目標作成　　　　　　　　　　　　　　　　　　　　9/25提出用

氏名＿＿＿＿＿＿＿　栄研ID＿＿＿＿＿＿＿　　記入日 H.18 年 9 月 24 日

あなたはこれからの1ヶ月で＿＿＿＿＿kgの減量を目指していきますね。
これからの1ヶ月間実施する食事計画と運動計画(目標)を立てていきましょう。
ここで立てた目標をこれからの1ヶ月間実施してください。

問題点：あなたの食習慣について知り、カロリーのとりすぎになる問題点を見つけましょう。
あなたの食行動アンケート結果の点数の高い項目があなたの問題点になります。
①アンケート項目について、改善を要すると考えられる項目を5つ下の枠に記入して下さい。
②次に問題について改善が重要と思われる順に番号を入れましょう。
③また、実行できそうな順に番号を入れましょう。

		要改善の順位	実行可能の順位
1			
2			
3			
4			
5			

上の5つの内、重要度の順位が高く、取り組みやすい問題点はどれですか？
目標：改善が必要で、実行できることから、具体的に実行目標を立てていきましょう。
①実行計画はできるだけ具体的に書くことが大切です。少なくとも2つは立ててみましょう。
　具体的に、たとえば、「私は、会社や自宅で、おやつが食べたくなった時には、お菓子ではなく、リンゴやバナナなどの果物を、半分～1個 食べる。」と書きましょう。
②実行する優先順位順に実行目標をつけましょう。実行目標ができたら○をつけ1ヶ月間がんばりましょう。
③運動目標についても記入しましょう。歩く以外の目標立てるときにも具体的に立てましょう。

		優先順位
食事目標		1
		2
		3
		4
		5
運動	1日＿＿＿＿＿＿歩	

この1ヶ月間の実行目標を、「健康手帳-日誌-」に記入して、毎日出来たか○△×で評価しましょう。また、体重の変化がわかるように毎日の体重をグラフにしましょう。

日誌の記入

① 目標減量体重は１ｋｇにします。
② 目標歩数を記録します。
③ 体重グラフのメモリの数値を現在の体重が真ん中より少し上になるように記入します。
点線の１目盛りが0.1ｋｇになります。以前の日誌を参考にしてください。
④ 目標の欄に①～⑤に目標を記入してください。
　① の目標の欄には、運動や活動の目標を記入してください。
　② 以下の番号に食事の目標を記入してください。

これで、今回の目標設定が終了しました。
これから１ヶ月間がんばって目標を実行していきましょう。

今回作成して頂いた、目標について、お送り頂いたシートをもとに、専門家がコメントをお返ししますので、送付書類チェックシートに従って、「評価シート」、「目標作成シート」、先月の「日誌」、先月の「食事記録」、「送付書類チェックシート」の５種類の書類を国立健康・栄養研究所にお送り下さい。

私の健康手帳 -日誌-　　　　　9/25 提出用

氏名＿＿＿＿＿＿＿　栄研ＩＤ＿＿＿＿＿＿＿

目標が達成出来たら○、一部出来たら△、出来なかったら×を記入しましょう。

月		8月						9月									
日		26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10
曜日		土	日	月	火	水	木	金	土	日	月	火	水	木	金	土	日
目標減量＿＿＿kg 目標歩数＿＿＿歩 体重のグラフ																	
体重（kg）																	
体脂肪率（%）																	
歩数（歩）																	
消費カロリー（kcal）																	
目標 できた○、一部できた△ できなかった×	①																
	②																
	③																
	④																
	⑤																
いつもと違ったことがありましたか？																	

私の健康手帳 -日誌-　　　　　9/25 提出用

氏名＿＿＿＿＿＿＿　栄研ＩＤ＿＿＿＿＿＿＿

目標が達成出来たら○、一部出来たら△、出来なかったら×を記入しましょう。

月		9月													
日		11	12	13	14	15	16	17	18	19	20	21	22	23	24
曜日		月	火	水	木	金	土	日	月	火	水	木	金	土	日
目標減量＿＿＿kg 目標歩数＿＿＿歩 体重のグラフ															
体重（kg）															
体脂肪率（%）															
歩数（歩）															
消費カロリー（kcal）															
目標 できた○、一部できた△ できなかった×	①														
	②														
	③														
	④														
	⑤														
いつもと違ったことがありましたか？															

私の健康手帳 -食事記録-　　　　提出用

氏名＿＿＿＿＿＿　栄研ID＿＿＿＿＿＿

月

日	曜日	食事記録					メモ（感じたことなど）
		朝食	昼食	夕食	間食	夜食	

＿＿＿＿＿＿＿＿＿＿様

管理栄養士からのコメント

担当：

健康運動指導士からのコメント

担当：

参考資料3

ベースラインデータ論文集

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Letter to the Editor

Necessity of obesity control for preventing life-style related diseases

Overweight and excess weight gains are part of a serious modern epidemic that affects the majority of Japanese adults and a growing proportion of youth. Such obesity is a major risk factor of metabolic syndrome and following diabetes mellitus, hypertension and other life-style related diseases.[1] Effective primary prevention programs are urgently needed to address this public health issue.

