J. Phys. Ther. Sci. 32: 156–160, 2020

The Journal of Physical Therapy Science

Original Article

Intervention using behavior modification techniques to improve the lifestyle of high-risk metabolic syndrome patients

Rika Mangyo, RPT, PhD[1)*], Takeshi Arai, RPT, PhD[1)]

[1)] *Department of Physical Therapy, Faculty of Health Sciences, Mejiro University: 320 Ukiya, Iwatsuki-ku, Saitama-shi, Saitama 339-8501, Japan*

Abstract. [Purpose] The present study examined the effects of a 12-week intervention combined with behavior modification techniques to improve the lifestyle and biochemical indicators, of high-risk metabolic syndrome patients. [Participants and Methods] The 21 participants (10 participants in the intervention group and 11 participants in the control group) were provided with information about metabolic syndrome. Participants in the intervention group were asked to set goals to improve their lifestyle (dietary and exercise) and their self-efficacy. The participants completed and submitted a weekly, self-monitoring sheet and were provided with feedback on their lifestyle. [Results] Following intervention, the values of body mass index and abdominal circumference were significantly lower for the intervention group as compared to the control group. There were no differences in the total physical activity level, total energy intake, or blood levels of lipids between the two groups. [Conclusion] According to Motivational Interviewing, to modify and continue behaviors, it is important for people to recognize "their significance" and have "confidence". In the present study, information about metabolic syndrome was provided to enable the recognition of the importance of behaviors. Moreover, participants in the intervention group were required to set goals to increase their self-efficacy. We attribute the participants' weight loss and decrease in abdominal circumference to this.

Key words: Behavior change, Lifestyle modification, Metabolic syndrome

(This article was submitted Aug. 1, 2019, and was accepted Nov. 28, 2019)

INTRODUCTION

A state in which metabolic errors, such as hyperglycemia, hypertension, and dyslipidemia accumulate due to visceral fat-type obesity is termed metabolic syndrome. Abdominal visceral adipose cell accumulation affects adipocytokine secretion, deteriorating arteriosclerosis, hyperglycemia, hypertension, and dyslipidemia. Although there are no symptoms, the risk of heart disease in persons with three to four factors for metabolic syndrome is more than 30 times higher than in those without them[1)]; therefore, this disorder is called a silent killer. According to the National Health and Nutrition Survey in 2007, persons for whom metabolic syndrome is strongly suspected (those meeting the abdominal circumference and two or more other factors) and high-risk persons (those meeting the abdominal circumference and another factor), one of every two Japanese males aged 40 to 74 years and one of every five females are estimated to meet these criteria[2)].

To inhibit an increase in the number of patients with metabolic syndrome, preventive strategies for high-risk persons may be effective. A basic countermeasure against metabolic syndrome is to reduce abdominal obesity. For this purpose, it is important to improve the primary etiological factors for abdominal obesity, lifestyle-related factors, such as diet and exercise. However, as this disorder is asymptomatic, patients do not feel inconvenience in daily living; therefore, it is difficult for many

*Corresponding author. Rika Mangyo (E-mail: mangyo@mejiro.ac.jp)

patients to start or continue behaviors to improve lifestyle-related factors. In an interventional study recently conducted in the United States regarding the prevention of diabetes mellitus involving high-risk patients (the Diabetes Prevention Program)[3], knowledge to improve lifestyle-related factors was given, and guidance was performed using "behavior change theory" techniques, such as methods to overcome problems, leading to successful results. Rollnick et al. proposed motivational interviewing[4], which is a part of behavioral modification theory, in which two factors are considered necessary for the target behavior to be initiated and continued. First, the patient must strongly feel that it is important to perform the target behavior; second, the patient must have a high level of confidence in being able to perform the target behavior. In this study, we examined the effects of lifestyle improvements on abdominal obesity through an intervention applying behavior change techniques with persons with abdominal obesity.

PARTICIPANTS AND METHODS

The participants were teachers, aged 30 years or older, working for University A and meeting a diagnostic criterion for metabolic syndrome (essential item, abdominal circumference: ≥85 and ≥90 cm for males and females, respectively). In addition, conditions for participation included the absence of metabolic syndrome and no drug therapy for hyperglycemia, hypertension, or dyslipidemia. Participants were recruited by delivering leaflets or directly approaching them. The 21 study participants were randomly divided into two groups: Intervention (n=10, 9 males, 1 female, mean age: 41.8 ± 9.2 years) and control (n=11, 11 males, mean age: 44.8 ± 11.9 years) groups (Fig. 1).

