

A study of the usefulness of body weight training programs for middle-aged and older women

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Abstract

Continued exercise is effective as primary prevention of lifestyle-related diseases. However, only about 30% of people in Japan take regular exercise, and it is difficult to establish a habit of regular exercise. Therefore, the body weight training program (BWT program) was devised for the purpose of exercise adherence. This study investigated the kind of exercise habits in middle-age and older women for which a BWT program is useful.

The mean implementation rate during 131 days was $67.7 \pm 25.3\%$ for 3-minute exercises and $58.0 \pm 26.7\%$ for the daily calendar. Implementation of the 3-minute exercises and the daily calendar showed strong correlation ($p < 0.001$). There was no significant difference in the implementation rate in the non-exercise group, 1-2 times/week group and 3 times or more/week group. Body weight, body fat percentage, amount of body fat and BMI significantly decreased after classes in the non-exercise group. Subjects who did not exercise decreased from 11 before the classes to 2 after the classes, and frequency of exercise significantly increased ($p < 0.05$). Time of activity of moderate intensity also significantly increased ($p < 0.05$).

Implementation of the BWT program was useful in increasing the frequency of exercising, decreasing body weight and body fat percentage, and increasing time of physical activity of moderate intensity among middle-age and older women who do not exercise. These results suggest that body weight training is an effective means of promoting exercise in middle-age to older women who are not in the habit of exercising.

Key words : Body weight training, Exercise adherence, Physical activity, Health class, Lifestyle-related disease

I . Introduction

Continued exercise is effective as primary prevention of lifestyle-related diseases¹⁾. However, according to the 2010 National Health and Nutrition Survey in Japan²⁾, only about 30% of people take regular exercise (exercising at least 30 minutes at a time twice a week or more, continued for at least 1 year), and it is difficult to establish a habit of regular exercise. In terms of gender, a smaller percentage of women than men exercise regularly²⁾.

The formation of exercise habits involves physical factors³⁾ (injury makes exercise adherence difficult), environmental factors⁴⁾ (having the time, exercise facilities or place), social factors⁵⁾ (understanding of those around you and local support for participating in physical activity) and psychological factors^{5,6)} (setting goals and intrinsic motivation). Regarding exercise adherence, 45-50% of people who start an exercise

program reportedly dropout within 3-6 months^{7,8)}, and half the people who participated in strength-building programs are unable to continue regular physical activity⁸⁾. Therefore, finding methods of continuing to exercise is an important issue.

In reports on exercise intervention in health classes using Thera-Bands, dumbbells and machines^{9,10)} improved motor function has become apparent. However, due to the costs associated with preparation of exercise equipment and instructors, and the limitations on participants due to safety considerations, exercises which are inexpensive and which anyone can do would be useful for more people to continue exercising.

Therefore we focused on body weight training as exercise which can be continued. This is a training method aimed at muscle strengthening in which one's own body weight is the load, such as push-ups and sit-ups. The advantage of this type of training is that it can be done easily regardless of the

environment. Muscle strength training centered on one's own body weight is reported to be useful for the purpose of preventing long term nursing care in the elderly^{11,12)}, and in research with independent elderly people as subjects, the effectiveness of performing muscle strength training five times a week was reported¹³⁾. From these previous studies, on the hypothesis that body weight training by women who spend much time at home focused on housework could have effects (changes in body composition, improvement in amount and intensity of physical activity, etc.), we devised a body weight training program (BWT program) with the objective of exercise adherence. The feature of this program is the adoption of exercises which do not require a large space or apparatus, in order not to miss exercising in any weather, place or time. For continuation of exercise, simple, easily remembered movements with low-level exercise intensity were adopted because of reports that intervention by behavior therapy with the goal of unsupervised, low to moderate activity is good¹⁴⁾, and that an easily manualized program can be readily learned even by a beginner¹⁵⁾. However, depending on the practitioner's exercise habits and physical abilities, body weight training may not provide the level of intensity at which effects of exercise can be expected. Since the exercise effects which can be obtained presumably differ depending on the exercise habits of the practitioner, clarifying the kind of exercise habits for which a BWT program is useful will help to create an exercise guidance program that is tailored to the subjects.

