

Target for body weight management in middle-aged and older women that attended local health classes

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Abstract

There are a number of previous studies about the effects of health classes on women with a body mass index (BMI) of 25 or greater, and a target for weight loss to reduce the risk of lifestyle-related diseases is well established. In contrast, few studies have addressed the target for middle-aged and older non-obese women with a BMI of less than 25 (<25). Thus, we conducted a study on the target for body weight management in middle-aged and older women with a BMI of <25 that attended a health class for promoting maintenance and improvement of health condition.

Diabetes Prevention Classes were held every year from 2005 through 2010. The subjects of this study were 146 middle-aged and older women (63.7 ± 3.8 years old) that who attended one of these classes. Weight loss rate was calculated based on the change in body weight between the beginning of the class and end of the class for each subject. The subjects were classified into the following 4 groups: a group with <1% loss (Group <1%), a group with $\geq 1\%$ to <3% loss (Group 1%-3%), a group with $\geq 3\%$ to <5% loss (Group 3%-5%), and a group with $\geq 5\%$ loss (Group $\geq 5\%$). The differences between the beginning and end of the class and changes from baseline in body composition, blood biochemistry, amount and intensity of physical activity, energy intake, and nutrient intake were evaluated.

The average rate of body weight loss for all subjects was $2.9 \pm 2.9\%$. There were 37 subjects in Group <1%, 40 subjects in Group 1%-3%, 32 subjects in Group 3%-5%, and 37 subjects in Group $\geq 5\%$. In Groups 3%-5% and $\geq 5\%$, body weight and body fat percentage were significantly decreased at the end of the class ($p<0.001$). Blood biochemistry revealed a significant decrease in hemoglobin A1c (HbA1c) level [JDS (Japan Diabetes Society)-assigned value] in Groups 3%-5% and $\geq 5\%$ at the end of the class ($p<0.01$). The total cholesterol (TC) level also decreased significantly in Groups 3%-5% ($p<0.05$) and $\geq 5\%$ ($p<0.001$).

Since $\geq 3\%$ body weight loss decreased the body fat percentage and improved some blood biochemical parameters, $\geq 3\%$ body weight loss is considered to be effective for maintenance and improvement of health condition in middle-aged and older women with a BMI of <25. Also, since approximately half of all the attendees achieved $\geq 3\%$ weight loss, $\geq 3\%$ weight loss is not considered to be a difficult target for body weight management.

Based on the study results, we concluded that body weight loss of 3%-5% can be the target for body weight management for health maintenance and improvement in women with a BMI of <25 that attend health classes, since body weight loss of 5%-10% is a large burden in these populations.

Key words: Lifestyle-Related Disease Prevention, Health Support, Body Weight Management, Middle-Aged and Older Women

I . Introduction

Weight loss is recommended for obese people with a high risk of lifestyle-related diseases¹⁾, and weight loss of 5% to 10% is reportedly effective to reduce the risk²⁾. In lifestyle-related disease prevention classes for people with a high risk,

weight loss of 5% or greater is set as a target, and it has been reported that $\geq 5\%$ weight loss is associated with improvement of some blood biochemical parameters^{3,4)}.

To reduce the rates of overall morbidity and mortality of lifestyle-related diseases, it is important to not just focus on high-risk populations; populations without a high risk also

require attention. For instance, some epidemiologic studies about diabetes reported that pre-disease or early stage interventions prevent disease progression or complications in mild diabetes patients ^{5,6)}. In addition, a study evaluating the relationship between serum total cholesterol levels and coronary artery disease (CAD)-related mortality ⁷⁾ revealed that a population with normal or borderline cholesterol levels accounted for 70% of overall mortality, although a group with a high serum total cholesterol level showed a trend toward a high mortality rate. Thus, to reduce the overall morbidity and mortality rates, improved health maintenance and activities should be applied not only to high-risk populations but also to populations without a high risk (the term “low-risk population” is used hereafter).