Few studies have been conducted to intervene on these environmental influences for obesity prevention interventions. The Pound of Prevention study (POP) was the first weight gain primary prevention trial in adults in the USA.[2] Five key behaviors were targeted: 1) increase fruit intake, 2)increase vegetable intake, 3)increase physical activity especially walking, 4) increase frequency of self-weighing, and 5) decrease dietary fat intake. After three years, weight gain did not differ by treatment group. However, the intervention was successful in increasing the frequency of self-weighing and healthy weight control behaviors. Results of the POP study are encouraging and suggest several ways to improve the efficacy of a low intensity weight gain prevention program.

The Ministry of Health, Labour and Welfare distributed the guideline for eating habit and physical activity in 1999 and 2006, respectively,[3,4] but the prevalence of obesity and diabetes mellitus has continuously increasing.[5] In 2006, seven academic associations decided the criteria of metabolic syndrome and nationwide primary prevention is planned by implementing it to the mass screening program.[6]

However, the proposed education method by the guideline is not yet evaluated by epidemiological program. It is necessary to show the efficacy of the intervention to control obesity. So, we planned to do the intervention study by the cognitive behavior alteration method through dietary change and physical activity under the support of the Ministry of Health, Labor and Welfare. The result of the current study will provide important information on the effectiveness of a broad-reaching weight-gain prevention program. It will also provide unique data about whether changing these environmental influences will have an impact on preventing weight gain. The incorporation of a stronger environmental component to support the behavioral recommendations and their implementation by individuals should also strengthen the intervention's effectiveness on body weight and behavior changes.[7]

The pilot data provided useful planning information on intervention and measurement protocols. The current literature supports stronger and more specific behavioral recommendations to prevent weight gain.
Cognitive behavioral modification approaches for improving people's intrinsic motivation for weight loss and maintenance. Positive support, rewarding or praising, and modeling desired eating and exercise behaviors are important. Psychological and genetic (single nucleotide polymorphism) variables are also important to build so-called tailor-made nutrition or health education. In addition to the dietary intake and physical activity, eating behavior is another important variable.

We had an experience with the cooperation of public health center to make a cohort consisting of 40- to 59-year-old area residents in 1989.[8] The original purpose was to identify cancer and cardiovascular disease risks, but it expanded to find risks of diabetes mellitus, cataract and other chronic diseases. We selected the area for intervention trial in the same cohort area. Health Dock Center in the Saku Central Hospital registered more than 50,000 health-check up examinees, and their longitudinal data becomes backbone of our intervention trial.[9] A large scale population-based cohort study is desirable as a means of elucidating risk factors for chronic non-communicable diseases. However, for intervention studies nested clinical trial in the cohort is more effective.

Recent development of molecular biology opened a new field for epidemiology to measure biomarkers as indices of exposure and process of disease progression. Importance of genetic markers is found as special SNP being related to the obesity.[10] Psychological influence is also considered to be important.[11] Based upon these requirement and possibility, multidisciplinary study from different dimensions is necessary.

In the separate reports we present the tabulated results of the baseline study on about 240 participants in the Saku Control Obesity Program (SCOP), including the biochemistry, behavior, eating habit and physical activity, psychology, genetic polymorphism, basal metabolic rate under the close collaboration between Nutritional Epidemiology Program, Health Promotion Program, Health Education Program in the National Institute of Health and Nutrition, Health Dock Center in the Saku Central Hospital, and the Nutritional Department, Tokyo University of Agriculture. We hope that it will prove to be of value as reference material to researchers in the public health field.

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ANTI-AGING MEDICINE

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Original Article

Study Design of the Saku Control Obesity Program (SCOP)

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3) National Medical Center
4) School of Medicine, Keio University
5) Tokyo University of Agriculture

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 (± 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 cm^2 in males and 103.7 ± 8.3 cm and 130 ± 47 cm^2 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.