Therefore, this study was conducted for the purpose of examining the kind of exercise habits in middle-age and older

women for which a BWT program is useful, from the implementation rate of BWT program, body composition, amount of physical activity, intensity of physical activity, biochemical examination of blood, etc.

II. Methods

1. Subjects

The subjects were 32 middle-age or older women (age 64.0 \pm 3.5 years) who consented to participate in diabetes prevention classes ("classes" hereinafter) in H City in 2009, from among 712 women who received a specific health checkup in H City in 2008 and who met all the criteria of age 40 to 69 years, HbA1c of at least 5.2% but less than 6.1%, not taking medication for diabetes, not subjects of specific health guidance, and able to perform exercise.

Table 1 Content of 3-minute Exercises

Item	Content
1	Neck stretching (left and right 20 sec each)
2	Side stretching (left and right 20 sec each)
3	Shoulder rotations (10 times)
4	Stepping in place (30 times)
5	Back exercise (rowing) (10 times)
6	Rising from a chair (10 times)

Table 2 Exercise Content of Daily Calendar

Item	Content	Item	Content
1	Abdominal exercise (knee lifts in a chair)	17	Lower body exercise (knee-ups)
2	Shoulder exercise (shoulder rotation)	18	Rest day
3	Lower body exercise (hip lifts)	19	Stomach exercise (stomach gazing in a chair)
4	Rest day	20	Upper body exercise (pressing palms together)
5	Shoulder exercise (shoulder shrugs)	21	Lower body exercise (leg extensions)
6	Lower body exercise (abductions)	22	Lower body/back exercise (knee-ups & rowing)
7	Arm exercise (arm curls)	23	Stomach exercise (twisting in a chair)
8	Lower body exercise (squats)	24	Upper body exercise (wall push-ups)
9	Trunk and pelvis exercise (dog and cat)	25	Rest day
10	Shoulder exercise (shoulder presses)	26	Calf exercises (calf raises)
11	Rest day	27	Back exercise (pull down)
12	Upper body exercise (shoulder press & pull down)	28	Shin exercise (toe-ups)
13	Trunk exercise (diagonal limb stretching)	29	Upper body exercise (chest tension, back stretching)
14	Lower body exercise (adductions)	30	Stomach exercise (trunk curls)
15	Rest day	31	Rest day
16	Back exercise (rowing)		

2. BWT Program

The BWT program consisted of 3-minute exercises (a combination of stretching and body weight training) and a daily calendar (photos and explanations of different body weight training exercises for each day in the form of a calendar). The content of the BWT program is shown in Tables 1 and 2.

3. Overview of Classes

The period of classes was about 5 months from June to November 2009. In the first class, practical guidance on the BWT program was provided, and the subjects were instructed to practice every day during the period of classes. The contents of exercise guidance other than the BWT program were stretching and check of walking form, exercises using a mini-ball, walking practice, and exercises using a PET bottle (500 ml). These were each instructed once collectively.

4. Evaluation Items

1) Survey of exercise frequency

Surveys were conducted at the start and completion of classes on the frequency of exercising per week. Responses were taken after explaining that exercise meant intentional exercise, not including housework (cooking, washing, cleaning, etc.) or physical labor (farming, carpentry, etc.).

2) BWT program implementation survey

Subjects recorded whether they implemented the BWT program every day on a self-check sheet.

3) Survey of body composition, amount of physical activity, intensity of physical activity, biochemical examination of blood, and diet

At the start and completion of classes, measurement of body composition, amount and intensity of physical activity, biochemical examination of blood, and survey of frequency of food intake were conducted. For body composition, body weight, body fat percentage, amount of body fat, fat-free mass and BMI were measured using a body composition analyzer (TANITA BC-I18D). Amount and intensity of physical activity were measured with an accelerometer (Kenz Lifecorder EX, SUZUKEN). 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 classes and 1 week before the final class, and average values were obtained. Because the accelerometer recorded physical activity every 4 seconds and classified its intensity as grade 0-9 from acceleration and frequency, intensity of physical activity was taken as low (grades 1-3),

moderate (grades 4-6) or high (grades 7-9), and average activity times were obtained. Amount of exercise said to be the total energy expenditure at intensity grades 4-9. Samples for biochemical examination of blood were collected from the cubital vein, fasting and at rest. Fasting blood glucose, HbA1c, total cholesterol, HDL cholesterol and triglycerides were measured. For the survey of frequency of food intake, energy intake was calculated using Excel Eiyokun FFQg Ver. 3.0.