Although it has been reported that local health classes for low-risk populations were associated with health maintenance and improvement^{8,9)}, no clear targets leading to these outcomes were determined. This deficiency was due to a lack of systemic data such as body weight, body fat percentage, and blood biochemistry data within the same class ^{8,9)}; therefore, it was difficult to evaluate the effects of a class systemically with only partial data. Thus, for evaluation of improved health maintenance and activities for low-risk populations, it is important to select classes for low-risk populations in which systemic data for body weight, body fat percentage, and blood biochemistry are available and then to establish clear indexes for health maintenance and improvement.

It has been reported that there are many middle-aged and older women with a high body fat rate even though their BMI are lower than 25¹⁰⁾, and these populations need special attention and instruction¹¹⁾. In addition, increased metabolic syndrome is observed in individuals in their 50s and 60s¹²⁾. Therefore, sufficient attention should be paid to non-obese populations with a BMI of <25 in terms of health support. In health classes for high-risk populations including obese people, a clear target for weight loss associated with a reduced risk of lifestyle-related diseases has been well established²⁾. In contrast, few studies have assessed appropriate targets for body weight management with respect to health maintenance and improvement in low-risk populations.

In this study, we analyzed objective data including body composition, blood biochemistry, and amount of physical activity in middle-aged and older women that attended a health class in H city at the beginning and end of the class and assessed an appropriate target for body weight management for health maintenance and improvement.

II. Methods

1. Study Subjects

The study subjects were 213 middle-aged and older women that met all of the following criteria: 1) they had annual health checkups performed by H city from 2003 through 2009; 2) they were women aged ≥ 40 and <70 years with a hemoglobin A1c (HbA1c) level [JDS (Japan Diabetes Society)-assigned value] within the range of $\geq 5.2\%$ and $<6.1\%$; 3) they were not receiving antidiabetics or specific health guidance; 4) they were able to exercise; and 5) they attended a Diabetes Prevention Class” (“the class” is used hereafter) once, which is held annually from 2005 through 2010. Among these subjects, 34 obese women with a BMI of ≥ 25 , 10 women who dropped out of the class, and 16 women with missing health data during the class were excluded from the study. Furthermore, 5 women less than 50 years of age and 2 women 70 years of age or older were excluded from the study to focus on the major population with metabolic syndrome (i.e., women in their 50s and 60s). The remaining 146 women (63.7 ± 3.8 years old) were evaluated for subsequent analysis.

2. Class Contents

The class was held from June to November (5 months) annually to focus on the prevention of diabetes and promote primary prophylaxis. During the class, the subjects received nutritional education, which included such things as introduction of well-balanced diets including staple foods, main dishes, and side dishes, and instruction about exercise, such as walking and easy exercises utilizing their own body weight or tubes. During the class period, nutritional education and exercise instruction were provided 2 or 3 times per month.

3. Evaluation Items

The differences between the beginning and end of the class and changes from baseline in body composition, blood biochemistry, amount and intensity of physical activity, energy intake, and nutrient intake were evaluated. Body composition items were measured by a body composition analyzer (BC-118D, Tanita Corp., Tokyo, Japan) and included body weight, body fat percentage, amount of body fat, fat-free mass, and BMI. Blood biochemistry included fasting blood glucose, HbA1c, total cholesterol (TC), HDL cholesterol (HDL-C), LDL cholesterol (LDL-C), and triglycerides (TG). LDL-C level was calculated using the Friedewald equation as follows: $LDL-C = TC - (HDL-C + TG \times 1/5)$ ¹³⁾. Amount and intensity of physical activity were measured with an accelerometer (Kenz Lifecorder EX, Suzuken Co., Ltd., Nagoya, Japan). It has been reported that the intensity of physical activity measured with an

accelerometer is correlated with the METs value¹⁴⁾. Use of the accelerometer was fully explained, and the number of steps, amount of exercise according to intensity, and total amount of energy expenditure were measured for 1 week after the start of the class and 1 week before the final class; the average values were then calculated. Because the accelerometer recorded physical activity every 4 seconds and graded its intensity on a scale of 0 to 9 based on acceleration and frequency, the intensity of physical activity was classified as light (grades 1-3), moderate (grades 4-6), or vigorous (grades 7-9), and average activity durations were obtained. The amount of exercise was considered to be the total energy expenditure at intensity grades 4-9.

