Scientific Research

The Effectiveness of Hyperlipidemia Prevention Intervention Designed to Affect Behavior Change: Focus on Changes in Health Behavior

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Abstract

Hyperlipidemia prevention intervention for behavior change was conducted on subjects in their 30s and 40s to evaluate changes in health behavior and investigate the effectiveness of these changes, with respect to early prevention and improvement of disease. Subjects were middle-aged individuals aged 30 - 49, suffering from serum lipid abnormalities. Intervention designed to affect behavior change was implemented for 3 weeks in 11 employees (nine males, two females) at five workplaces. Intervention mainly consisted of improving self-efficacy. The study's purpose was explained and the written consent was obtained from subjects. Subjects filled questionnaires (characteristics, history of present illness, health behavior, self-efficacy scale for prevention of hyperlipidemia, etc.) both before and after intervention. Subjects recorded their physical activity using accelerometers and dietary intake photographically. Each subject created realistic behavior goals and recorded their progress using self-monitoring charts. Data were analyzed using descriptive statistics; therefore, pre- and post-intervention data were compared. Physical activity and achievement rate of goals during the first week and over the next 2 - 3 weeks were compared. Health behavior scores showed modification of behavior in a desirable direction after interven-

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tion compared with those before intervention. No significant difference in self-efficacy before and after intervention was observed. However, the subscale for diet was significantly higher after intervention compared with that before intervention. Steps, total calories, and activity calories were increased in the second and third weeks compared with those in the first week. Three weeks of intervention resulted in health behavior changing in a desirable direction. We infer that intervention in the form of self-monitoring using accelerometers that make physical activity visible was effective in leading to behavior change.

Keywords

Hyperlipidemia Prevention, Middle Age, Health Behavior, Self-Efficacy, Behavior Change

1. Introduction

Hyperlipidemia is a risk factor for ischemic heart disease [1] [2]. In Japan, the number of patients with ischemic heart disease is increasing; indicating that prevention of coronary artery disorders is an important issue [3]. Hyperlipidemia is the most frequently detected illness in workplace medical examinations [4], making its prevention an important issue.

Initiatives being implemented as a part of health care in communities and workplaces to prevent hyperlipidemia have traditionally consisted of health education designed to affect behavior changes in people's lifestyles (diet and exercise). The theories of behavioral science have been applied to health education designed to affect behavior change [5]-[8]. The concept of "self-efficacy" that was proposed by Bandura (1977) within his social cognitive theory is the patient's expectation of whether they will be able to successfully carry out a behavior [9]. Increasing self-efficacy is an important part of encouraging behavior change. Self-efficacy is also a key concept in the trans-theoretical model, a behavioral science model [10].

Previous studies of the correlation between lifestyle and self-efficacy conducted in the United States since the 1980s have investigated the self-efficacy of desirable healthy behaviors as well as ceasing unhealthy behaviors. One such study elucidated the correlation between self-efficacy and changes in diet that lead to decreased serum cholesterol [11]. Other studies indicated that self-efficacy is an important factor related to physical activity [12] [13]. A study by Angotti *et al.* indicated that intervention in both diet and exercise designed to decrease serum cholesterol was effective [14]. Therefore, it is necessary to implement intervention focused on self-efficacy to verify the effectiveness of behavior change designed to prevent hyperlipidemia. We also believe that it is important to provide intervention designed to prevent hyperlipidemia at an early stage for middle-aged individuals.

The purpose of the present study was to provide middle-aged subjects aged 30 - 49 intervention designed to affect behavior change to prevent hyperlipidemia from the perspective of early prevention and improvement of disease and investigate the effectiveness when this intervention is focused on changes in health behavior.

2. Methods

2.1. Subjects

Subjects were employees aged 30 - 49 employed in Hokkaido, Japan whose medical examination results indicated that they required guidance or medical treatment for hyperlipidemia. Intervention was provided from March 2009 to April 2009 to 12 participants from five workplaces who agreed to cooperate in this study. "Requiring guidance" and "requiring medical treatment" are indicated when one or more of the following apply: 1) Total cholesterol (TC) level is 220 mg/dl or above or LDL cholesterol (LDL-C) is 140 mg/dl or above; 2) Triglyceride (TG) levels are 150 mg/dl or above; 3) HDL cholesterol (HDL-C) is 40 mg/dl or below. Those already receiving medication for hyperlipidemia and diabetes patients were exempted.

