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## Research Article

## Effects of Lifestyle Modification Program, KOHNODAI Program, on Metabolic Parameters in Japanese Obese People

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## Abstract

We developed the program to support obese patients to change their lifestyle related with obesity, KOHNODAI program. Here we studied effects of KOHNODAI program on metabolic parameters in 19 Japanese obese people. Mean body weight significantly decreased to 79.9 kg immediately after the KOHNODAI program, and at 3 (79.7 kg) and 6 months (77.3 kg) after the program as compared with body weight before the program (81.7 kg). Serum high-density lipoprotein-cholesterol levels significantly increased, and alanine aminotransferase tended to decrease 6 months after the program. Lower BMI tended to achieve weight reduction  $\geq 3\%$  at 6 months after the program. Frequency of participants who take anti-psychotic drugs was significantly lower in the group that achieved weight reduction  $\geq 3\%$  as compared with the group that could not achieve weight reduction  $\geq 3\%$ . In conclusion, our KOHNODAI program significantly reduced body weight, and ameliorated dyslipidemia and liver function in obese people.

**Keywords:** Anti-psychotic drugs, Body weight reduction, HDL-cholesterol, Lifestyle, Obesity

## Introduction

Obesity, especially abdominal obesity, has been known to be frequently associated with metabolic disorders, such as glucose intolerance, hypertension and dyslipidemia [1-7].

The mission of our institute, National Center for Global Health and Medicine (NCGM), is to provide the best general healthcare services to overcome diseases and improve health with the aim of contributing to society. Prevention of obesity-related metabolic abnormalities is one of important missions for NCGM. We developed the program to support obese patients to change their lifestyle related with obesity, and named this program KOHNODAI Hospital NCGM Obesity-related Diet and Physical Activity Improvement (KOHNODAI) program [8]. Here we studied effects of the KOHNODAI program on metabolic parameters in Japanese obese people.

## Subjects and Methods

### Subjects

We studied 19 patients who participated in the KOHNODAI Program. Clinical characteristics were shown in Table 1.

After 5 days admission, the participants visit our outpatient clinic and receive guidance about diet every month. Almost 40 patients were screened to participate in the KOHNODAI program, and almost half of screened patients rejected the participation.

### Methods

The summary of KOHNODAI program was shown in Table 2. Briefly, this program is scheduled to be completed for 5 days, and start on Friday and finish on next Tuesday for a busy businessman. On Day 1, we perform a medical check-up to understand that obese patients can take diet therapy and

exercise safely. We measure the markers of atherosclerosis, and also visceral and subcutaneous fat, which can motivate patients to participate actively in this program. Physical therapists make an individual exercise program which depends on age, exercise capacity and endurance, cardiopulmonary function of each patient, and instructed patients to do exercise. Our diet therapy includes the small restriction of calorie intake [25 kcal/kg (ideal body weight) /day]. On Day 2 and Day 3, patients take diet therapy and exercise. On Day 4, we measure serum metabolic parameters, and basal metabolic rate which influence on changes in body weight. In the afternoon of Day 4, patients receive the instruction of nutrition therapy by the registered dietitians individually. On Day 5, each patient reflects on the KOHNODAI program and their lifestyle.

Table 1: Clinical characteristics of 19 participants studied.

Age	49±14
Sex (male / female)	7 / 12
Height (cm)	159±8
Weight (kg)	81.7±18.7
Body mass index (kg/m <sup>2</sup> )	32.0±4.9
Systolic blood pressure (mmHg)	130±15
Diastolic blood pressure (mmHg)	79±10
Waist circumference (cm)	104±12
Visceral fat area (cm <sup>2</sup> )	199±78
Subcutaneous fat area (cm <sup>2</sup> )	316±120

Values are expressed as mean±SD.

To understand effects of the KOHNODAI program on metabolic parameters, we studied clinical and biochemical data and medical history before and immediately after the KOHNODAI program, and at 3 and 6 months after the program.

## Measurements

Height and weight were measured with a rigid stadiometer and calibrated scale (seca 764, seca Co., Ltd, Birmingham, United Kingdom). Body mass index (BMI) was calculated as body weight (kg) divided by the square of height (m). Waist circumference was measured in a standing posture at the umbilical level while breathing out.

## We determined visceral fat area (VFA) and subcutaneous fat area by using the abdominal computed tomography.

Venous blood samples were taken after a 12-h overnight fast. Fasting plasma glucose (FPG) was measured using an enzymatic method. Glycated hemoglobin (HbA1c) was measured by high-performance liquid chromatography (HPLC).

Triglyceride and high-density lipoprotein (HDL)-cholesterol were measured enzymatically using commercially available kits. Low-density lipoprotein-cholesterol was obtained by the Friedwald formula [9].