Initially, leaflets summarizing metabolic syndrome and the purpose/methods/effects of improving lifestyle-related factors were delivered to the two groups as "knowledge provision" (Fig. 2). This intervention was conducted to improve the participants' belief in the importance of improving one's lifestyle habits by understanding the correct information. The study period was 12 weeks. The contents of intervention were as follows: (1) In the intervention group, the participants were instructed to establish one to two target activities to improve exercise and diet based on the results of a survey regarding lifestyle; their contents were arranged so that the self-efficacy was high (self-confidence in practicing such activities: ≥95%). Given that it would be easier to perform the target activities when one's sense of self-efficacy becomes higher, this study guided participants to set a goal with a high self-efficacy. The contents were reviewed every four weeks. (2) They were instructed to record the degree of target achievement, body weight, number of steps, abdominal circumference, and comments in a self-recording table (Fig. 3) every day (abdominal circumference: once a week) and submit it by e-mail once a week. (3) Based on the contents of the self-recorded table, investigators praised the participants' activities and advised them to review the merits and limitations of their behavioral patterns by e-mail. The feedback session was conducted every week (a total of 12 times). For example, one participant went to a shopping mall over the weekend, and was particularly active. Researchers asked, "Why did you take so many steps this weekend?". Another ate too much during business trips. Researchers asked, "Do you have a good way to deal with overeating during business trips?".

Measurement was performed at the start and completion (after 12 weeks) of this study. For behavioral measurement, the total physical activity level (International Physical Activity Questionnaire (IPAQ)) and total energy intake (Food Frequency Questionnaire) were calculated. Among lipids in the blood, the levels of total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), and triglyceride (TG) were measured. Finally, abdominal circumference was measured and the body mass index (BMI) was calculated from the height and body weight.

Mann-Whitney U-test was used to compare the basic characteristics of the two groups at the start of the study and the changes in measurements at the completion of this study in comparison with those at its start between the two groups. A

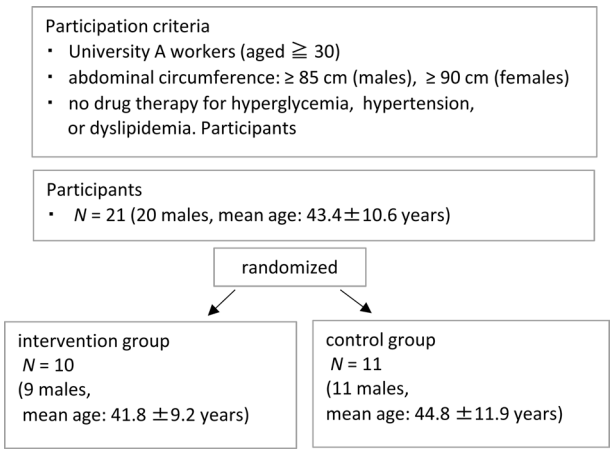

Fig. 1. Flow chart of participant recruitment.

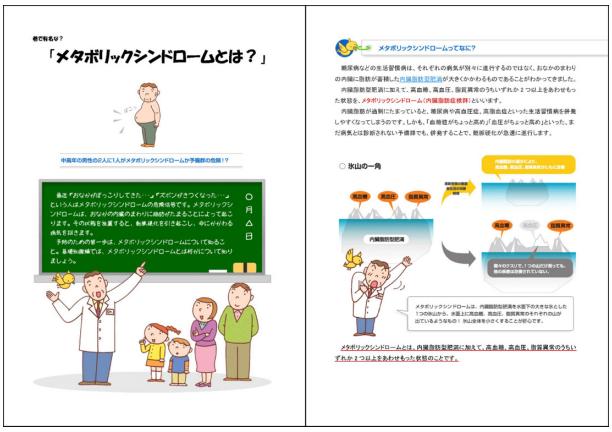

Fig. 2. Leaflets (summarizing metabolic syndrome).