Analysis of total energy intake, energy intake per 1 kg body weight, and nutrient intake was conducted by calculating energy, carbohydrate, lipid, and protein intakes using the Microsoft® Excel Add-In software Excel Eiyo-kun FFQg Ver. 3.0 based on results from a survey of the frequency of food intake.

4. Analytical Method

Based on the change in body weight from the beginning of the class to the end of the class, the weight loss rate (%) was calculated (body weight change from the beginning of the class to the end of the class / baseline body weight at the beginning of the class \times 100). Taking into consideration errors in measurement, there was considered to be no weight loss when the weight loss rate was less than 1%¹⁵⁾. To evaluate the degree of body weight loss in the same way as Muramoto et al.,⁴⁾ the subjects were divided into groups based on 2% increments in the body weight loss rate and categorized into the following 4 groups: a group with <1% loss (Group <1%), a group with \geq 1% to <3% loss (Group 1%-3%), a group with \geq 3% to <5% loss (Group 3%-5%), and a group with \geq 5% loss (Group \geq 5%). Differences between the beginning and end of the class, and changes from baseline (the beginning of the class) were evaluated for body composition, blood biochemistry, amount and intensity of physical activity, energy intake, and nutrient intake.

5. Statistical Analysis

The paired Student's t-test was used for comparison between the beginning of the class and the end of the class. For comparison of the change from baseline among the 4 groups, one-way analysis of variance was applied, and when a statistically significant difference was confirmed, Tukey's test was used. Statistical analysis was performed by using IBM® SPSS® Statistics 19 with the level of statistical significance set at $p < 0.05$.

6. Ethical Considerations

This study was conducted based on the Declaration of Helsinki and under approval by the Research Ethics Committee, Osaka Prefecture University. Informed consent of each patient was obtained.

III . Results

1. Overall Comparison between the Beginning and End of the Class of Body Composition, Blood Biochemistry, Amount of Physical Activity, Intensity of Physical Activity, Energy Intake, and Nutrient Intake

The results for the beginning and end of the class are shown in Table 1. Body weight, BMI, body fat percentage, amount of body fat, and fat-free mass were significantly decreased at the end of the class. The body weight loss was $2.9 \pm 2.9\%$. Strong positive correlation between weight loss and body fat loss was observed ($r=0.797$, $p < 0.001$). The levels of the blood biochemical parameters such as HbA1c, TC, TG, and LDL-C decreased significantly. With regard to the amount of physical activity, walking steps, exercise amount, and energy expenditure per 1 kg body weight increased significantly. Finally, all energy intake and nutrient intake parameters tested decreased significantly.

2. Comparison of Body Composition, Blood Biochemistry, Amount of Physical Activity, Intensity of Physical Activity, Energy Intake, and Nutrient Intake between the Beginning and End of the Class by Degree of Weight Loss

1) Body Composition

The results of examination of body composition are shown in Table 2. There were 37 subjects in Group <1%, 40 subjects in Group 1%-3%, 32 subjects in Group 3%-5%, and 37 subjects in Group \geq 5%. Body fat percentage and BMI decreased significantly only in Groups 3%-5% and \geq 5% at the end of the class.

2) Blood Biochemistry

The results of blood biochemistry are shown in Table 3. The HbA1c and TC levels decreased significantly in Groups 3%-5% and \geq 5% at the end of the class. The TG level decreased significantly in all groups except Group 3%-5%; it was also reduced in Group 3%-5%, but the difference was not statistically significant. There was little change in the LDL-C level in Groups <1% and 1%-3%. The level decreased in Group 3%-5%, but the difference was not statistically significant. Conversely, the LDL-C level decreased significantly in Group \geq 5%. There was little change in the HDL-C and fasting blood glucose levels in any group.

