7	Eat noodles too much	5	8.5	0	0.0	
	Eat meal served in large plate	1	1.7	1	1.7	Eat the main dish too much	4	6.8	2	3.4	
	Eat until feel full	1	1.7	1	1.7	Eat meat too much	4	6.8	0	0.0	
	Eat late supper	4	6.8	4	6.8	Alcohol	Drink alcohol too much	13	22.0	3	5.1
Behavior related eating	Skip meal	3	5.1	4	6.8	Sweets	Drink sweet beverage too much	3	5.1	5	8.5
	Lay down immediately after eating meal	2	3.4	4	6.8	Eat fruits too much	1	1.7	3	5.2	
Snacks	Eat at any time when the others eat	0	0.0	1	1.7	Eat sweets too much	6	10.2	18	30.5	
	Eat something when I feel stress	1	1.7	0	0.0	Dietary balance	Eat unbalanced meal	2	3.4	0	0.0
	Can not refuse when the others offer	0	0.0	1	1.7						
	Eat snacks surrounded myself	0	0.0	2	3.4						
	Buy too much	0	0.0	1	1.7						
	Eat often outside	1	1.7	1	1.7						

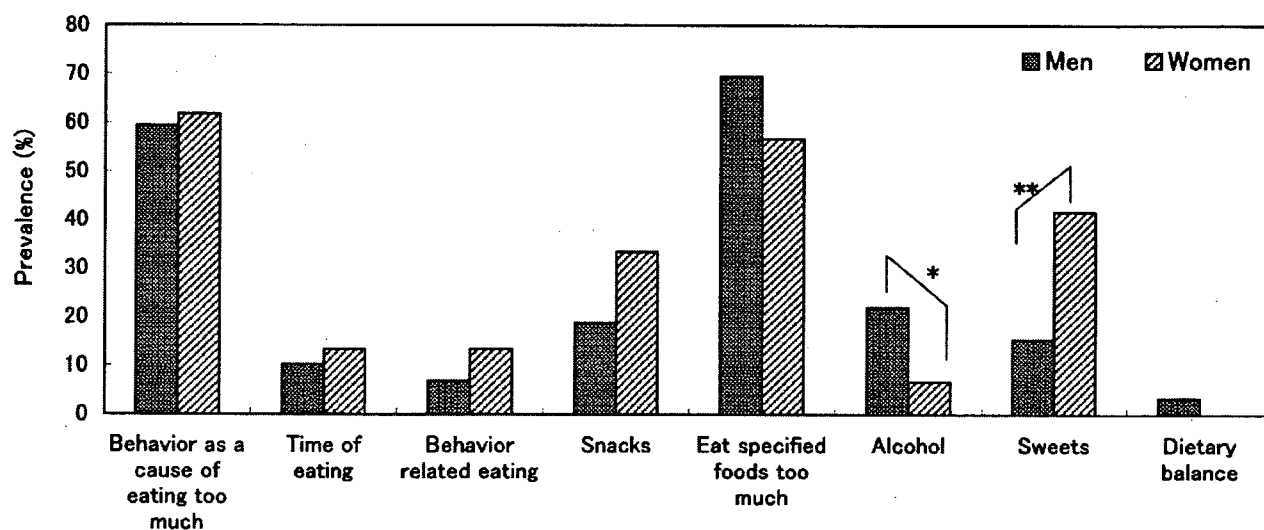


Fig. 1. Prevalence of dietary problems in men and women. The complete list of dietary problems is shown in Table 3. *p < 0.05, **p < 0.01

Table 2 shows the relationships between the awareness of the need to keep healthy by oneself and the other six psychological variables. In men, this awareness was significantly associated with level of motivation to resolve the situation ($p = 0.002$) and the availability of support from others ($p = 0.004$). In women, however, the awareness of the need to keep healthy by oneself was significantly associated with seeing the benefits of weight loss ($p < 0.001$), probability of losing weight ($p = 0.003$), motivation to resolve the situation ($p = 0.001$), and obstacle to executing the plans ($p = 0.027$).