Table 2: Summary of the KOHNODAI program

### Day 1 (Friday)

- Medical check-up (physical examination, electrocardiogram, chest X-ray)
- Evaluation of atherosclerosis (ankle brachial index, pulse wave velocity)
- Evaluation of visceral and subcutaneous fat by computed tomography
- Making the individual exercise program and instruction of exercise (aerobic and anaerobic exercise) by physical therapists
- Diet therapy [carbohydrate 55-60%, protein 15-20%, fat 20-25%; daily calorie of 25 kcal/kg (ideal body weight)]

Ideal body weight was calculated as the following formula; [body height (m)]<sup>2</sup> x 22

### Day 2 (Saturday)

- Exercise and diet therapy

### Day 3 (Sunday)

- Exercise, taking a walk and diet therapy

### Day 4 (Monday)

- Measurement of markers for liver function, lipid and glucose metabolism
- Measurement of basal metabolic rate
- Instruction of nutrition therapy by registered dietitians individually

### Day 5 (Tuesday)

- Soul-searching and reconsideration of KOHNODAI program and their own lives

### Days 1-5

- Measurement of body weight four times a day at before and after breakfast, at before and after dinner
- Patients and nurses discuss on their lifestyles for one hour. Nurses make patients discover their problems and remedy, and encourage patients to modify their lifestyle related with obesity

## Statistical Analysis

All statistical analyses were performed using SPSS version 19 (IBM Co., Ltd, Chicago, IL). We analyzed the difference in values between two groups by paired T test, and analyzed the difference in frequency between two groups by chi-square test. A P value of < 0.05 was considered statistically significant.

## Results

Body weight significantly decreased immediately after the KOHNODAI program, and at 3 and 6 months after the program as compared with body weight before the program (Figure 1).

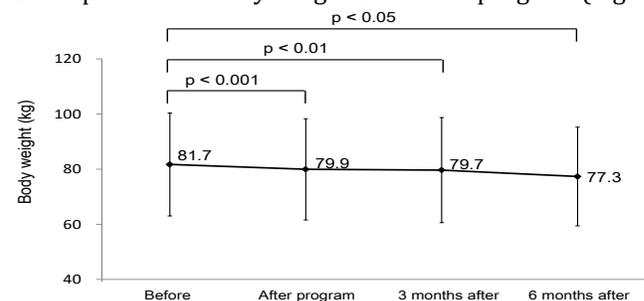


Figure 1. Changes in body weight immediately after the KOHNODAI program, at 3 months and 6 months after the program. Box and bar indicates mean±SD. Statistical analysis was performed by paired T test.

Changes in clinical and metabolic parameters at 6 months after the KOHNODAI program were shown in Table 3. Serum HDL-cholesterol levels significantly increased, and alanine aminotransferase (ALT) tended to decrease 6 months after the program.

Table 3: Changes in Clinical and Metabolic Parameters at 6 Months after the KOHNODAI program.

	N	Before program	6 months after	P value
Systolic BP (mmHg)	15	129±14	126±10	0.41
Diastolic BP (mmHg)	15	78±12	74±9	0.20
Plasma glucose (mg/dl)	17	105±17	110±19	0.26
HbA1c (%)	16	6.5±0.9	6.1±0.5	0.22
Triglyceride (mg/dl)	18	147±79	158±59	0.48
HDL-cholesterol (mg/dl)	18	42±11	46±12	0.02
LDL-cholesterol (mg/dl)	12	117±30	107±40	0.43
AST (mg/dl)	18	46±18	36±23	0.15
ALT (mg/dl)	18	66±38	48±32	0.07
Creatinine (mg/dl)	18	0.7±0.2	0.7±0.2	0.37
eGFR (ml/min/hr)	18	81±23	82±23	0.56
Urate (mg/dl)	17	6.7±2.0	6.0±1.6	0.12

Values are expressed as mean±SD. P value indicate statistical significant difference of values at 6 months after program vs. before program, which was analyzed by paired T test. ALT, alanine transaminase; AST, aspartate transaminase; BP, blood pressure; eGFR, estimated glomerular filtration rate; HDL, high-density lipoprotein; LDL, low-density lipoprotein.

Clinical differences between the group that achieved weight reduction  $\geq 3\%$  and the group could not achieve weight reduction  $\geq 3\%$  at 6 months after the KOHNODAI program was shown in Table 4. Lower BMI tended to achieve weight reduction  $\geq 3\%$  at 6 months after the program.

Table 4: Clinical Differences between the Group that Achieved Weight Reduction  $\geq 3\%$  and the Group that Could Not Achieve Weight Reduction  $\geq 3\%$  at 6 Months after the KOHNODAI program.

	Weight reduction rate $\geq 3\%$	Weight reduction rate $< 3\%$	P value
N	11	8	
Age	49±17	50±11	0.84
Sex (male / female)	3 / 8	4 / 4	0.31
Height (cm)	158±9	160±7	0.58
Weight (kg)	76.8±21.1	88.4±11.7	0.20
Body mass index (kg/m <sup>2</sup> )	30.3±4.6	34.4±4.1	0.07
Systolic blood pressure (mmHg)	129±15	132±15	0.74
Diastolic blood pressure (mmHg)	76±9	80±12	0.44
Waist circumference (cm)	102±14	108±8	0.37
Visceral fat area (cm <sup>2</sup> )	174±68	237±77	0.11
Subcutaneous fat area (cm <sup>2</sup> )	307±146	331±58	0.70

Values are expressed as mean±SD. Statistical analyses of differences in clinical characteristics except for sex were performed by paired T test, and statistical analysis of sex was performed by chi-square test.