Table 1. Overall Comparison between the Beginning and End of the Class of Body Composition, Blood Biochemistry, Amount of Physical Activity, Intensity of Physical Activity, Energy and Nutrient Intake"

All Subjects (N=146)	Beginning of the Class			End of the Class		
Body Composition						
Height (cm)	152.7	±	5.5			
Weight (kg)	49.5	±	5.4	48.1	±	5.4***
BMI (kg/m ²)	21.2	±	2.0	20.7	±	2.0***
Body fat percentage (%)	30.1	±	5.0	29.0	±	5.5***
Amount of body fat (kg)	15.1	±	3.6	14.1	±	3.8***
Fat-free mass (kg)	34.5	±	3.0	34.0	±	2.8***
Blood Biochemistry						
Fasting blood glucose (mg/dl)	96.6	±	13.2	95.7	±	13.5
Hemoglobin A1c (JDS) (%)	5.47	±	0.47	5.37	±	0.33***
Total cholesterol (mg/dl)	245.3	±	34.0	232.8	±	33.3***
Triglycerides (mg/dl)	141.2	±	86.8	108.3	±	49.8***
LDL cholesterol (mg/dl) ※	143.4	±	28.8	136.4	±	29.9**
HDL cholesterol (mg/dl)	74.3	±	17.1	74.5	±	17.1
Amount of Physical Activity						
Walking (steps)	10189.4	±	3451.4	10737.5	±	3589.8*
Exercise (kcal)	222.8	±	93.3	242.1	±	102.0**
Total energy expenditure (kcal)	1629.3	±	153.8	1636.9	±	169.7
Energy expenditure per 1 kg body weight (kcal/kg)	33.1	±	2.8	34.3	±	3.7***
Intensity of Physical Activity						
Light (min)	78.6	±	96.6	69.2	±	21.6
Moderate (min)	31.6	±	19.1	34.9	±	20.2*
Vigorous (min)	2.3	±	3.6	3.4	±	6.6*
Energy and Nutrient Intake						
Energy intake (kcal)	1887.1	±	483.2	1723.7	±	411.0***
Energy intake per 1 kg body weight (kcal/kg)	38.5	±	10.2	36.2	±	8.8***
Carbohydrate (g)	261.6	±	63.2	237.2	±	54.6***
Lipid (g)	58.9	±	21.2	54.0	±	18.7***
Protein (g)	73.2	±	20.5	70.2	±	17.7*

Mean ± S.D.

* p<0.05; ** p<0.01; *** p<0.001.

※ LDL cholesterol levels were compared in the subjects with triglyceride levels of ≥ 400 mg/dl (N=144).

Table 2. Comparison of Body Composition between the Beginning and End of the Class by Degree of Weight Loss

	<1% Loss (N=37)		≥1% to <3% Loss (N=40)		≥ 3% to <5% Loss (N=32)		≥ 5% Loss (N=37)	
	Age 63.2 ± 4.9		Age 64.4 ± 3.2		Age 64.7 ± 3.3		Age 62.6 ± 3.4	
	Beginning of the Class	End of the Class	Beginning of the Class	End of the Class	Beginning of the Class	End of the Class	Beginning of the Class	End of the Class
Height (cm)	151.5 ± 5.1	—	154.1 ± 5.7	—	152.6 ± 5.8	—	152.3 ± 5.4	—
Weight (kg)	47.7 ± 5.3	48.0 ± 5.4*	51.1 ± 5.9	50.1 ± 5.8***	49.8 ± 5.3	47.9 ± 5.1***	49.4 ± 4.8	46.1 ± 4.6***
BMI (kg/m ²)	20.8 ± 2.2	20.9 ± 2.1*	21.4 ± 2.1	21.2 ± 2.2	21.4 ± 1.8	20.6 ± 1.7***	21.3 ± 2.0	19.9 ± 1.9***
Body fat percentage (%)	29.7 ± 5.5	30.8 ± 5.1**	30.0 ± 5.4	29.9 ± 6.0	29.9 ± 3.9	28.4 ± 4.5***	30.7 ± 4.8	26.6 ± 5.5***
Amount of body fat (kg)	14.4 ± 3.8	15.0 ± 3.8**	15.6 ± 3.9	15.3 ± 4.1*	15.0 ± 3.3	13.8 ± 3.4***	15.3 ± 3.4	12.4 ± 3.3***
Fat-free mass (kg)	33.4 ± 2.5	33.0 ± 2.5*	35.6 ± 3.2	34.9 ± 3.0***	34.8 ± 2.7	34.2 ± 2.7***	34.1 ± 2.9	33.7 ± 3.0

Mean ± S.D.

* p<0.05; ** p<0.01; *** p<0.001.