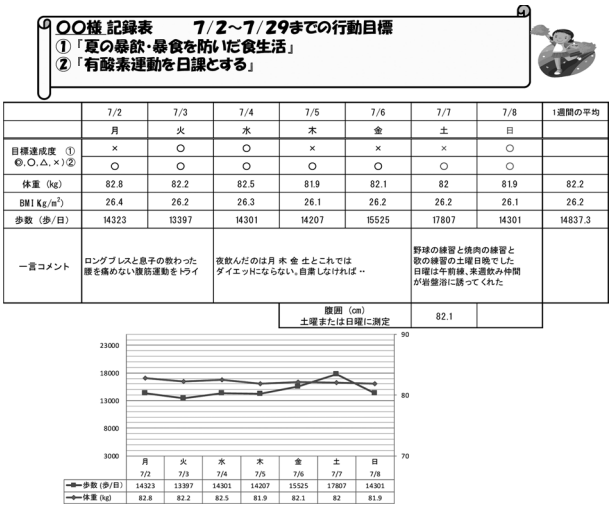

Fig. 3. Self-recording table.

p-value of 0.05 was regarded as significant. For analysis, we used IBM SPSS Statistics 22.0 software.

Before conducting the study, the protocol was approved by the Ethics Review Board of Mejiro University. After explaining the outline, purpose, advantages, and disadvantages of this study to participants verbally and using documents, only those who gave informed consent by signing a consent from were enrolled as study participants.

RESULTS

Table 1 presents baseline and the changes in body weight, BMI, abdominal circumference, total physical activity level, total energy intake, and blood levels of lipids at the completion of this study relative to the values at the start of this study. Baseline data showed no differences between the two groups in any parameter. The mean weigh of the intervention and control groups at the start and after the intervention were 82.9 (SD 10.4) vs. 81.6 (SD 8.6) kg and 79.7 (SD 11.3) vs. 80.8 (SD 8.4) kg. The mean BMI of the intervention and control groups at the start and after the intervention were 28.8 (SD 5.4) vs. 28.1 (SD 3.3) kg/m^2 and 27.9 (SD 5.7) vs. 27.9 (SD 3.2) kg/m^2. The mean abdominal circumference of the intervention and control groups at the start and after the intervention were 97.0 (SD 12.5) vs. 95.5 (SD 7.1) cm and 93.6 (SD 11.4) vs. 96.7 (SD 6.4) cm. The changes in body weight in the intervention and control groups were −3.2 and −0.8 kg, respectively; in BMI they were −0.9 and −0.2 kg/m^2, respectively; and in abdominal circumference they were −3.4 and 1.2 cm, respectively. In the intervention group, the body weight, BMI, and abdominal circumference significantly decreased in comparison with the control group (p=0.013, p=0.013, and p=0.001, respectively). There were no differences in the changes in the total physical activity level, total energy intake, or blood levels of lipids between the two groups.

DISCUSSION

A total of 21 participants at risk of developing metabolic syndrome were provided with a summary of the disease and its prevention. Following this, the intervention group set target behaviors aimed at improving their lifestyle that had a self-efficacy of 95% or more. Moreover, self-monitoring of target behavior was performed, and the researchers provided feedback once a week. After 12 weeks of intervention, the intervention group's body weight (kg), BMI (kg/m^2), and abdominal circumference improved compared with the control group, which had only been provided with information.

Because metabolic syndrome and diabetes are conditions with few subjective symptoms, it is often difficult to motivate patients to improve their lifestyle, even when given guidance to do so. To help patients maintain lifestyle improvements, techniques from behavioral modification theory were taught in addition to simply instructing patients on methods. For example, for a male participant who ate lots of high-calorie western foods, such as hamburgers, because he had a small child and could not easily change the menu, his goal was set as "to eat vegetables during meals". In his feedback, behaviors that the participant was able to perform were praised, providing him with information that matched his lifestyle (e.g., informing him that fruit juices are surprisingly high in calories). As a result, the calories consumed decreased by 300 kcal/day on average, with his weight decreasing by approximately 2 kg. The weight loss might improve the participant's back pain, further reinforcing his habits . Furthermore, with a male participant whose goal was "to do aerobic exercise everyday", his step count exceeded over 15,000 steps/day on average. In his feedback, he was praised for having done the most exercise of all the participants. By increasing his step count, his confidence improved, prompting him to take up weight training and