2.2. Intervention for the Purpose of Prevention of Hyperlipidemia

2.2.1. Framework and Components of Intervention

The intervention incorporated the techniques of self-monitoring and small step method to obtain four major

sources of information that improve self-efficacy: Enactive Mastery Experience, Vicarious Experience, Verbal Persuasion, and Physiological and Affective State. The program was based on individual health education that was provided three times over the course of 3 weeks. The intervention period is shortened in order to reduce the omission of participants. We set the period in reference to a short-term intervention study [15].

Health behaviors designed to prevent hyperlipidemia were diet, exercise, maintenance of appropriate weight, and self-management, which were based on the Guidelines for Prevention of Atherosclerotic Cardiovascular Diseases [16] and other guidelines. The components of health education included reducing intake of total calories and animal fats, switching to low-fat foods, increasing physical activity, regularly monitoring weight, and creating and working toward individual goals. Monitoring reports via email and fax for the purpose of making them simple and easy to submit on a continuous basis was also included. These reports made it possible to achieve behaviors and provide verbal persuasion of these achievements. An overview of intervention is provided in **Figure 1**.

2.2.2. Goals of Intervention
Intervention had four goals: 1) Motivation for health behaviors designed to prevent hyperlipidemia; 2) Understanding of specific health behavior skills; 3) Improvement of self-efficacy for health behaviors; and 4) Implementation of health behaviors.

2.3. Data Collection

2.3.1. Pre- and Post-Intervention Questionnaires
Subjects filled out self-administered questionnaires both before and after intervention. The questionnaires contained questions regarding characteristics such as sex, age, marital status, cohabitant family members, educational background, and medical history. We obtained TC levels, LDL-C levels, TG levels, and HDL-C levels from subjects' health care medical records. Body mass index (BMI) was calculated using subjects' self-reported weight and height figures.

We used the scale created by Tohnai *et al.* (1994) [17], which consists of 13 items related to diet, exercise, rest, and alcohol and tobacco use behaviors to measure health behavior. The answers were scored as follows: "Practicing" was 2 points, "Practicing sometimes" was 1 point, and "Not practicing" was 0 point. The maximum score was 26, and the minimum score was 0.

We measured self-efficacy using "The self-efficacy scale for prevention of hyperlipidemia (SESPHL)" which consists of 16 items developed in a previous study [18]. SESPHL consists of the following three subscales: "Active modification of eating" (eating SE), "exercise and activity modification without impossibility" (activity SE), and "foundation of behavior modification" (foundation SE). This scale has been confirmed to have a Cronbach's alpha of 0.855 and has both reliability and validity. Answers to each item are chosen from the following four
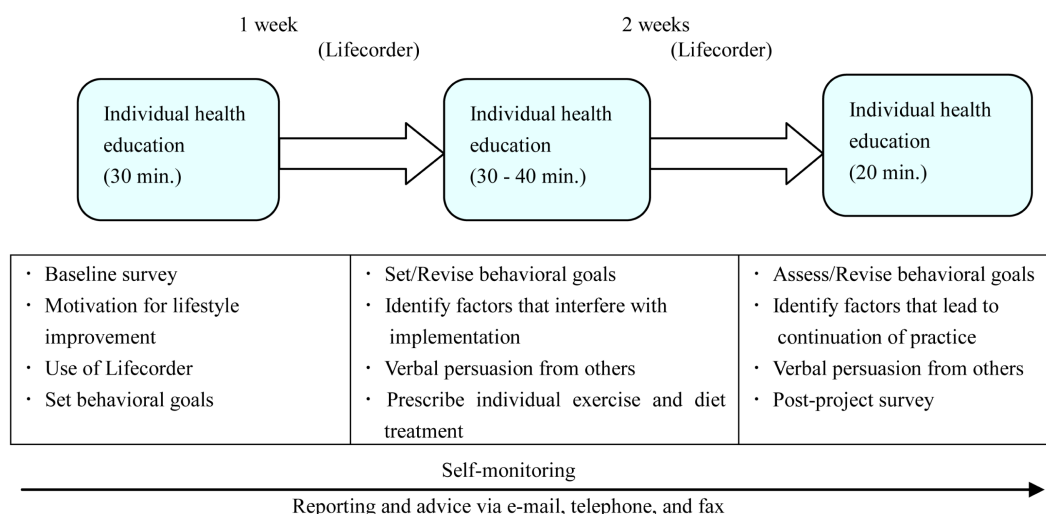

Figure 1. Program progress over 3 weeks.

selections: "Agree," "Agree somewhat," "Disagree somewhat," and "Disagree." These are scored in order from the highest to the lowest SE and assigned 4, 3, 2, or 1 point. The maximum score was 160, and the minimum score was 40.