Table 3. Comparison of Blood Biochemistry between the Beginning and End of the Class by Degree of Weight Loss

	<1% Loss (N=37)		≥1% to <3% Loss (N=40)		≥3% to <5% Loss (N=32)		≥5% Loss (N=37)	
	Beginning of the Class	End of the Class	Beginning of the Class	End of the Class	Beginning of the Class	End of the Class	Beginning of the Class	End of the Class
Fasting blood glucose (mg/dl)	98.7 ± 15.1	96.7 ± 16.2	94.2 ± 12.3	92.9 ± 12.2	94.9 ± 10.0	95.2 ± 14.5	98.6 ± 14.3	98.2 ± 10.7
Hemoglobin A1c (JDS) (%)	5.44 ± 0.34	5.43 ± 0.36	5.38 ± 0.39	5.35 ± 0.30	5.45 ± 0.41	5.35 ± 0.32**	5.63 ± 0.65	5.37 ± 0.35**
Total cholesterol (mg/dl)	246.7 ± 27.4	241.7 ± 25.3	233.5 ± 35.5	226.6 ± 35.1	246.1 ± 35.5	233.3 ± 39.5*	256.1 ± 34.2	230.0 ± 32.0***
Triglycerides (mg/dl)	138.2 ± 57.9	111.3 ± 55.5**	143.5 ± 61.1	113.7 ± 53.4**	154.8 ± 136.4	112.1 ± 39.7	130.0 ± 81.4	96.1 ± 47.6**
LDL cholesterol (mg/dl) ※	143.3 ± 26.1	143.6 ± 25.1	135.0 ± 29.0	134.0 ± 30.5	146.9 ± 30.7	138.0 ± 35.7	149.7 ± 28.3	130.5 ± 28.0***
HDL cholesterol (mg/dl)	75.7 ± 16.0	75.9 ± 16.8	69.9 ± 14.9	69.9 ± 16.4	72.8 ± 17.6	74.2 ± 15.2	78.9 ± 19.0	78.3 ± 19.1

※ LDL cholesterol levels were compared in the subjects with triglyceride levels of ≥400 mg/dl.

Mean ± S.D.

<1% Loss (N=37), ≥1% to <3% Loss (N=40), ≥3% to <5% Loss (N=31), and ≥5% Loss (N=36)

* p<0.05; ** p<0.01; *** p<0.001.

Table 4. Comparison of Amount and Intensity of Physical Activity between the Beginning and End of the Class by Degree of Weight Loss

	<1% Loss (N=37)		≥1% to <3% Loss (N=40)		≥3% to <5% Loss (N=32)		≥5% Loss (N=37)	
	Beginning of the Class	End of the Class	Beginning of the Class	End of the Class	Beginning of the Class	End of the Class	Beginning of the Class	End of the Class
Amount of Physical Activity								
Walking (steps)	10775.7 ± 3912.7	10739.7 ± 3991.3	9899.6 ± 2696.4	9798.9 ± 2865.8	9062.5 ± 3026.9	10510.2 ± 3326.8*	10890.9 ± 3850.0	11946.5 ± 3875.6*
Exercise (kcal)	233.9 ± 102.3	240.9 ± 113.1	219.2 ± 79.8	219.6 ± 81.2	195.2 ± 79.8	237.0 ± 90.5**	239.5 ± 105.3	272.2 ± 115.9*
Total energy expenditure (kcal)	1609.9 ± 145.9	1612.7 ± 205.7	1660.4 ± 166.6	1636.5 ± 151.0	1594.6 ± 137.3	1628.9 ± 143.3*	1645.1 ± 157.7	1668.5 ± 171.9
Energy expenditure per 1 kg body weight (kcal/kg)	34.0 ± 3.2	33.8 ± 4.8	32.6 ± 2.3	32.8 ± 2.5	32.2 ± 2.6	34.1 ± 2.8***	33.4 ± 3.0	36.3 ± 3.4***
Intensity of Physical Activity								
Light (min)	71.5 ± 19.0	68.0 ± 21.6	101.1 ± 181.6	69.9 ± 22.9	65.2 ± 19.7	66.1 ± 20.3	72.9 ± 19.8	72.5 ± 21.5
Moderate (min)	35.4 ± 22.6	36.7 ± 24.1	28.1 ± 12.9	27.2 ± 12.5	27.3 ± 18.2	36.2 ± 21.5*	35.3 ± 20.7	40.2 ± 19.9
Vigorous (min)	3.0 ± 5.1	3.5 ± 3.2	2.0 ± 3.1	2.2 ± 3.0	1.6 ± 1.8	2.7 ± 3.0*	2.4 ± 3.6	5.3 ± 12.0

Mean ± S.D.

