Original Article

Non-pharmacological Intervention Study of Hypercholesterolemia among Middle-Aged People

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Abstract

Middle-aged people with a serum total cholesterol of more than 220 mg/dl at the latest health examination (n=197) at a chemical company were invited to join a health education program for 6 months. Participants meeting inclusion criteria were randomly assigned to an intervention (n=96) and a control group (n=92). Periodical interviews and blood tests were performed every 2 months for both groups. The intervention group was educated by health professionals in the factories through programs developed for hypercholesterolemia. After a 6-month intervention, the reduction of cholesterol levels and the differences between the groups were analysed.

The mean total cholesterol (TCH) levels at the baseline measurement were 239.7 mg/dl in the intervention group and 236.5 mg/dl in the control group. During the intervention period, decreased levels of TCH were 27.1 mg/dl for the intervention group and 18.5 mg/dl for the control group. Declines in body weight, TCH and triglyceride levels in the intervention group were significantly larger than those in the control group. The decline of apoprotein-B was also significantly larger in the intervention group while high-density lipoprotein cholesterol levels essentially did not change.

The health education by health professionals proved to be useful in reducing the risk factor levels for coronary heart disease. These results suggest that health education would also be useful against other major risk factors in cardiovascular diseases.

Key words: lifestyles, serum cholesterol, health education

Introduction

Cardiovascular disease is one of the major causes of death among the Japanese. The risk factors for cardiovascular diseases have been changing during over the last 30 years in Japan (1, 2). With these changes, mortality from cardiovascular disease has declined rapidly (3). As for serum cholesterol levels, a continuous increase has been reported among Japanese (2, 4). Although declining trends in mortality from ischemic heart disease have been observed (5, 6), an increase in the incidence of acute myocardial infarction has been reported among workers in urban areas (7). To control the increasing trends in serum cholesterol levels, effective health education method should be developed (8).

However, few reports have focused on the effectiveness of health education by health professionals (9). In this report, we present the results of a 6-month health education program by health professionals, and discuss the effectiveness of the health education.

Subjects and Methods

In 1990, we conducted a randomised control trial with 8 health professionals in 7 factories of a chemical company. Workers aged 30 to 64 years old with serum total cholesterol (TCH) of more than 220 mg/dl (n=254) at the periodical health check-ups in 1989 were invited to join the health education program for 6 months. Written informed consent was obtained from 197 participants. According to the baseline measurement of serum lipid levels, participants with cholesterol levels of less than 300 mg/dl (n=191) were randomly assigned to an intervention group (n=98) and a control group (n=93). Periodical interviews, anthropometry and blood tests were performed every 2 months for both groups. Ninety-six participants in the intervention group and 92 participants in the control group