5. Analytic Method

Subjects were divided into three groups: those who did not exercise according to the survey of exercise frequency at the starting of class (non-exercise group), those who exercised once or twice a week (1-2 times/week group) and those who exercised three or more times a week (3 times or more/week group). Then the implementation rates of the 3-minute exercises and daily calendar, body composition before and after classes, amount of physical activity, intensity of physical activity, and biochemical examination of blood were compared. Changes in the frequency of exercise before and after the classes were also examined. Implementation of the BWT program was taken as the percentage of times of entry in the self-check sheet during the possible 131 days.

6. Statistical Processing

Items measured before and after classes were compared by paired t-test. Comparison of three groups was done by one-way analysis of variance, and Scheffe's test was conducted if significance was observed. Pearson's correlation coefficient was used for the correlation of BWT program implementation rate. Frequency of exercise was compared by Wilcoxon signed rank test. The level of significance was less than 5%.

7. Research Ethics

Because this study used humans as the subjects of research, it was conducted with the approval of Osaka Prefecture University Research Ethics Committee (Approval No. 09-306), the purpose of the study was fully explained to the subjects, and informed consent was obtained.

III . Results

1. Survey of the Frequency of Exercise at the Start of the Classes

In the frequency of exercise at the start of classes, there were 11 women who did not exercise, 7 who exercised once or twice a week, and 14 who exercised three or more times a week.