* p<0.05; ** p<0.01; *** p<0.001.

Table 5. Comparison of Energy and Nutrient Intake between the Beginning and End of the Class by Degree of Weight Loss

	<1% Loss (N=37)		≥1% to <3% Loss (N=40)		≥3% to <5% Loss (N=32)		≥5% Loss (N=37)	
	Beginning of the Class	End of the Class	Beginning of the Class	End of the Class	Beginning of the Class	End of the Class	Beginning of the Class	End of the Class
Energy intake (kcal)	1904.2 ± 518.4	1777.3 ± 446.4*	1882.5 ± 517.8	1736.2 ± 468.7**	1897.0 ± 460.8	1803.5 ± 408.4	1866.5 ± 444.4	1587.8 ± 268.0***
Energy intake per 1 kg body weight (kcal/kg)	40.1 ± 10.4	37.2 ± 8.9**	37.2 ± 10.2	34.9 ± 8.8*	38.7 ± 10.6	38.3 ± 10.9	38.1 ± 9.7	34.7 ± 6.5*
Carbohydrate (g)	266.2 ± 66.1	243.7 ± 63.4***	260.1 ± 63.4	238.0 ± 53.1*	265.9 ± 62.5	250.9 ± 52.5	255.0 ± 62.4	217.9 ± 44.3***
Lipid (g)	58.1 ± 20.6	56.1 ± 17.0	59.2 ± 24.8	54.9 ± 24.8*	57.9 ± 20.9	55.2 ± 17.8	60.2 ± 18.3	49.8 ± 12.6***
Protein (g)	73.9 ± 24.5	71.1 ± 18.0	72.9 ± 22.4	68.5 ± 19.4*	74.2 ± 17.6	72.9 ± 19.1	71.8 ± 16.5	68.7 ± 14.2

Mean ± S.D.

* p<0.05; ** p<0.01; *** p<0.001.

3) Amount and Intensity of Physical Activity

The results of examination of physical activity are shown in Table 4. Walking steps, exercise amount, and total energy expenditure per 1 kg body weight were significantly increased in Groups 3%-5% and ≥5% at the end of the class. There was little change in walking steps, exercise amount, or total energy expenditure per 1 kg body weight in Groups <1% and 1%-3%. The durations of moderate and vigorous intensity physical activity increased significantly only in Group 3%-5% ($p<0.05$).

4) Energy and Nutrient Intake

The results of examination of energy and nutrient intake are shown in Table 5. In Group 1%-3%, all items tested were significantly decreased at the end of the class. In Groups <1% and ≥5%, energy intake per 1 kg body weight and carbohydrate intake decreased significantly. Although the differences were not statistically significant, all items tested decreased in Group 3%-5%.