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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/m^2) 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 (± 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 ± 54.1cm² 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 ± 6.6	54.4 ± 6.5
Height (cm)	168.4 ± 5.8	155.4 ± 5.5 *
Weight (kg)	86.4 ± 11.8	75.2 ± 9.5 *
BMI (kg/m²)	30.4 ± 3.5	31.1 ± 3.1
Waist circumference (cm)	101.5 ± 8.7	103.7 ± 8.3 *
Visceral fat area (cm²)	159 ± 54.1	129.8 ± 47.0 *
Numbr of steps	7601 ± 3300	8015 ± 3127
PAEE (kcal)	271 ± 127	246 ± 102 *
Adjusted PAEE (METs·h/wk)	3.02 ± 1.43	3.15 ± 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.

Acknowledgements

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Original Article

Anthropometric and Clinical Findings in Obese Japanese: The Saku Control Obesity Program (SCOP)

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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/m^2) 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 cm^2 in men and 75.2 ± 9.5 kg, 103.7 ± 8.3 cm, and 129.8 ± 47.0 cm^2 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 founded 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 disorders[4)]; 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.

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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/m^2) 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. 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 (m^2). 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 (μg/mL) was determined using ELISA (Fujirebio Inc., Tokyo, Japan) with a detection limit of 0.18 μg/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 (μIU/mL) was measured using CLEIA (Lumipulse Presto Insulin, Fujirebio Inc.) with a minimal detection limit of 0.3 μIU/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/m^2, 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 ± 6.6	54.4 ± 6.5
Height (cm)	168.4 ± 5.8	155.4 ± 5.5 *
Weight (kg)	86.4 ± 11.8	75.2 ± 9.5 *
BMI (kg/m^2)	30.4 ± 3.5	31.1 ± 3.1
Waist circumference (cm)	101.5 ± 8.7	103.7 ± 8.3 *
Visceral fat area (cm^2)	159.0 ± 54.1	129.8 ± 47.0 *
Systolic blood pressure (mmHg)	132 ± 15	136 ± 18
Diastolic blood pressure (mmHg)	82 ± 13	83 ± 12
Total cholesterol (mg/dL)	204 ± 28	216 ± 39 *
HDL cholesterol (mg/dL)	50 ± 10	56 ± 12 *
LDL cholesterol (mg/dL)	122 ± 27	131 ± 34 *
Triglyceride (mg/dL)	175 ± 120	148 ± 78 *
Fasting glucose (mg/dL)	112 ± 25	112 ± 26
HbA1c (%)	5.9 ± 1.1	5.9 ± 1.1
Uric acid (mg/dL)	6.6 ± 1.3	5.3 ± 1.0 *
C-reactive protein (mg/dL)	0.17 ± 0.28	0.18 ± 0.17
Free fatty acid (mEq/L)	0.51 ± 0.19	0.57 ± 0.21 *
Leptin (ng/mL)	8.2 ± 5.6	21.3 ± 11.2 *
Tumor necrosis factor-α (pg/mL)	1.6 ± 2.9	1.2 ± 0.4
Adiponectin (μg/mL)	2.8 ± 1.8	5.5 ± 3.1 *
C-peptide (ng/mL)	2.86 ± 1.25	2.54 ± 0.92 *
Insulin (μIU/mL)	12.11 ± 9.97	11.11 ± 5.91

Values are means±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 < 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: > 85 cm, women: > 90 cm). The prevalence of subjects with visceral fat area less than 100 cm^2 was 19.1% (men: 8.6%, women: 29.4%). One-fifth of the women with a BMI ≥ 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,

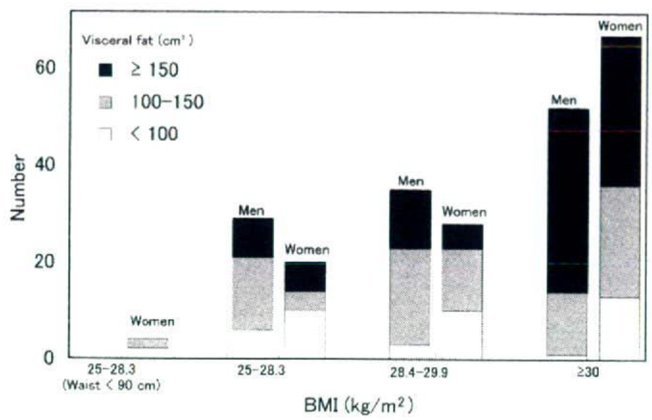

Fig. 1. Distribution of all subjects classified according to BMI and visceral fat area.