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                              ┌─────────────────────────┐      ┌──────────────────────┐
                              │  Baseline dietary survey │  ←   │  Life-size food models│
┌─────────────────┐          └─────────────────────────┘      └──────────────────────┘
│ Clinical findings│    →              ↓
├─────────────────┤          
│ Weight and Height│    →              ↓
├─────────────────┤          
│Physical Activities│   →              ↓
└─────────────────┘  Step(1) ┌─────────────────────────────┐
                              │Calculating categorical food intake│
                                         ↓
                     Step(2) ┌─────────────────────────┐      ┌──────────────────────┐
                              │ Comparing with standard intake│ → │ Summary of Dietary Habits│
                              └─────────────────────────┘      └──────────────────────┘
                                         ↓
                              ┌─────────────────────────┐      ┌──────────────────────┐
                     Step(3) │     Giving advice from   │  →   │  Hints for participants│
                              │ dietary habits and cholesterol│  └──────────────────────┘
                              │          levels          │
                              └─────────────────────────┘
                                         ↓
┌──────────────────┐         ┌─────────────────────────┐
│Personal counseling│   →    │   Deciding main targets  │
└──────────────────┘         │     (No more than 3)     │
                              └─────────────────────────┘
                                       ↓ ↑
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                              ┌─────────────────────────┐      ┌──────────────────────┐
                              │   Periodical Interviews  │  ←   │       Pamphlet        │
                              │     (Every 2 months)     │  ←   │      Newsletters      │
                              └─────────────────────────┘  ←   │ Four day dietary record│
                                       ↓ ↑                 ←   │  Two week diet diary  │
                                       ↓ ↑                      └──────────────────────┘
                                         ↓
                              ┌─────────────────────────┐
                              │ Evaluating cholesterol values│
                              │   and life-style changes │
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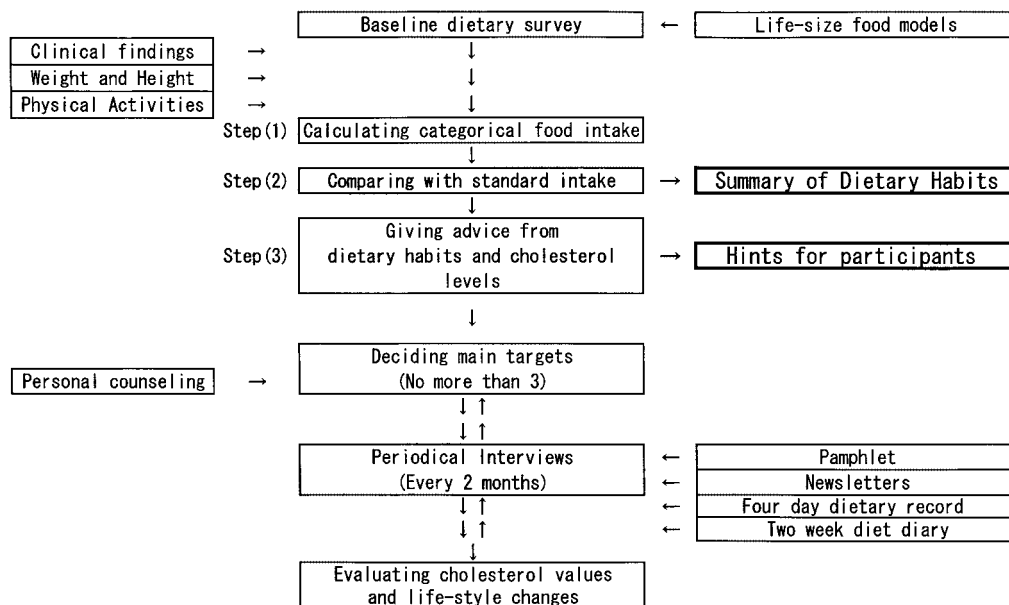
Fig. 1　Schematic procedure of a systematic cholesterol education program using developed education materials.

completed this program.

Health professionals (n=8) in the 7 factories conducted this health education program for the intervention group. Health professionals met the participants of the intervention group and discussed the lifestyles which should be modified. Participants made personal plans to change their dietary habits to reduce body weights or increase physical activities. The health professionals repeated the interview every 2 month discussing the current lifestyles and serum cholesterol levels of the participants and giving advice on reducing serum cholesterol levels effectively. We asked all participants to use a pedometer for 2 days before each interview and we used the average amount of walking per day as an index of physical activities.

We developed health education materials and trained the health professionals to use the education materials instead of educating participants directly (9). Figure 1 shows the procedures of this health education program. Before the first interview, dietary habits were assessed by a dietary survey with a food frequency and quantity method using life-size food models. We used 30 food categories to characterize the dietary habits of the participants. On the basis of the assessment of dietary habits, exercise, smoking and drinking, the health professionals interviewed the participants and advised them for

1. Incorporate exercise into daily life.

2. Change breakfast style from Western to Japanese.

3. Reduce meat and egg intakes and increase fish and soybean product intakes.

4. Use low-fat dairy products.

5. Eat vegetables or seaweed at every meal.

6. Use salad oil instead of butter or lard.

7. Choose Japanese-style confectionaries rather than fatty cakes or biscuits.

Fig. 2　Seven rules of daily life for controlling serum cholesterol levels.

6 months. We made 7 rules for reducing serum cholesterol levels (Figure 2). We encouraged participants to increase their physical activities. As for dietary habits, we stressed changing the main resource of protein from meat and eggs to fish and soybean products. Regarding sweets, we recommended Japanese sweets instead of fatty biscuits and cakes. We explained these rules and gave them to the participants.