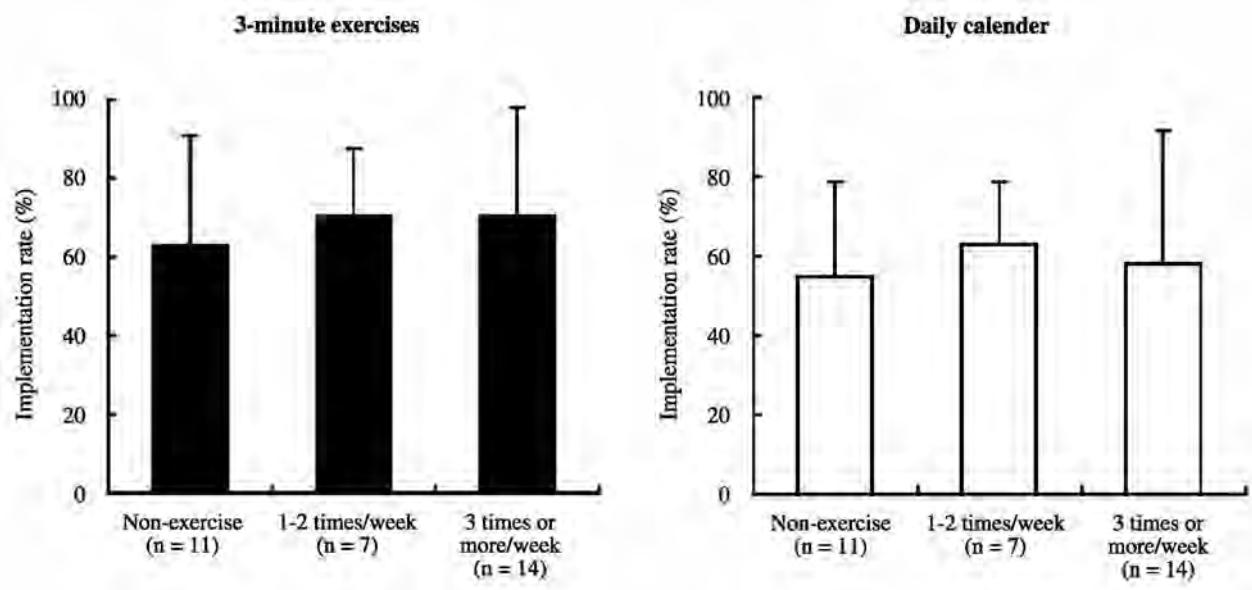


Fig. 1 BWT program implementation rates

2. BWT Program Implementation Rate

The mean number of implementations and mean implementation rate of the BWT program among all subjects during 131 days were 88.7 ± 33.2 times and $67.7 \pm 25.3\%$ for the 3-minute exercise, and 76.0 ± 35.0 times and $58.0 \pm 26.7\%$ for the daily calendar. Implementation rates of the two programs showed strong correlation ($r=0.808$, $p<0.001$). BWT program implementation rates in the three groups of exercise frequency are shown in Fig. 1. Mean implementation rates for the 3-minute exercise were $62.8 \pm 27.9\%$ in the non-exercise group, $70.3 \pm 17.1\%$ in the 1-2 times/week group, and $70.3 \pm 27.7\%$ in the 3 times or more/week group. Mean implementation rates for the daily calendar were $54.8 \pm 23.9\%$ in the non-exercise group, $63.0 \pm 15.8\%$ in the 1-2 times/week group, and $58.0 \pm 33.6\%$ in the 3 times or more/week group. No significant difference was observed between any of the three groups.

3. Comparison of Body Composition, Amount of Physical Activity, Intensity of Physical Activity, Biochemical Examination of Blood and Energy Intake Before and After Classes

Results of body composition, amount of physical activity, intensity of physical activity, biochemical examination of blood and energy intake before and after classes are shown in Table 3 by frequency of exercise.

1) Body composition

In the non-exercise group, body weight, body fat percentage, amount of body fat and BMI all showed significant decreases. In the 1-2 times/week group, body weight and body

fat percentage did not show significant decreases. In the 3 times or more/week group, body weight decreased significantly, but body fat percentage did not show significant decrease. No difference between the three groups was observed in any item. Changes in body composition are shown in Fig. 2. The amount of body weight decrease was highest in the non-exercise group at -2.3 ± 1.0 kg, and significant difference was observed between the three groups.

2) Amount of physical activity

In the non-exercise group, the number of steps increased 12.1%, amount of exercise 16.9% and total energy expenditure 0.4%. In the 1-2 times/week group, the rate of increase in the number of steps increased, amount of exercise and total energy

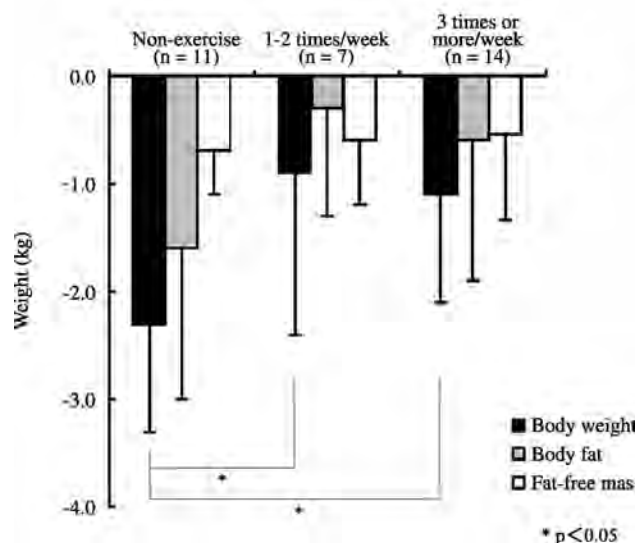


Fig. 2 Changes in body weight, total body fat and fat-free mass before/after classes

Table 3 Body Composition, Physical Activity, Biochemical Examination of Blood and Energy Intake Before and After Classes