All men had a waist circumferences > 85 cm; with the exception of four subjects (left), all women had waist circumference > 90 cm.

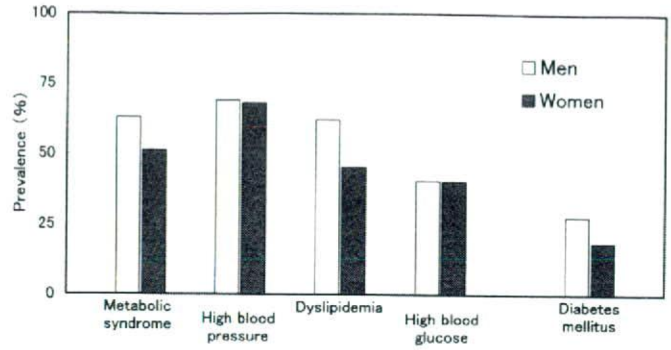

Fig. 2. Prevalence of metabolic syndrome and each metabolic abnormality.

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)

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.

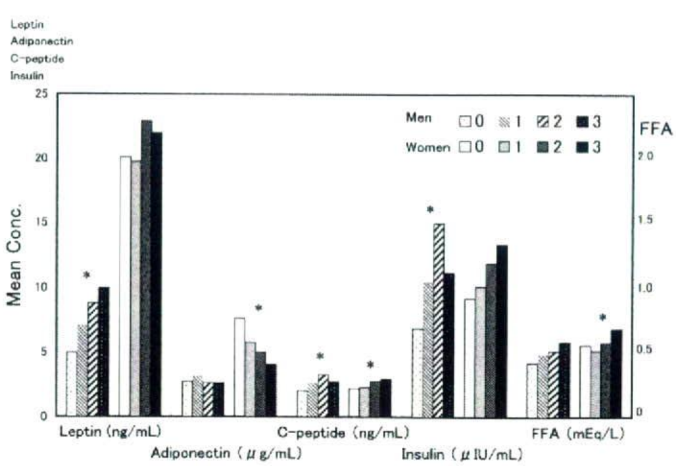

Fig. 3. Association between adipocytokines and the number of the risk factors: high blood pressure (≥ 130/85 mmHg); high triglyceride (≥ 150 mg/dL) and/or low HDL cholesterol (< 40 mg/dL); high blood glucose (≥ 110 mg/dL); or under treatment for hypertension, dyslipidemia, and/or diabetes, according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

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 definition[11] 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 cm^2 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.

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Original Article

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

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Abstract

BACKGROUND: We planed 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/m^2) 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 questionnair, 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/m^2) 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 planed 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 ≥ 25kg/m^2) 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

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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 (≥once/ week) but not appearing in the DHQ. The food and beverages items and portion sizes in the DHQ were derived mainly from data in the National Nutrition Survey of Japan. Dietary intake, including 150 food and beverage items, energy and dietary fiber, was calculated using an ad hoc computer program for the DHQ, which was based on the food composition table in Japan; information in dietary supplement and from the open-ended section is not used in the calculation. Methods of calculating dietary intake and the validity of the DHQ have been published elsewhere.[1-3] Pearson correlation coefficient between DHQ and 3-day dietary records was 0.48 for energy in 48 normal-weight women.[1] DHQ was completed by all subjects just before the baseline health check-up. At the orientation meeting, subjects were directed to complete the DHQ. The questionnaires were checked by dietitians, and missing or illogical answers were obtained or corrected by interview.

Statistical analysis

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

Results

All subjects completed the DHQ at baseline survey. ***Table 1*** shows basic demographic and dietary behavior characteristics of subjects at baseline. The mean (± standard deviation) was as follows: 53.5±6.5 years for age, 30.8±3.3 kg/m^2 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 ± 6.5	52.9 ± 6.6	54.1 ± 6.4	0.161
Sex (% women)	51.1			
Body height (cm)	161.8 ± 8.6	168.4 ± 8.6	155.4 ± 5.5	<.0001
Body weight (kg)	80.7 ± 12.1	86.4 ± 11.8	75.2 ± 9.5	<.0001
Body mass index (kg/m^2)	30.8 ± 3.3	30.4 ± 3.5	31.1 ± 3.1	0.124
Change of body weight from 20 years old (kg)**	18.8 ± 8.8	17.8 ± 8.7	19.7 ± 9.0	0.102
Intentional of dietary change (%)				
No	60.5	59.5	61.5	
Yes (within 1y)	19.3	20.7	18.0	0.927
Yes (within 3y)	9.0	9.5	8.6	
Yes (more than 3y ago)	11.2	10.3	12.0	
Current dietary couseling (%)				
No	83.0	85.3	80.7	0.341
Yes	17.0	14.7	19.3	
Rate of eating (%)				
Very fast	26.8	34.5	19.3	
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 prefarence (%)				
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±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 egges was higher in men than in women,