2.3.2. Data Collection during Intervention

Physical activity: During the 3 weeks of program participation, physical activity was monitored by measuring steps, total calories, and activity calories using accelerometers (Lifecorder, Suzuken, Nagoya, Japan).

Dietary intake: Subjects recorded their dietary intake photographically while participating in the program (meal recording method). Participants who indicated reducing energy intake as one of their goals continued recording their dietary intake photographically after the program was concluded.

Self-monitoring chart: Each individual established goals toward behavior change. They recorded their progress in self-monitoring charts. The template is used to format your paper and style the text. All margins, column widths, line spaces, and text fonts are prescribed; please do not alter them. You may note peculiarities. For example, the head margin in this template measures proportionately more than is customary. This measurement and others are deliberate, using specifications that anticipate your paper as one part of the entire journals, and not as an independent document. Please do not revise any of the current designations.

2.4. Data Analysis

Of the 12 subjects who participated in this study, data from 11, excluding one participants whose eating and exercise habits changed dramatically due to a business trip, were analyzed. Due to the small sample size, a nonparametric test was utilized. For characteristics, descriptive statistics were used for history of present illness and health history, and the Wilcoxon signed-rank test was used on pre- and post-intervention BMI, health behavior, and SESPHL. The rate of goal attainment for steps, total calories, and activity calories during the first, second, and third weeks of intervention was converted to medians, and the Wilcoxon signed-rank test was applied to these medians. Energy intake was calculated using nutrition calculation software (BASIC-4 for Windows, Kagawa Nutrition University Publishing Division, Tokyo, Japan) on the basis of intake amounts estimated from each day's photographs. The achievement rate of goals was calculated on the basis of self-monitoring charts.

The statistical software SPSS Statistics ver. 21 for Windows (IBM) was used to perform statistical analyses. A p-value less than 5% was considered as statistically significant.

2.5. Ethical Considerations

This study was conducted with the approval of the ethics committee of Sapporo Medical University. Consent was obtained from workplace managers after providing them with both written and oral overviews of the study. Participants were also provided with both written and oral overviews of the study, and their written consent was obtained before intervention was initiated. The researchers assured participants that they could refuse to participate or interrupt participation at any stage of the study. Participants were also assured that the data obtained via this study would not be used for any purpose other than the study and that protecting the privacy of participants was the researchers' paramount concern.

3. Results

3.1. Participants' Characteristics

Nine participants (81.8%) were male and two (18.2%) were female. Mean age was 42.3 ± 0.41 years. Nine participants (81.8%) were married and ten (90.9%) cohabited with family members. Educational background indicated that eight participants (72.7%) had a college or graduate school education. Four participants (33.3%) had a history of present illness (**Table 1**).

The average levels of participants' serum lipids were as follows: TC was 245.3 mg/dl, LDL-C was 156.9 mg/dl, TG was 108.8 mg/dl, and HDL-C was 56.6 mg/dl.

3.2. Pre- to Post-Intervention Changes

Median pre-intervention BMI was 26.0 kg/m^2, and median post-intervention BMI was 25.4 kg/m^2, indicating no statistically significant difference (p = 0.306). The median pre-intervention health behavior score was 8.0, and

Table 1. Characteristics of participants (N = 11).

		n	%
Gender	Males	9	81.8
	Females	2	18.2
Age (year old)	Mean ± Standard deviation	42.3 ± 0.41	
Marital status	Married	9	81.8
	Unmarried	2	18.2
Living with family	Yes	10	90.9
	No	1	9.1
Level of education	High school	2	18.2
	Vocational	1	9.1
	Degree or higher	8	72.7
History of present illness	Yes	4	36.4
	No	7	63.6

the median post-intervention health behavior score was 15.0, indicating a significant improvement in behavior change (p = 0.012) (**Table 2**).