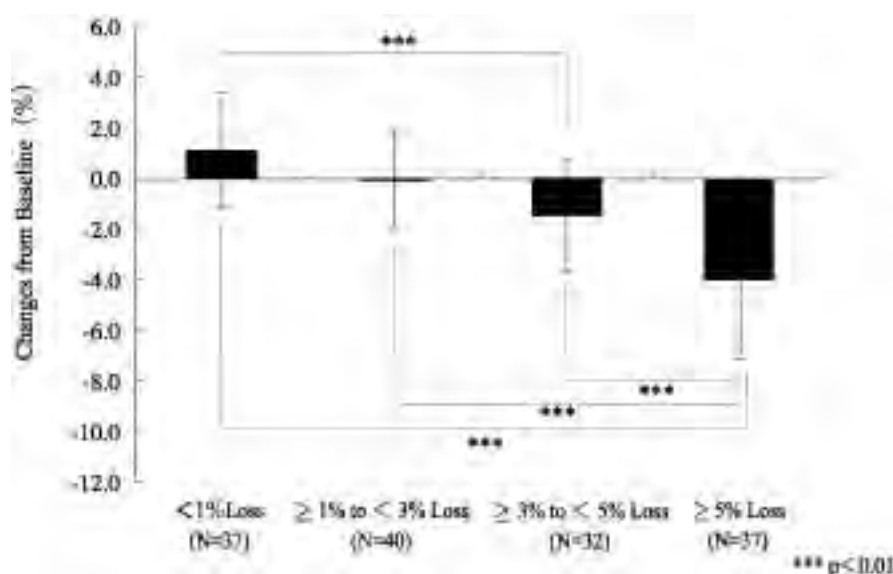


Figure 1. Changes from Baseline (%) in Body Fat Ratio by Degree of Weight Loss

3. Comparison of Changes from Baseline of Body Composition, Blood Biochemistry, Amount of Physical Activity, Intensity of Physical Activity, and Energy Intake Among the Four Groups

The change from baseline for body fat percentage is shown in Figure 1. Increasing body weight loss enhanced the decrease in body fat percentage. The body fat percentage in Group 3%-5% was significantly decreased compared with that of Group <1% ($p<0.001$), and that of Group $\geq 5\%$ was significantly decreased compared with those of the other 3 groups ($p<0.001$).

Blood biochemistry revealed that the HbA1c level in Group $\geq 5\%$ was significantly decreased when compared with those of Groups <1% ($p<0.01$) and 1%-3% ($p<0.05$). The TC and LDL-C levels in Group $\geq 5\%$ were also significantly decreased when compared with those of Groups <1% and 1%-3% ($p<0.05$). There were no statistically significant differences in the changes from baseline for fasting blood glucose, TG, and HDL-C levels among the 4 groups.

Regarding physical activity, walking steps were significantly increased in Group 3%-5% when compared with Groups <1% ($p<0.01$) and 1%-3% ($p<0.05$). A significant increase in walking steps was also observed in Group $\geq 5\%$ when compared with Groups <1% and 1%-3% ($p<0.001$).

There were no statistically significant differences in the intensity of physical activity, energy intake, or nutrient intake.

IV . Discussion

In this study, we analyzed multiple parameters, such as body composition, blood biochemistry, and physical activity, at

the end of the class by the degree of weight loss in middle-aged and older women with a BMI of <25 attending a local health class to determine an appropriate target for body weight management for maintenance and improvement of health condition for this population.

1. Overall Outcomes of the Health Class — Differences between the Beginning and End of the Class

This study revealed a significant decrease in body fat percentage at the end of the class accompanied by decreases in several blood biochemical parameters including the HbA1c, TG, TC, and LDL-C levels. The average body weight loss for all subjects was $2.9 \pm 2.9\%$. These results suggest the possibility that modest weight loss in a low-risk population with a BMI of <25 improves blood biochemical parameters, although the degree of weight loss was less than the target of 5% established for obese patients.

2. Differences between the Beginning and End of the Class and Changes from Baseline in Body Composition, Blood Biochemistry, Amount of Physical Activity, Intensity of Physical Activity, Energy Intake, and Nutrient Intake

1) Body Composition

Since a significant decrease in body fat percentage was observed in Groups 3%-5% and $\geq 5\%$, $\geq 3\%$ weight loss may be effective for reduction of body fat percentage. Approximately half of all the subjects (69 women) achieved $\geq 3\%$ weight loss in this study; therefore, $\geq 3\%$ weight loss was considered to be an achievable target.

2) Blood Biochemistry

Body weight management is effective prophylaxis against cardiovascular diseases, and it has been reported to reduce coronary risk factors¹⁶⁾. In this study, decreases in the HbA1c and TC levels were observed in Groups 3%-5% and $\geq 5\%$ at the end of the class. The EPIC-Norfolk study demonstrated a correlation between cardiovascular diseases and HbA1c level, and it was calculated that a 0.1% reduction in HbA1c level would be associated with a 6% decrease in overall mortality¹⁷⁾. The HbA1c levels in Groups 3%-5% and $\geq 5\%$ decreased by 0.11% and 0.26%, respectively; therefore, $\geq 3\%$ weight loss may contribute to maintenance and improvement of health in this population.