Table 1. Baseline and post-intervention data

	Intervention (n=10, males 9, female 1)		Difference between baseline and after 12 weeks	Control (n=11, males 11)		Difference between baseline and after 12 weeks	p-values
	Baseline	After 12 weeks		Baseline	After 12 weeks		
	Mean (SD)			Mean (SD)			
Age (years)	41.8 (9.2)			44.8 (11.9)			0.672
Height (cm)	169.8 (8.2)			170.4 (4.5)			0.86
Weight (kg)	82.9 (10.4)	79.7 (11.3)	−3.2	81.6 (8.6)	80.8 (8.4)	−0.8	0.013*
Body mass index (kg/m^2)	28.8 (5.4)	27.9 (5.7)	−0.9	28.1 (3.3)	27.9 (3.2)	−0.2	0.013*
Abdominal circumference (cm)	97.0 (12.5)	93.6 (11.4)	−3.4	95.5 (7.1)	96.7 (6.4)	1.2	0.001**
Total physical activity (Mets•minutes/week)	1,691 (2,504)	1,969 (1,353)	+278	1,801 (1,054)	1,860 (1,465)	+59	0.439
Total energy intake (kcal/day)	1,968 (462)	1,792 (278)	−176	2,372 (940)	2,340 (498)	−32	0.526
Total cholesterol (mg/dL)	198 (23)	187 (26)	−11	194 (30)	180 (22)	−14	0.972
Triglyceride (mg/dL)	127 (39)	104 (30)	−23	157 (147)	220 (218)	+63	0.113
HDL-cholesterol (mg/dL)	59 (13)	57 (11)	−2	52 (9)	50 (9)	−2	0.417

*p<0.05,**p<0.01.

to drink alcohol more moderately. As shown here, each participant was asked to reflect on their lifestyle habits, to list their problem areas, and to set an easy goal that they would be able to accomplish at least 95% of the time. As feedback, the actions the participants were able to prerform were praised, with individual messages being sent that made the participants aware of the advantage of performing the actions, as well as messages that were supportive and considerate reminding them not to overexert themselves. A person's behavior can be reinforced by improving their self-efficacy and acknowledging the benefits brought on by their actions.

Rollnick et al. proposed the motivation interview method[4] and emphasized that in order to start and continue behaviors, it is important to increase "importance and confidence". If patients do not sufficiently recognize the importance of the target behavior, it is important to provide them information to help them to understand the necessity and effectiveness of the treatment. However, it is likely that despite recognizing its importance, many patients will be unable to do so due to a lack of confidence in performing and continuing the target behavior. That is, there may be many patients who know what they have to do but feel unable to do it. Regarding the confidence of patients in performing target behaviors, Bandura[5] proposed "self-efficacy" (SE) as "the degree to which individuals estimate whether certain behavior is possible", which is used with broadly the same meaning as confidence. SE comprises four factors, namely, "performance accomplishment", "vicarious experience", "verbal persuasion", and "emotional arousal". Higher SE is associated with a greater chance of being able to perform a particular behavior. Moreover, SE is low before initiating the behavior and increases as the behavior is performed and continued. Therefore, it is effective to initiate treatment starting with a target behavior with high SE, leading to SE improvement by having the patient continue that behavior.

With reference to the characteristics of SE mentioned above, this study aimed to improve SE and achieve continuation of behaviors by having participants continuously perform target behaviors for which they have high SE (in other words, they were confident that they could perform the target behaviors). Furthermore, participants were encouraged through feedback and comments, and any issues that arose were dealt with in the way, further strengthening the behavior. As a result, the BMI and abdominal circumference of the intervention group improved over the control group.

This study had the limitation that the behavior of the control group was not recorded; therefore, it was impossible to determine the extent to which differences in lifestyles between the two groups affected the differences in BMI and abdominal circumference. In future studies, we will continue this investigation by increasing the number of participants and examining the changes in primary outcome behaviors related to disease management and prevention.

Funding

None.

Conflict of interest

In this study, no conflicts of interest are declared by the author.

REFERENCES

1) Nakamura T, Tsubono Y, Kameda-Takemura K, et al. Group of the Research for the Association between Host Origin and Atherosclerotic Diseases under the Preventive Measure for Work-related Diseases of the Japanese Labor Ministry: Magnitude of sustained multiple risk factors for ischemic heart disease in Japanese employees: a case-control study. Jpn Circ J, 2001, 65: 11–17. [Medline] [CrossRef]
2) Ministry of Health, Labour and Welfare. Outline for the results of the National Health and Nutrition Survey Japan, 2007. http://www.nibiohn.go.jp/eiken/english/research/pdf/nhns2007.pdf (Accessed Feb. 29, 2019)
3) Knowler WC, Barrett-Connor E, Fowler SE, et al. Diabetes Prevention Program Research Group: Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. N Engl J Med, 2002, 346: 393–403. [Medline] [CrossRef]
4) Rollnick S, Mason P, Butler C: Health behavior change: a guide for practitioners. New York: Churchill Livingstone, 1999.
5) Bandura A: Self-efficacy: toward a unifying theory of behavioral change. Psychol Rev, 1977, 84: 191–215. [Medline] [CrossRef]