Following the advice of dietitians, participants were asked to define the problems with their dietary habits and behaviors while setting personal goals for the following month. 30 recognized problems were classified into 8 categories and into two final categories of dietary behaviors and meal contents (Table 3). More than 40% of men and women recognized eating fast as a problem, and about 15% of men and women recognized eating too much as a problem. Insufficient intake of vegetables and excess intake of fat or fatty foods were recognized by both men and women. Figure 1 shows the differences between men and women across the categories. With regard to meal contents, 41.7% of women reported eating too many sweets as a problem, whereas only 15.3% of men listed this as a problem ($p < 0.01$). In contrast, 22.0% of men reported drinking too much alcohol as a problem, whereas only 6.7% of women listed this as a problem ($p < 0.05$). The problems of behaviors as a cause of eating too much and eating specified food too much were major common problems to men and women.

At their first meeting, dietitians and participants discussed which problems could be solved easily and which were the most important to solve. Following these evaluations, participants set and declared their personal dietary goals. Twenty-nine dietary goals were set and fell into the categories of dietary behavior and meal contents and were classified into seven categories (Table 4). The most prevalent goal of both men (31%) and women (39%) was chewing well during meal time. More women than men set goals of decreasing their snacking after supper and not eating snacks between meals. Similar percentages of men and women set the goals of eating more vegetables and decreasing their intake of fat or fatty foods. 23.7% of men set the goal of consuming less alcohol, whereas only 3.4% of women set this

Table 4 The dietary goal-setting at first meeting

Classification	Contents	Men		Women	
		n	%	n	%
<i>Behaviors for diet</i>					
Decrease intake of snacks	Eat less snacks after supper	4	5.8	9	15.0
	Do not eat anything 2 hours before sleep	2	3.4	2	3.4
	Eat fruits on the time decided	2	3.4	3	5.1
	Quit a snack or eat less	9	15.3	19	32.2
	Do not eat nuts	2	3.4	0	0.0
Decrease the amount of meal	Eat with chewing food well	18	30.5	23	39.0
	Leave food when finish meal	0	0.0	5	8.5
	Do not eat once full	1	1.7	2	3.4
	Do not eat continuing for long time	0	0.0	1	1.7
	Serve a meal individually	3	5.1	2	3.4
	Record the energy displayed on foods	2	3.4	0	0.0
Eat regularly	Do not skip meals	3	5.1	2	3.4
	Order of certain foods	5	8.5	6	10.0
	Take some drinks or soup first	0	0.0	2	3.4
<i>Meal contents</i>					
Decrease intake of specified foods	Decrease intake of grains	10	16.9	7	11.9
	Decrease intake of main meal	1	1.7	2	3.4
	Decrease intake of meals	5	8.5	4	6.8
	Decrease side dish with alcohol	2	3.4	0	0.0
	Decrease intake of alcohol	14	23.7	2	3.4
	Decrease intake of salt or salty food	1	1.7	6	10.0
	Decrease intake of fat or fatty food	15	25.4	14	23.7
	Decrease amount of supper meals	2	3.4	0	0.0
Increase the amount of specified food	Increase intake of vegetables	16	27.1	14	23.7
	Replace with low-calories from high-calories				
Replace with low-calories from high-calories	Replace a main dish with other low-calories	5	8.5	1	1.7
	Replace with other kinds of grains	1	1.7	0	0.0
	Replace snacks with other low-calories	2	3.4	9	15.0
	Replace drinks with other low-calories	4	6.8	4	6.8
	Replace alcohol with other low-calories	0	0.0	1	1.7

goal. Compared to men, more women set the goals of decreasing salt intake and replacing high-calorie snacks with low-calorie foods.

Compared to men, more women (30.5% vs. 50.0%) set a goal of decreasing the intake of snacks ($p < 0.05$). In contrast, more men (72.9%) set a goal of decreasing the intake of a specified food compared to women (48.3%; $p < 0.01$; Figure 2). There were no differences between the genders with regard to the other five goal categories.