	All subjects (n=32)				Non-exercise (n=11)				1-2 times/week (n=7)				3 times or more/week (n=14)			
	Before class		After class		Before class		After class		Before class		After class		Before class		After class	
	Age 64.0 ± 3.5				Age 62.1 ± 4.3				Age 63.6 ± 2.0				Age 65.6 ± 2.6			
Body composition																
Height (cm)	153.4 ± 5.2	—	—	—	153.6 ± 4.7	—	—	—	149.8 ± 4.4	—	—	—	155.0 ± 5.3	—	—	—
Weight (kg)	49.4 ± 5.4	47.9 ± 5.5***	48.7 ± 3.7	46.3 ± 3.7***	48.7 ± 3.7	46.3 ± 3.7***	47.8 ± 3.8	46.9 ± 3.9	47.8 ± 3.8	46.9 ± 3.9	46.9 ± 3.9	50.7 ± 7.0	49.5 ± 6.9**	—	—	—
BMI (kg/m ²)	21.0 ± 1.9	20.3 ± 1.9***	20.7 ± 1.9	19.7 ± 1.8***	20.7 ± 1.9	19.7 ± 1.8***	21.3 ± 1.4	20.9 ± 1.5	21.3 ± 1.4	20.9 ± 1.5	20.9 ± 1.5	21.0 ± 2.3	20.6 ± 2.2**	—	—	—
Body fat percentage (%)	28.7 ± 5.5	27.7 ± 5.5*	27.4 ± 6.2	25.3 ± 5.7*	27.4 ± 6.2	25.3 ± 5.7*	30.2 ± 4.2	30.0 ± 4.7	30.2 ± 4.2	30.0 ± 4.7	30.0 ± 4.7	29.0 ± 5.8	28.4 ± 5.3	—	—	—
Amount of body fat (kg)	14.4 ± 3.9	13.5 ± 3.9**	13.5 ± 3.4	11.9 ± 3.2**	13.5 ± 3.4	11.9 ± 3.2**	14.5 ± 2.9	14.2 ± 3.1	14.5 ± 2.9	14.2 ± 3.1	14.2 ± 3.1	15.0 ± 4.7	14.4 ± 4.5	—	—	—
Fat-free mass (kg)	35.0 ± 2.9	34.4 ± 2.8***	35.2 ± 2.6	34.5 ± 2.5***	35.2 ± 2.6	34.5 ± 2.5***	33.3 ± 1.9	32.7 ± 2.0*	33.3 ± 1.9	32.7 ± 2.0*	32.7 ± 2.0*	35.7 ± 3.3	35.2 ± 3.1*	—	—	—
Amount of physical activity																
Walking (steps)	10038.6 ± 2723.0	10553.9 ± 3369.5	9215.7 ± 2713.8	10330.8 ± 2770.1	9215.7 ± 2713.8	10330.8 ± 2770.1	8521.7 ± 2384.4	9250.1 ± 2878.3	8521.7 ± 2384.4	9250.1 ± 2878.3	9250.1 ± 2878.3	11443.6 ± 2335.4	11381.2 ± 3956.5	—	—	—
Exercise (kcal)	215.7 ± 76.6	237.1 ± 96.2	196.1 ± 70.7	229.2 ± 81.1	196.1 ± 70.7	229.2 ± 81.1	170.9 ± 55.2	184.9 ± 52.4	170.9 ± 55.2	184.9 ± 52.4	184.9 ± 52.4	253.5 ± 76.3	269.5 ± 114.4	—	—	—
Total energy expenditure (kcal)	1624.5 ± 151.1	1632.9 ± 200.7	1605.3 ± 93.6	1612.5 ± 116.4	1605.3 ± 93.6	1612.5 ± 116.4	1539.5 ± 68.0	1531.1 ± 63.4	1539.5 ± 68.0	1531.1 ± 63.4	1531.1 ± 63.4	1682.1 ± 194.4	1699.8 ± 270.2	—	—	—