As for the participants in the control group, the health professionals similarly monitored their dietary habits and noted their serum cholesterol levels but they did not give any advice on changing lifestyles. After the 6-month intervention period, the same dietary survey by the food frequency and quantity method was performed for all participants. This study was approved by the committee on occupational health and safety of the company.

Blood test

Blood samples were collected from participants under a fasting condition in each factory by health professionals at the baseline survey (the baseline measurement), after 2 months (the first measurement), after 4 months (the second measurement), and after 6 months (the third measurement). Serum total cholesterol (TCH), high-density lipoprotein cholesterol (HDL-C), serum triglyceride (TG), blood sugar (FBS), apoprotein-A1, and apoprotein-B were measured in one laboratory throughout the intervention period. All values were adjusted using internal quality control data supplied from the laboratory.

Statistical analysis

Standard statistical analysis was performed using SPSS version 11.0 (Illinois, USA). A test for repeated measurements was used to evaluate the difference in the changes from the baseline measurement in body weight, and the levels of TCH, HDL-C, TG, and apoprotein-A1 and -B, between the intervention group and the control group during the first, second and the third measurements.

Table 1   Baseline Characteristics of the Participants in the Intervention and Control Groups. P values were calculated between the intervention group and the control group

	Intervention group	Control group	P value
Number	96	92	
Men (%)	96%	91%	0.243
Age (year)	45.2±9.4	43.9±9.1	0.349
Body mass index (kg/m²)	24.2±2.9	24.1±2.6	0.899
Amount of walking (/day)	7982.4±3649.0	7975.0±3648.3	0.989
Serum cholesterol (mg/dl)	239.7±28.1	236.5±23.0	0.402
High density lipoprotein cholesterol (mg/dl)	57.0±14.9	57.5±14.8	0.818
Triglyceride (mg/dl)	165.5±102.7	170.8±128.6	0.757
Apoprotein-A1 (mg/dl)	137.6±21.0	137.0±20.7	0.859
Apoprotein-B (mg/dl)	117.0±16.4	120.1±22.6	0.728
Fasting blood sugar (mg/dl)	97.3±18.4	99.2±15.8	0.575

Table 2   Changes in the body wieght, and levels of serum cholesterol, HDL-cholesterol, triglyceride, apo-poprotein-A1 and apo-protein-B in the intervention and control groups

	Baseline	First (2 months)		Second (4 months)		Third (6 months)		P value
Intervention group	N=96							
Body weight (kg)	68.0±8.1	68.0±8.1	ns	67.5±8.2	**	67.2±8.3	**	0.017
Serum cholesterol (mg/dl)	239.7±28.1	235.6±28.9	ns	223.8±26.6	**	212.6±27.2	**	0.037
HDL-cholesterol (mg/dl)	57.5±14.8	61.7±21.4	**	59.6±19.0	ns	59.2±15.3	**	0.782
Triglyceride (mg/dl)	170.8±128.6	136.3±67.3	**	152.6±97.7	**	138.7±82.3	**	0.091
Apoprotein-A1 (mg/dl)	137.0±20.7	139.7±22.3	ns	138.8±22.1	ns	137.8±21.8	ns	0.801
Apoprotein-B (mg/dl)	120.1±22.6	117.9±21.0	ns	119.0±24.2	ns	109.5±20.4	**	0.048
Control group	N=92							
Body weight (kg)	66.8±9.0	67.2±8.8	*	67.0±9.1	ns	66.5±9.1	*	—
Serum cholesterol (mg/dl)	236.5±23.0	237.1±26.8	ns	226.6±26.2	**	218.0±29.3	**	—
HDL-cholesterol (mg/dl)	57.0±14.9	61.1±14.7	**	59.4±15.0	ns	60.5±15.3	ns	—
Triglyceride (mg/dl)	165.5±102.7	155.2±90.2	ns	162.5±100.2	ns	161.6±167.6	ns	—
Apoprotein-A1 (mg/dl)	137.6±21.0	141.5±19.5	ns	140.7±19.8	ns	139.3±21.4	ns	—
Apoprotein-B (mg/dl)	117.0±16.4	119.3±23.6	ns	120.6±23.7	ns	112.3±24.4	*	—

Significance by paired t test between baseline and the first, second and third measurements are shown at each column. P values are between the intervention and control groups using test for repeated mesurements.