As indicated in **Table 3**, a significant change between pre- and post-intervention health behavior items "drink 200 ml of milk per day" and "reduce the amount of animal fats" (p = 0.046, p = 0.034) was observed. No significant differences were observed for any other items.

Median pre-intervention SESPHL was 41, and median post-intervention SESPHL was 45, indicating an increasing trend, although it was not statistically significant (p = 0.139). However, significant increases were observed in the post-intervention subscale of "eating SE" (p = 0.046) (**Table 2**).

3.3. Changes during Intervention

Physical activity: Average steps, as a measure of physical activity, increased significantly in the second and third week compared with those in the first week (p = 0.008). Similarly, average of total calories and activity calories showed significant increases in the second and third weeks compared with those in the first week (p = 0.033, p = 0.021) (**Table 4**).

Dietary intake: The average energy intake of participants through meals and snacks between meals was 1862.9 kcal (range: 1230 - 2937 kcal). Seven subjects who indicated that reducing energy intake was one of their goals reduced intake on an average of 326.1 kcal (range: 80 - 656 kcal; not shown in the table).

Goal establishment and achievement: Each participants established two or three goals that were possible to attain. In particular, the diet-related goals included "Have only one bowl of rice." "Try to have two servings of vegetables." and "Reduce snacks by half." and exercise-related goals included "Walk at least 8000 steps per day." and "Walk a distance equivalent to one subway stop." Self-management behaviors included "Weigh myself every day." Goal achievement rates increased, but these increases were not statistically significant (p = 0.197) (**Table 4**).

4. Discussion

Three weeks of intervention led to changes in health behavior in a desirable direction. The pre-intervention health behavior scores of participants in this study were lower than those of subjects in previous studies [17]. The behavior change of reducing intake of animal fat was observed. The behavior change of drinking 200 ml of milk resulted from recommending low-fat milk as a part of individual health education. When total energy intake is restricted, serum cholesterol levels and serum triglyceride levels both decrease [19]. Saturated fatty acids included in large amounts in animal fats have been shown in previous studies to increase LDL cholesterol [20] [21]. Therefore, it is important that dietary treatment of hyperlipidemia focuses not only on correcting serum lipid levels but also on preventing arteriosclerotic diseases.

In this study, 81.8% of participants were males. In Japanese households, the percentages of those who prepare meals are wives, 89.7%; husbands, 1.4%; and all family members, 6.0% [22]. Because most participants in this study had spouses or cohabiting with family members, we assume that they had assistance from family members. It has been reported that family members recommending behavior change acts as motivation [23]. Thus, when

Table 2. Change in Body Mass Index, Health Behavior and SEPHL (N = 11).

	Pretest	Posttest	P-Value
	Median (25 - 75 percentile)	Median (25 - 75 percentile)	
BMI（Kg/m^2)	26.0 (22.8 - 26.5)	25.4 (22.8 - 26.5)	0.306
Health Behavior Score	8 (7.0 - 12.0)	15 (11 - 16	0.012
SEPHL	41 (33 - 47)	45 (39 - 48)	0.139
Eating SE	14 (11 - 16)	15 (12 - 17)	0.046
Activity SE	13 (12 - 16)	15 (13 - 17)	0.371
Foundation SE	14 (12 - 14)	15 (11 - 17)	0.232

Wilcoxon signed-rank test.

Table 3. Change in health behavior items (N = 11).