Differences in biochemical data and medical history between the group that achieved weight reduction  $\geq 3\%$  and the group that could not achieve weight reduction  $\geq 3\%$  at 6 months after the KOHNODAI program was shown in Table 5. Frequency of participants who take anti-psychotic drugs was significantly lower in the group that achieved weight reduction  $\geq 3\%$  as compared with the group that could not achieve weight reduction  $\geq 3\%$ .

Table 5: Differences in Biochemical Data and Medical History between the Group that Achieved Weight Reduction  $\geq 3\%$  and the Group that Could Not Achieve Weight Reduction  $\geq 3\%$  at 6 Months after the KOHNODAI program.

	Weight reduction rate $\geq 3\%$	Weight reduction rate $< 3\%$	P value
N	11	8	
Plasma Glucose (mg/dl)	105±18.7	101±14	0.66
HbA1c (%)	6.6±1.0	6.2±0.6	0.38
Triglyceride (mg/dl)	162±89	119±51	0.27
HDL-cholesterol (mg/dl)	43±13	39±7	0.43
LDL-cholesterol (mg/dl)	119±31	110±23	0.54
AST (mg/dl)	41±17	49±19	0.33
ALT (mg/dl)	57±32	73±45	0.42
Creatinine (mg/dl)	0.7±0.1	0.8±0.3	0.15
Urate (mg/dl)	7.2±1.8	5.7±1.6	0.15
Psychiatric diseases (N)	3	5	0.13
Participants who take anti-psychotic drugs (N)	2	5	< 0.05

Values are expressed as mean±SD. Statistical analyses of differences in clinical characteristics except for psychiatric diseases and persons who take anti-psychotic drugs were performed by paired T test, and statistical analyses of psychiatric diseases and persons who take anti-psychotic drugs were performed by chi-square test. ALT, alanine transaminase; AST, aspartate transaminase; HDL, high-density lipoprotein; LDL, low-density lipoprotein.

## Discussion

Present study showed effectiveness of our KOHNODAI program to obtain a significant reduction of body weight in a short period (5 days), and also prolonged significant effects on body weight reduction. The KOHNODAI program has two characteristic contents. First, the patients measure and record body weight four times a day by themselves on Days 1-5, which make patients discover what increase or decrease their body weight, and how their body weight change. Secondly, patients and nurses discuss on their lifestyle for one hour on Days 1-5. Nurses make patients discover their problems and remedy, and encourage patients to modify their lifestyle. These characteristic contents of our program may help obese people to reduce their body weight.

Visceral fat accumulation leads to insulin resistance, which induces dyslipidemia such as hypertriglyceridemia and low HDL-C [10]. In Japan, the number of metabolic disorders was greater than 1.0 at 100 cm<sup>2</sup> of VFA and the best combination of the sensitivity and specificity for determining subjects with multiple risk factors was 100 cm<sup>2</sup> of VFA [11]. The regression line obtained from simple correlation analyses indicated that the waist circumference corresponding to 100 cm<sup>2</sup> of VFA is defined as abdominal obesity in the

Japanese diagnostic criteria for metabolic syndrome [11]. The mean±SD of VFA in our participants was 199±78 cm<sup>2</sup>, which was significantly higher than the upper limit of VFA defined as the metabolic syndrome. Present study showed a significant increase in HDL-C at 6 months after the program, suggesting that our program improved insulin resistance and ameliorated insulin resistance-related dyslipidemia.

Non-alcoholic fatty liver disease (NAFLD) is now the most frequent chronic liver disease, and is associated with obesity and insulin resistance and is considered the hepatic manifestation of the metabolic syndrome [12]. Current treatment relies on weight loss and exercise [12]. The KOHNODAI program tended to reduce ALT, proposing the effectiveness of our program for the treatment of NAFLD.

In the analyses of differences in clinical, biochemical data and medical history between the group that achieved weight reduction  $\geq 3\%$  and the group could not achieve weight reduction  $\geq 3\%$  at 6 months after the KOHNODAI program, we found that frequency of participants who take anti-psychotic drugs was significantly lower in the group that achieved weight reduction  $\geq 3\%$  as compared with the group that could not achieve weight reduction  $\geq 3\%$ . Recently, a growing interest has been observed on weight gain, which is now a well-known adverse effect of many anti-psychotics [13], supporting our results.

We have to mention the limitation of our study. The most findings were statistically nonsignificant. We should increase the number of participants to prove the valid effects of the KOHNODAI program. We should also mention the possibility that the participants of this 5 days admission program were likely already highly motivated before the start of program.

## Conclusion

The KOHNODAI program significantly reduced body weight in a short period, and also showed prolonged significant effects on body weight reduction. Our program ameliorated dyslipidemia and liver function in obese people. Present study also indicated that patients who take anti-psychotic drugs are unlikely to reduce body weight by our program.

## Conflict Interests

The authors declare that they have no competing interests.

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