**: $p < 0.01$, *: $p < 0.05$, ns: not significant

Results

A total of 176 men and 12 women with less than 300 mg/dl of TCH joined this study. The baseline characteristics of the two groups are shown in Table 1. Ninety-six participants were assigned to the intervention group and 92 to the control group. The mean TCH levels in the intervention group (239.7 mg/dl) and the control group (236.5 mg/dl) did not differ significantly. The mean age, body mass index and levels of HDL-C, TG, apoprotein-A1 and apoprotein-B were also similar in both groups.

Table 2 shows the changes in body weight and levels of TCH, HDL-C, TG, apoprotein-A1 and apoprotein-B during the intervention period. In the intervention group, the TCH levels at the first measurement tended to decrease, although not significantly. TCH levels at the second and third measurements decreased significantly ($p < 0.01$). Apoprotein-B levels decreased significantly at the third measurement ($p < 0.05$). Body weight also decreased significantly at the second and third measurements ($p < 0.01$). TG levels decreased significantly at the first ($p < 0.05$), second ($p < 0.01$) and third ($p < 0.01$) measurements. Levels of HDL-C increased significantly at the first and third measurements. Apoprotein-A1 levels did not change signifi-

cantly throughout the intervention period.

In the control group, TCH levels did not change at the first measurement and decreased similarly to those in the intervention group ($p < 0.01$). Apoprotein-B levels decreased significantly at the third measurement ($p < 0.05$). Body weight decreased significantly at the third measurement ($p < 0.05$). TG levels did not change significantly throughout the period. Levels of HDL-C and apoprotein-A1 did not change essentially throughout the intervention period.

The reduction of TCH levels during the study period was 27.1 mg/dl in the intervention group and 18.6 mg/dl in the control group. The mean difference (8.6 mg/dl) was significantly larger in the intervention group than in the control group. Reductions in body weight and apoprotein-B levels were also significantly larger in the intervention group than in the control group. Reduction of triglyceride levels tended to be higher in the intervention group, but not significantly. Changes in the HDL-C and apoprotein-A1 levels were not different between the two groups.

Discussion

Trends in cholesterol levels among the Japanese

Cholesterol levels among the Japanese have been increas-

Table 3   Serum cholesterol levels (mg/dl) among Japanese men and women in 1980, 1990 and 2000
National Carviovascular Surveys. Serum cholesterol levels in National Health and Nutrition Survey in U.S.A. is also shown for comparison

	Age Band			
	30–39	40–49	50–59	60–69
Men				
National Cardiovascular Survey (1980)	186.7	188.4	188.6	185.1
National Cardiovascular Survey (1990)	196.4	204.2	200.0	197.4
National Cardiovascular Survey (2000)	196.1	202.5	195.8	183.4
National Health and Nutrition Examination Survey (USA, 2000)	195.4	210.4	215.4	213.5
Women				
National Cardiovascular Survey (1980)	176.9	185.7	202.7	203.1
National Cardiovascular Survey (1990)	185.9	200.0	218.0	222.6
National Cardiovascular Survey (2000)	184.6	198.2	220.0	215.0
National Health and Nutrition Examination Survey (USA, 2000)	188.7	204.0	225.0	235.0
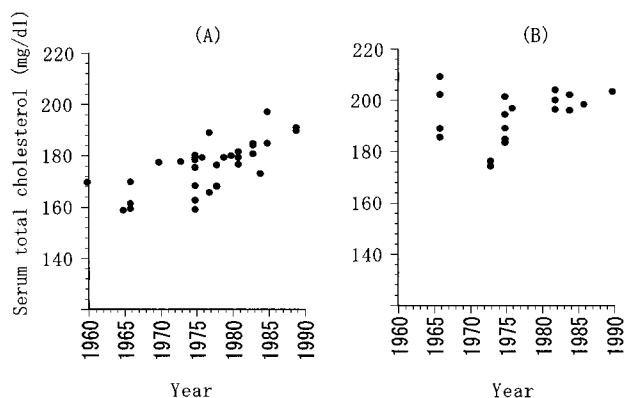
Fig. 3 Secular trends in age-adjusted serum total cholesterol levels among middle-aged people in rural (A) and urban (B) areas of Japan. Data were obtained from 35 reports (redrawn from Okayama et al. 1993)

ing. Table 3 shows time trends in the age-specific serum cholesterol levels from the 1980, 1990 and 2000 National Cardiovascular Surveys (10–12). We also show the serum cholesterol levels in U.S. (13). This data clearly shows that continuous increasing trends in serum cholesterol levels have been observed in both sexes among the Japanese. In contrast to Western countries, the increase in serum cholesterol levels with age among the Japanese is not clear. This may reflect the difference in dietary habits between generations (i.e., more meat intake in the younger generation and more fish and soybean products in the elderly generation).