Regarding lipid metabolism, it has been reported that there is a significant correlation between the amount of visceral fat and the serum cholesterol level¹⁸⁾. The TC level decreased in Group 3%-5%, and the body fat percentage decreased significantly in Group $\geq 5\%$. On the other hand, it can be inferred that no decreases in TC level were observed in Groups <1% and 1%-3% because there was no decrease in body fat percentage in these groups. The LDL-C level also decreased significantly in Group $\geq 5\%$, in which a change in body fat percentage was seen. Group 3%-5% also showed a trend toward a decreased LDL-C level, although the difference was not statistically significant. In contrast, Groups <1% and 1%-3%, in which little change in body fat percentage was observed, showed small changes. A significant decrease in TG was observed in all groups except Group 3%-5%. To improve the TG level, it is important to maintain appropriate energy intake and prevent obesity¹⁹⁾. Since Groups <1% and 1%-3% had significant decreases in energy intake and carbohydrate intake, the decreased TG levels in these groups may be attributed to improvement of dietary life despite the lack of a decreased body fat percentage.

Conversely, only slight changes in the HDL-C and fasting blood glucose levels were observed in all groups. At least, none of the values for these parameters were worsening at the end of the class, which suggests that there were no negative effects on these parameters.

These results suggest the possibility that $\geq 3\%$ weight loss effectively improves some blood biochemical parameters.

3) Amount of Physical Activity

Significant increases in walking steps and exercise amount were observed in Groups 3%-5% and $\geq 5\%$, which showed significant decreases in body weight and body fat percentage. There were only slight increases in walking steps and exercise amount in Groups <1% and 1%-3%, suggesting that increasing the number of walking steps and amount of exercise is critical to achieving $\geq 3\%$ weight loss.

4) Intensity of Physical Activity

In Group 3%-5%, the durations of moderate and vigorous intensity physical activity increased significantly, suggesting that 3%-5% weight loss may be associated with intensity of physical activity.

5) Energy and Nutrient Intake

Energy and carbohydrate intake decreased significantly in all groups except Group 3%-5%, suggesting that the weight loss in Groups 1%-3% and $\geq 5\%$ may have been related to decreased energy and carbohydrate intake.

6) Overall Discussion

Our study indicates that $\geq 3\%$ weight loss contributes to significant decreases in body fat percentage and improvement of some blood biochemical parameters. It also suggests that in order to achieve $\geq 3\%$ weight loss, not only decreased energy intake but also an increased amount of physical activity was required. For people with a BMI of <25, 5% to 10% weight loss, the target for obese patients for risk reduction of lifestyle-related diseases, may be a burden because of the large rate of body weight loss. Greater body weight loss is not always associated with improvement of health condition²⁰⁾. Therefore, providing a minimal target to achieve maintenance and improvement of health condition is helpful to motivate subjects to improve lifestyle. In this study, approximately half of the subjects achieved $\geq 3\%$ weight loss during the 5-month period, and 3% to 5% weight loss improved some blood biochemical parameters.

Based on these findings, 3% to 5% weight loss is considered to be the appropriate short-term target for body weight management in middle-aged and older women with a BMI of <25 attending health classes for low-risk individuals to maintain and improve health condition.

7) Limitations of the Study

The subjects in this study were the attendees of a health class specifically focusing on diabetes prevention; therefore, medical histories including therapies and medications for various background diseases other than diabetes were not fully identified. Also, the number of subjects was small, and no follow-up assessment for continuous maintenance of health condition after the class was performed. Further assessment to overcome these limitations is required.

V . Conclusion

We determined an appropriate target for body weight management in middle-aged and older women with a BMI of <25 attending a health class for maintenance and improvement of health condition. The study results indicated that $\geq 3\%$ weight loss decreased the body fat percentage and improved

some blood biochemical parameters and that the amount of physical activity needed to be increased to achieve $\geq 3\%$ weight loss.

For people with a BMI of <25 , 5% to 10% weight loss, the target for obese patients, may be a large burden; therefore, 3% to 5% weight loss is considered to be the appropriate target for body weight management in health classes for middle-aged and older women with a BMI of <25 .

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