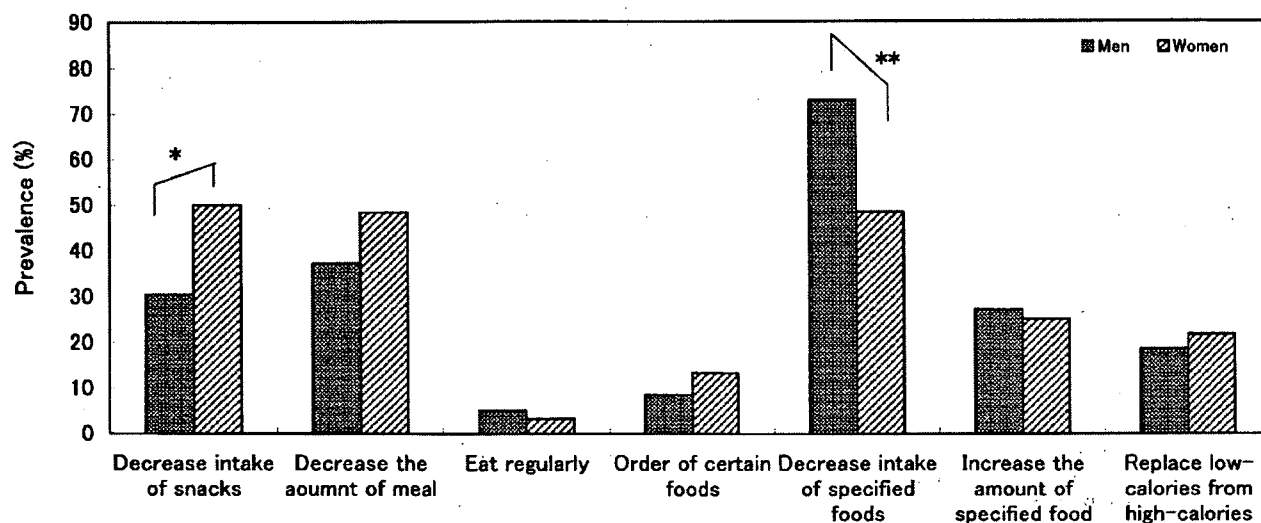


Fig. 2. Prevalence of dietary goals in men and women. The complete list of dietary goals is shown in Table 4. * $p < 0.05$, ** $p < 0.01$

The final exercise goal was basically set at 10,000 walking steps per day. At the beginning of the program, 21 participants already walked over 10,000 steps per day on average, and their exercise goal was to maintain this level of exercise. The remaining participants walked fewer than 10,000 steps, and their goal was to walk an additional 1,000 steps per day every month, except those participants who had knee or lower back pain. For those participants who were walking fewer than 10,000 steps per day, the average walking steps per day at the beginning of the program were 6314.6 ± 1915.7 (SD) steps in men and 6780.6 ± 1582.4 steps in women, the additional walking steps first goals were 1232.8 ± 789.4 steps in men and 928.1 ± 597.1 steps in women, and the target exercise goals per day were 7581.6 ± 1934.7 steps in men and 7662.8 ± 1470.8 steps in women; there were no significant differences between genders.

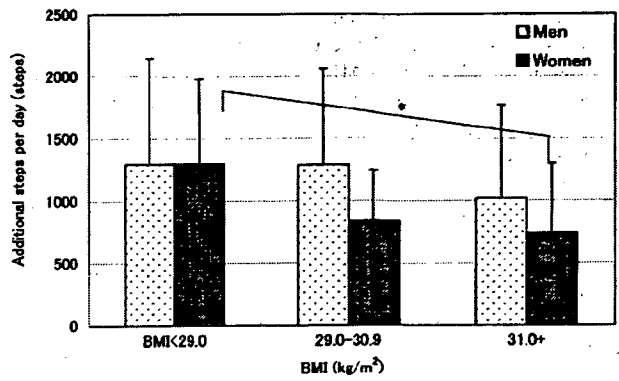


Fig. 3. The additional steps as an exercise goal among body mass index (BMI) tertiles in men and women. Data represent subgroup mean \pm SD. * $p < 0.05$