Health Behavior Items		Pretest		Posttest		P-Value
		n	%	n	%	
Taking regular meals	Yes	1	9.1	3	27.3	
	Sometime	5	45.5	6	54.5	0.059
	No	5	45.5	2	18.2	
Eating vegetables	Yes	4	36.4	4	36.4	
	Sometime	5	45.5	6	54.5	0.739
	No	2	18.2	1	9.1	
Drinking 200ml of milk everyday	Yes	1	9.1	3	27.3	
	Sometime	3	27.3	3	27.3	0.046
	No	7	63.6	5	45.5	
Avoiding saccharide	Yes	1	9.1	3	27.3	
	Sometime	7	63.6	6	54.5	0.257
	No	3	27.3	2	18.2	
Avoiding salty food	Yes	1	9.1	1	9.1	
	Sometime	2	18.2	4	36.4	0.157
	No	8	72.7	6	54.5	
Refraining from drinking	Yes	6	54.5	7	63.6	
	Sometime	1	9.1	3	27.3	0.102
	No	4	36.4	1	9.1	
Refraining from snacks and midnight snacks	Yes	3	27.3	5	45.5	
	Sometime	3	27.3	5	45.5	0.119
	No	5	45.5	1	9.1	
Avoiding animal fat	Yes	1	9.1	1	9.1	
	Sometime	2	18.2	8	72.7	0.034
	No	8	72.7	2	18.2	
No smoking	Yes	8	72.7	8	72.7	
	Sometime	1	9.1	1	9.1	1.000
	No	2	18.2	2	18.2	
Sleeping more than seven hours	Yes	0	0.0	0	0.0	
	Sometime	5	45.5	7	63.6	0.317
	No	6	54.5	4	36.4	
Relaxing on holidays	Yes	3	27.3	2	18.2	
	Sometime	2	18.2	5	45.5	0.564
	No	6	54.5	4	36.4	
Resting whenever feeling physical or mental fatigue	Yes	1	9.1	1	9.1	
	Sometime	9	81.8	10	90.9	0.317
	No	1	9.1	0	0.0	
Exercising everyday	Yes	0	0.0	0	0.0	
	Sometime	1	9.1	4	36.4	0.083
	No	10	90.9	7	63.6	

Wilcoxon signed-rank test.

Table 4. Change of physical activity and performance rate of the tasks during the intervention (N = 11).

	Average of the first week	Average of the second and the third week	P-Value
	Median (25 - 75 percentile)	Median (25 - 75 percentile)	
Steps (per day)	6113.9 (5211.3 - 9408.0)	8550.8 (5923.9 - 10643.3)	0.008
Total calories (kcal)	2260.0 (2037.2 - 2594.2)	2393.7 (2037.9 - 2620.9)	0.033
Activity calories (kcal)	182.5 (162.2 - 372.4)	325.6 (162.8 - 471.9)	0.021
Achievement rate of the goals (%)	66.7 (47.6 - 80.9)	78.6 (51.1 - 83.4)	0.197

Wilcoxon signed-rank test.

implementing intervention for males in Japan, support from spouses and family members who prepare meals is necessary.

Steps, total calories, and activity calories showed significant increase after intervention. It has been shown that assessment of physical activity via accelerometer results in no difference in the average value when monitored for 21 days compared with when monitored for one week [24]. It has further been shown that assessments of an individual's physical activity are fairly accurate when monitored using an activity monitor (pedometer or accelerometer) for approximately 1 week [25]. It has also been reported that wearing an accelerometer leads to increased number of steps [26]. Therefore, we believe that the fact that participants of this study wore accelerometers generated motivation, making their physical activity visible, and self-monitoring led to increase in steps and activity calories. Physical activity results in decreased triglycerides and increased HDL-C [27]. Because increase in physical activity lead to restricted total energy intake, it probably result in improvement of lipid abnormalities. In addition to changes in health behavior, comparative study must also be done of serum lipid levels.

The fact that participants in this study did not show statistically significant self-efficacy was probably due to the small sample size. Post-intervention diet-related self-efficacy showed significant increases, which suggests that the components designed to improve self-efficacy were functioning.

BMI may not have been an appropriate index to measure the effectiveness of 3 weeks of intervention. Intervention led to clear increase in physical activity. However, it did not lead to calorie levels that would result in weight loss. A longer period of intervention is probably necessary.

Studies have indicated that intervention implemented as a part of workplace health programs that combines exercise and diet to reduce the risk of coronary artery disorders is effective [28] [29]. In the present study, subjects established goals in accordance with their personal wishes. Subjects who set diet-related goals reduced calories. This suggests that it is important to support the establishment of both exercise and diet goals.

5. Conclusion

Three weeks of intervention led to health behavior changing in a desirable direction. We believe that elements including self-monitoring using accelerometers that made physical activity visible in this intervention made it effective in causing behavior change.

6. Limitations

A limitation of this study was the quasi-experimental design, which created a lack of randomization in the study. Small sample size and use of convenience samples are also limitations and thus affect generalizability of results.

Future studies should assess the long-term effects of such intervention in improving serum lipid levels and leading to continuous lifestyle improvements.

Acknowledgements

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