In the previous paper, we showed that the continuous increasing trends observed among the Japanese were due to those in the rural areas, while cholesterol levels remained high among urban populations over the last 30 years (4). Figure 3 shows the trends in cholesterol levels among middle-aged Japanese in rural areas and those in urban areas using data from epidemiological reports published in Japan. In the 1970s, serum cholesterol levels were apparently higher in urban populations than in rural populations. The increase in serum cholesterol levels among rural populations was continuous. The levels were still lower in rural populations than in urban populations in 1990, while the differences observed in the 1970s were almost completely diminished. This difference in the trends could be explained by the different trends in dietary habits between rural

and urban populations. According to the National Nutrition Survey in 1966, the saturated fat intake, which is strongly related to serum cholesterol levels, among rural populations was extremely low compared to that of urban populations. This difference rapidly diminished with the increase of saturated fat intake in rural populations.

Now, it seems that the difference in serum cholesterol levels and dietary intake is not clear between urban and rural populations. However, the risk for ischemic heart disease increases not only with the levels of serum cholesterol but also with the period of high serum cholesterol levels. Considering the past cholesterol levels, urban populations may a have higher risk for ischemic heart disease. Thus, effective programs for controlling cholesterol levels are needed. However, effective education programs for reducing cholesterol levels among the Japanese have not been developed.

Strategy for Effective Health Education

In this study, we developed a health education program for health professionals. This program principally consists of advice based on the results of a dietary survey, periodical interviews and various education materials. Using this program, we obtained significantly larger reduction in TCH and apoprotein-B levels in the intervention group compared to that in the control group, while HDL-C levels essentially did not change. Declines in apoprotein-B levels in the intervention group were significantly greater than those in the control group. Decreases in body weight in the intervention group were also significantly larger than those in the control group. From these results, health professionals were proven to be able to perform this health education program effectively. Among participants with less than 300 mg/dl of TCH (n=191), 188 participants completed 2 or more and 185 participants completed all 4 interviews. The major cause of dropout was moving by temporary transfer. The percentage of dropout was 5.1% in the intervention group and 1% in the control group.

The difference in decline in total cholesterol levels was only 8.6 mg/dl, while the net reduction in the intervention group was 27.1 mg/dl. This may mean that life styles have been changed not only in the intervention group but also in the control group. For both groups, we repeated periodical interviews using the information of cholesterol levels. In the control

group, the pattern that cholesterol levels at the first measurement did not change, and then decreased rapidly shows that only periodical interviews, with the information of the cholesterol levels of the participants, may have influenced behaviours substantially. Thus, the net reduction by this program may be larger than 8.6 mg/dl. On the other hand, the net reduction in the intervention group (27.1 mg/dl) may change due to the participants, since the participants in this study were volunteer workers who were well-educated and may have received information from health professionals even before the program.

This health education program is integrated and easy to use. It should be encouraged that researches on health education should show the details of the programs to health professionals who want to use effective programs.

Annual health check-ups widely introduced among the Japanese may reveal new mild disorders through cholesterol level, blood pressure and so on. However, relatively little interest has been paid to managing these mild disorders. Thus, non-pharmacological treatment should be stressed more often. Although this health education method requires the resources of health professionals and is time-consuming, health professionals do not have to repeat this health education for all participants. Since participants who have experienced the education once know how to change their lifestyle and reduce cholesterol levels, they may understand the brief comments at the health examination. Health professionals can educate all workers with disorders if appropriate plans are made.

Conclusion

Health education by health professionals using the results of a dietary survey proved to be useful in reducing TCH levels, a risk factor, significantly. These results suggest that health education would also be useful against other major risk factors in cardiovascular diseases. More attention should be paid to reducing risks among the Japanese.

Acknowledgments

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