Energy expenditure per 1kg body weight (kcal/kg)	33.0 ± 2.1	34.4 ± 4.9	33.1 ± 2.1	34.9 ± 2.0**	33.1 ± 2.1	34.9 ± 2.0**	32.4 ± 2.7	32.9 ± 3.4	32.4 ± 2.7	32.9 ± 3.4	32.9 ± 3.4	33.3 ± 2.0	34.8 ± 6.8	—	—	—
Intensity of physical activity																
Low (min)	74.3 ± 21.7	68.3 ± 22.8*	65.7 ± 16.4	60.5 ± 13.5	65.7 ± 16.4	60.5 ± 13.5	69.0 ± 13.9	69.3 ± 14.9	69.0 ± 13.9	69.3 ± 14.9	69.3 ± 14.9	83.7 ± 25.5	73.9 ± 30.2	—	—	—
Moderate (min)	28.7 ± 15.2	35.5 ± 18.9*	25.6 ± 16.7	36.6 ± 18.6*	25.6 ± 16.7	36.6 ± 18.6*	21.6 ± 10.8	27.3 ± 15.0	21.6 ± 10.8	27.3 ± 15.0	27.3 ± 15.0	34.6 ± 14.5	38.7 ± 20.8	—	—	—
High (min)	2.3 ± 2.5	3.1 ± 3.5*	2.9 ± 3.1	3.7 ± 3.8	2.9 ± 3.1	3.7 ± 3.8	1.6 ± 1.3	1.0 ± 0.6	1.6 ± 1.3	1.0 ± 0.6	1.0 ± 0.6	2.3 ± 2.6	3.7 ± 3.8	—	—	—
Blood biochemical exam.																
Blood glucose (mg/dl)	101.3 ± 16.2	94.9 ± 11.7*	99.0 ± 17.1	96.9 ± 14.9	99.0 ± 17.1	96.9 ± 14.9	103.4 ± 13.0	91.7 ± 9.3*	103.4 ± 13.0	91.7 ± 9.3*	91.7 ± 9.3*	102.1 ± 17.7	95.0 ± 10.2	—	—	—
HbA1c (%)	5.5 ± 0.6	5.4 ± 0.4	5.8 ± 0.9	5.6 ± 0.5	5.8 ± 0.9	5.6 ± 0.5	5.2 ± 0.3	5.3 ± 0.2*	5.2 ± 0.3	5.3 ± 0.2*	5.3 ± 0.2*	5.4 ± 0.3	5.3 ± 0.3	—	—	—
Total cholesterol (mg/dl)	260.3 ± 39.0	242.1 ± 35.5*	274.6 ± 31.7	233.4 ± 38.2*	274.6 ± 31.7	233.4 ± 38.2*	256.3 ± 30.0	240.9 ± 30.0	256.3 ± 30.0	240.9 ± 30.0	240.9 ± 30.0	250.9 ± 46.4	249.5 ± 36.6	—	—	—
HDL cholesterol (mg/dl)	77.9 ± 16.8	76.9 ± 17.1	78.6 ± 17.1	75.8 ± 20.2	78.6 ± 17.1	75.8 ± 20.2	79.7 ± 10.1	77.6 ± 9.9	79.7 ± 10.1	77.6 ± 9.9	77.6 ± 9.9	76.5 ± 19.8	77.4 ± 18.3	—	—	—
Triglycerides (mg/dl)	147.9 ± 82.2	88.1 ± 38.9***	158.6 ± 84.1	93.6 ± 51.3*	158.6 ± 84.1	93.6 ± 51.3*	111.3 ± 26.2	75.7 ± 31.0*	111.3 ± 26.2	75.7 ± 31.0*	75.7 ± 31.0*	157.8 ± 97.1	90.1 ± 32.1**	—	—	—
Energy intake																
Energy intake (kcal)	2166.1 ± 482.7	1940.0 ± 340.7**	2174.2 ± 417.8	1960.2 ± 475.9	2174.2 ± 417.8	1960.2 ± 475.9	2070.3 ± 296.4	2029.9 ± 97.8	2070.3 ± 296.4	2029.9 ± 97.8	2029.9 ± 97.8	2207.6 ± 611.6	1879.2 ± 251.0*	—	—	—
Energy intake per 1kg body weight (kcal/kg)	44.1 ± 9.2	41.0 ± 8.1*	44.7 ± 7.5	42.3 ± 9.4	44.7 ± 7.5	42.3 ± 9.4	43.6 ± 7.9	43.7 ± 8.5	43.6 ± 7.9	43.7 ± 8.5	43.7 ± 8.5	43.9 ± 11.4	38.5 ± 6.5*	—	—	—