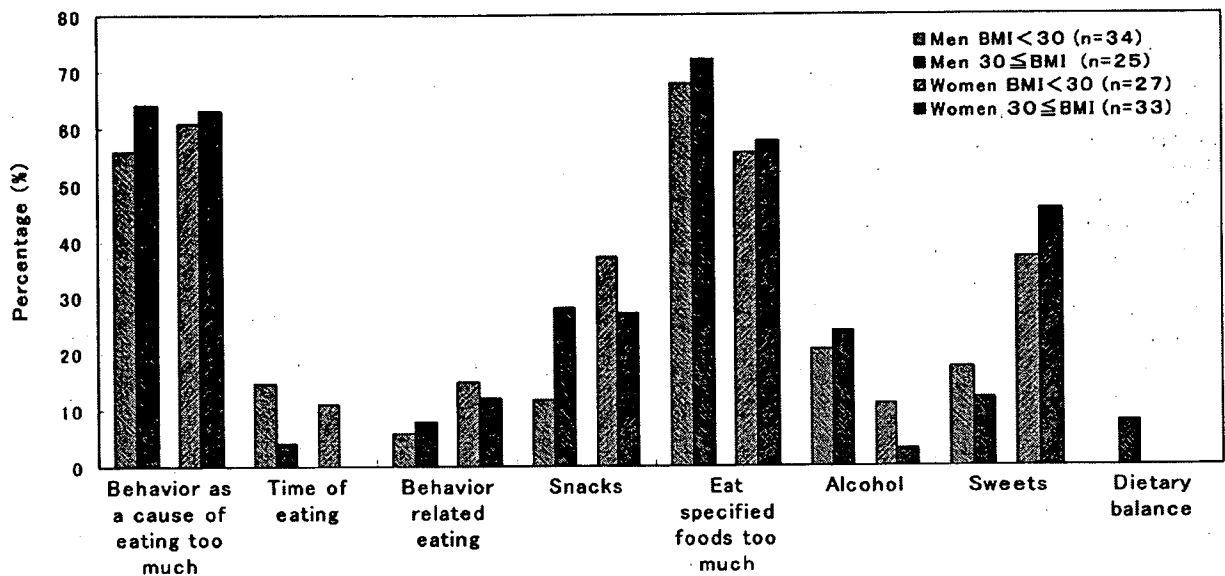


Fig. 4. Prevalence of the diet problems between body mass index (BMI) levels over or under 30 kg/m² in men and women.

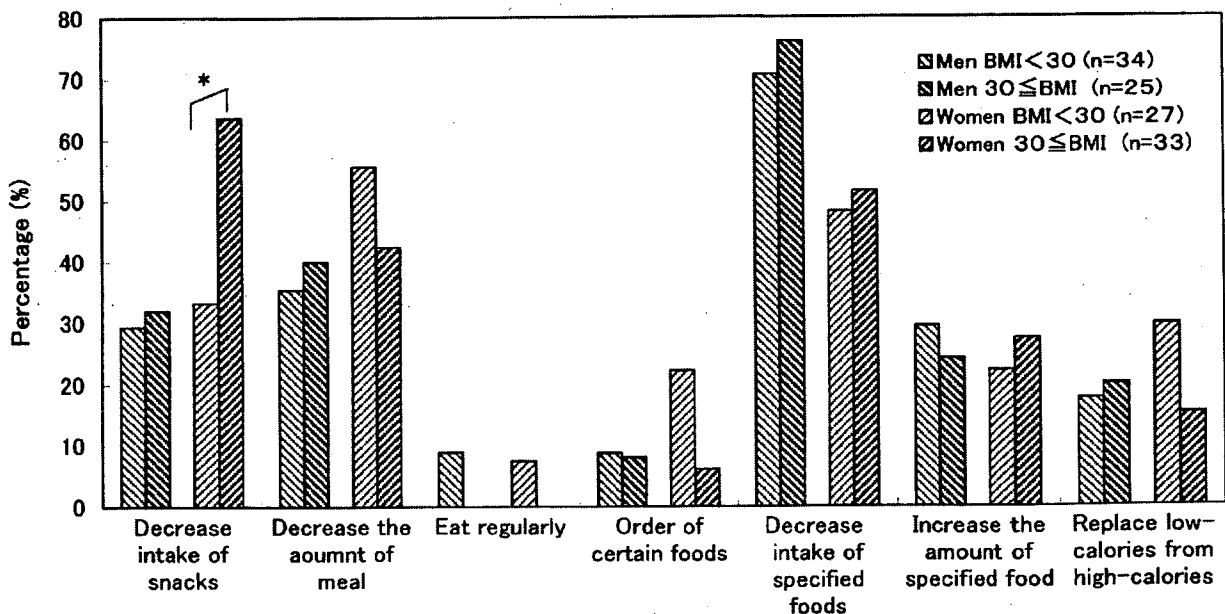


Fig. 5. Prevalence of the diet goals between body mass index (BMI) levels over or under 30 kg/m² in men and women. * $p < 0.05$: chi-square tests