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

	Quartiles of BMI Men (n = 116)					Quartiles of BMI 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 couseling (%)										
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		31.0	63.3	50.0	60.0	
Medium	24.1	20.7	17.2	17.2	0.413	31.0	16.7	23.3	6.7	0.030
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 prefarence (%)										
Pork fat and beef fat										
like and usually eat	13.8	34.5	34.5	31.0		13.8	3.3	6.7	20.0	
Neither like nor dislike	51.7	48.3	44.8	51.7	0.445	34.5	43.3	46.7	36.7	0.462
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		17.2	6.7	16.7	13.3	
Neither like nor dislike	41.4	51.7	48.3	41.4	0.354	34.5	26.7	33.3	50.0	0.348
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) Mean ± SD	Women (n = 119) Mean ± SD	P-value **	Men (n = 116) Mean ± SD	Women (n = 119) Mean ± SD	P-value **
Cereals	595.7 ± 218.7	422.7 ± 123.2	<0.001	223.9 ± 63.1	202.8 ± 59.7	<0.001
Nuts	3.4 ± 5.5	3.8 ± 9.0	0.672	1.1 ± 1.4	1.4 ± 3.2	0.328
Potatoes	30.5 ± 24.8	36.6 ± 47.1	0.213	11.2 ± 8.4	15.4 ± 13.4	0.005
Sugars	13.7 ± 8.8	12.7 ± 7.3	0.369	5.2 ± 3.3	5.8 ± 2.7	0.102
Confectionaries	60.3 ± 43.4	96.4 ± 82.6	<0.001	22.5 ± 15.1	40.8 ± 24.4	<0.001
Animal fat	0.5 ± 1.0	0.5 ± 1.1	0.955	0.2 ± 0.4	0.2 ± 0.5	0.510
Vegetable oil	29.2 ± 19.9	29.2 ± 25.8	0.993	10.6 ± 6.5	12.4 ± 7.9	0.055
Pulses	62.1 ± 37.9	60.8 ± 37.8	0.792	23.6 ± 13.9	28.7 ± 17.8	0.014
Fruits	104.6 ± 130.4	140.0 ± 182.8	0.088	40.0 ± 53.4	61.4 ± 78.6	0.015
Green-yellow vegetables	112.9 ± 84.7	130.5 ± 86.2	0.116	42.0 ± 30.1	60.8 ± 36.0	<0.001
Other vegetables	165.6 ± 97.4	189.2 ± 141.5	0.138	63.1 ± 34.7	86.7 ± 44.5	<0.001
Mushrooms	12.1 ± 12.1	17.7 ± 14.6	0.002	4.5 ± 4.2	8.0 ± 6.5	<0.001
Seaweeds	12.5 ± 10.7	19.6 ± 19.0	0.001	4.7 ± 4.1	9.2 ± 7.5	<.0001
Seasonings	20.4 ± 10.9	23.4 ± 20.8	0.168	7.6 ± 3.9	10.5 ± 8.2	<0.001
Alcoholic beverages	322.6 ± 416.2	51.4 ± 120.6	<0.001	111.2 ± 127.0	24.5 ± 63.0	<0.001
Nonalcoholic beverages	982.7 ± 533.6	917.0 ± 608.5	0.380	385.7 ± 254.4	434.1 ± 257.5	0.148
Fish and shellfish	114.3 ± 69.3	99.0 ± 63.1	0.078	41.6 ± 20.4	44.2 ± 21.7	0.336
Meats	83.3 ± 65.0	53.2 ± 42.9	<0.001	29.3 ± 16.8	22.8 ± 13.9	0.001
Eggs	43.0 ± 30.1	32.6 ± 22.1	0.003	16.2 ± 11.3	15.1 ± 10.4	0.465
Dairy products	403.3 ± 180.7	413.3 ± 171.0	0.665	158.4 ± 80.3	197.7 ± 81.5	<0.001
Water	463.3 ± 481.1	439.8 ± 416.9	0.690	180.6 ± 204.9	225.4 ± 251.4	0.136

* Values are expressed as mean±standard deviation
** Significant difference between sexes (analysis of variance)

while mean crude intake of confectioneries, 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, confectioneries, 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 veverages, 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 experessed 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 experessed 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