Mean ± S.D.
 * p<0.05, ** p<0.01, *** p<0.001

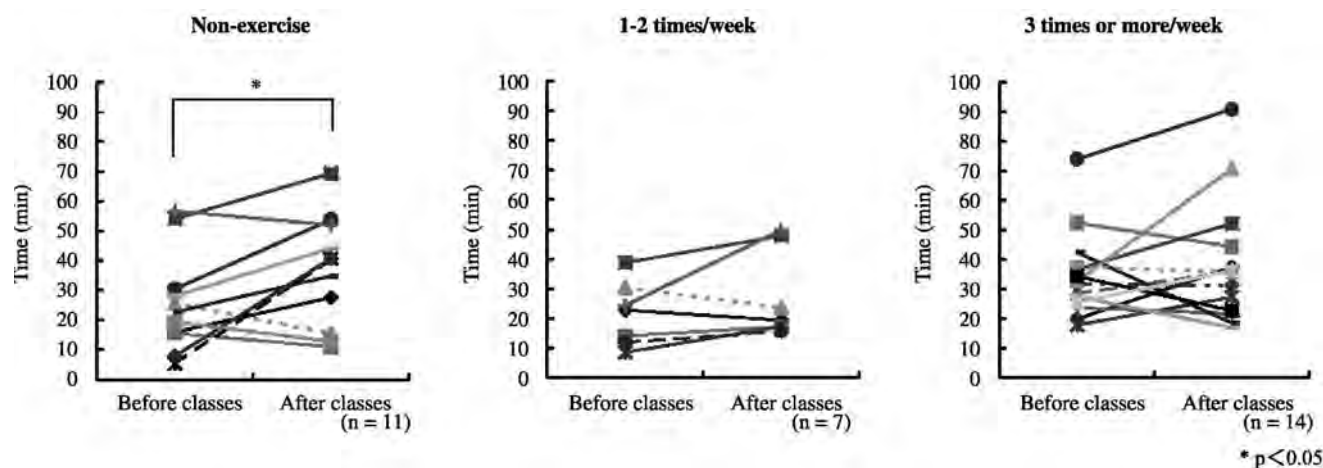


Fig. 3 Time of activity of moderate intensity before/after classes

expenditure was 8.5%, 8.2% and -0.5%, respectively. In the 3 times or more/week group, the rate of increase in the number of steps increased, amount of exercise and total energy expenditure was -0.5%, 6.3% and 1.1%. Significant increase was not observed in any group, and there was no significant difference between any of the three groups. However, the non-exercise group showed significant increase in energy expenditure per kg of body weight at 5.4% ($p < 0.05$).

3) Intensity of physical activity

Times of activity of moderate intensity before and after the classes are shown in Fig. 3. Time of activity of moderate intensity increased significantly only in the non-exercise group ($p < 0.05$). The rate of increase was 43.0%. Time of activity of moderate intensity increased 26.4% in the 1-2 times/week group and 11.8% in the 3 times or more/week group. There was no significant difference between any of the three groups.

4) Biochemical examination of blood

In the non-exercise group, triglycerides decreased 41.0 % and total cholesterol decreased 15.0% ($p < 0.05$). In the 1-2 times/week group, blood glucose decreased 11.3% ($p < 0.05$) and triglycerides decreased 32.0% ($p < 0.05$). In the 3 times or more/week group, only triglycerides showed a decrease of 42.9% ($p < 0.01$). There was no significant difference between any of the three groups.

5) Energy intake

No significant decrease was observed in the non-exercise group or 1-2 times/week group. In the 3 times or more/week group, energy intake per kg of body weight significantly decreased ($p < 0.05$). There was no significant difference

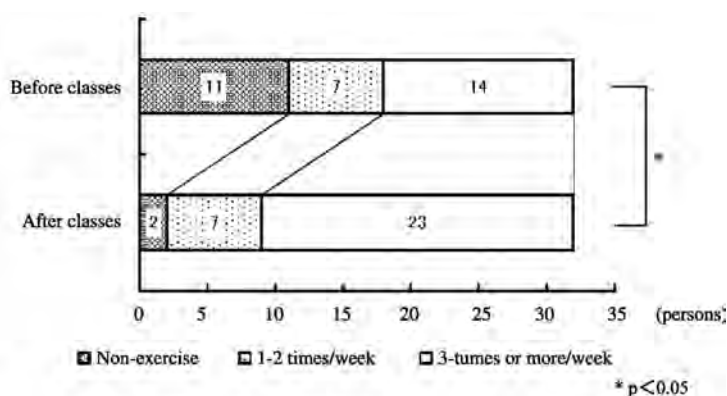


Fig. 4 Frequency of exercise before and after classes

between any of the three groups.

4. Frequency of Exercise at the End of Classes

Frequency of exercise per week before and after classes is shown in Fig. 4. There were 11 subjects who did not exercise before the classes, which decreased to 2 subjects after the classes, and the frequency of exercise significantly increased ($p < 0.05$). Of these 11 subjects, 7 (63.6%) exercised 3 times a week or more after the classes.

IV. Discussion

When creating an exercise guidance program for the purpose of preventing or improving lifestyle-related diseases, it is important to understand the frequency of exercise among the class participants. This is because it enables the specific prediction of the kind of exercise program which needs to be presented. Kiuchi et al.¹⁶⁾ report that in the field of health education, aside from the approach of sports science, a concrete and feasible behavioral science approach is also needed. Sallis et al.¹⁷⁾ report that in dealing with barriers to

physical activity, for example if it is raining when one planned to go walking, it is also useful to formulate some way of overcoming the barrier to physical activity beforehand. In order to clarify the kind of exercise habits for which a BWT program devised in consideration of these points is useful, we compared and examined the implementation rate of the BWT program, as well as body composition, amount of physical activity and intensity of physical activity, according to frequency of exercise.

1. Implementation of the BWT Program

The number of times per week that the BWT program was implemented by all subjects was about 4.7 times for the 3-minute exercise and about 4.1 times for the daily calendar. This suggests that the BWT program is an exercise program which can be implemented in daily life. The implementation rates of the two programs were strongly correlated, demonstrating that both can be similarly implemented.

The 3-minute exercise is a brief, manualized program, and it is reported that an easily manualized program is easily mastered even if the practitioner is a beginner¹⁵⁾. The implementation rate of the 3-minute exercise program showed no difference due to exercise habits, suggesting that it can be mastered even by people who are not in the habit of exercising, similar to previous research¹⁸⁾.

Unlike the 3-minute exercise, the exercises in the daily calendar differ every day. Therefore, it was thought that the exercises would be more complicated and difficult to continue. However, the results showed strong correlation with the 3-minute exercise. Nomura et al.¹⁹⁾ have reported that attaching a message banner to the stairs to encourage use of the stairs tended to increase the number of people using the stairs. By hanging the daily calendar on the wall, it presumably becomes a banner of exercise enlightenment, perhaps leading to implementation of the exercises.

All of which suggests that the BWT program can be an effective means of encouraging middle-age and older women who are not in the habit of exercising.

2. Body Composition, Biochemical Examination of Blood

Decrease in body weight and body fat percentage was highest in the non-exercise group. This suggests that physical activity became more vigorous than previously by implementing the BWT program, and that energy consumption was increased. However, there was no significant decrease in body fat percentage in the 1-2 times/week group or the 3 times or more/week group. This may be because they were already exercising regularly before the classes, and the BWT program did not provide exercise which especially exerted a load.

However, the exercise intensity of the BWT program was not examined in this study, and must be further investigated.

In biochemical examination of blood, blood glucose, total cholesterol and triglycerides significantly decreased in all participants. Triglycerides especially decreased in all three groups, and total cholesterol also decreased in tandem in the non-exercise group. When a registered dietician provides nutrition education to people who are not exercising under specific health guidance, proposing an easily implemented BWT program or body weight training may be expected to improve values in biochemical examination of blood.

3. Amount and Intensity of Physical Activity

The CDC/ACSM²⁰⁾ recommends at least 30 minutes a day of moderate physical activity. The non-exercise group did not meet the recommended standard before the classes, but significantly increased after the classes and met the recommended standard along with the 3 times or more/week group. In the increased time of activity of moderate intensity in the non-exercise group, strengthening of the muscle groups involved in walking was presumably one factor. In a previous study with women as subjects, it is reported that there is significant correlation between the cross-section area of the psoas major and femoral extensor group and walking speed²¹⁾. The 3-minute exercises include stepping in place and rising from a chair, which are strengthening exercises for muscles involved in walking such as the psoas major and femoral extensor group. For improvement in the amount and intensity of physical activity among people without the habit of exercising, an approach of continuing exercises which use muscle groups involved in walking such as the 3-minute exercises is presumably useful.

4. Increased Frequency of Exercise at the End of the Classes

One factor in the increased frequency of exercise after the classes is probably enlightenment about exercise from implementing the BWT program. However, since improved motivation to exercise due to participation in the classes is also possible, further study of factors in increasing the frequency of exercise is needed.

V. Conclusion

Implementation of the BWT program by middle-age and older women who do not exercise was suggested to be useful in decreasing body weight and body fat percentage, increasing the time of physical activity of moderate intensity, and increasing the frequency of exercise. Therefore, body weight training is

thought to be an effective means of encouraging middle-age and older women who do not exercise to exercise. In order to generalize, further investigation of the factors increasing exercise intensity and frequency of exercise in the BWT program will be needed.

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