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Effects of a Stroke Primary Prevention Program on Risk Factors for At-Home Elderly

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

ABCDEFG 1 Mi Yang Jeon
ABCDEFG 2 HyeonCheol Jeong

1 Department of Nursing, Institute of Health Science, Gyeongsang National University, Jinju, Korea
2 Department of Nursing, Sahmyook University, Seoul, Korea

Corresponding Author: HyeonCheol Jeong, e-mail: love2hc@syu.ac.kr
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Background: To prevent stroke from occurring, stroke risk factors in at-risk subjects should be controlled and the diseases causing stroke should be managed. This study evaluated a nursing intervention to prevent stroke in at-risk elderly living at home. The program consisted of stroke and nutrition education as well as exercise guidance.

Material/Methods: This study targeted 93 elderly people living at home residing in E province with 1 or more stroke risk factors, including high blood pressure, diabetes, hyperlipidemia, obesity, smoking, or drinking alcohol. The 12-week program included a stroke education class once a week, a nutrition management class once a week, and exercise guidance 3 times a week. Each session lasted 50–70 min. Each disease education and nutrition management session lasted for 20 min and each exercise session lasted for 30–50 min.

Results: The experimental group's body mass index (BMI) (t=8.27, $p<.001$), systolic blood pressure (t=2.39, $p=.021$), fasting blood sugar (t=0.39, $p=.700$), total cholesterol (t=4.18, $p<.001$), triglyceride levels (t=2.50, $p=.016$), and depression scores (t=5.48, $p<.001$) were significantly reduced and high-density phospholipid protein levels increased significantly by the end of the program (t=−2.94, $p=.005$).

Conclusions: Based on the results of this study, participating in a stroke prevention program enabled at-risk elderly participants who lived at home in rural areas to perform health-promoting behaviors. This program may reduce the incidence of stroke by reducing risk factors and managing stroke precursor diseases.

MeSH Keywords: Exercise • Frail Elderly • Home Health Aides • Risk Factors • Stroke

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Background

The rate of chronic diseases is increasing because of the aging population, changes in lifestyle and eating habits, and an increase in environmental pollution. Given that the prevalence of stroke increases drastically with age (from 2.1% in adults aged 30 or older to 4.7% those aged 50 or older and 7.6% in those aged 65 or older), stroke onset will also continue to increase as society ages [1]. In 2013, cerebrovascular diseases were the second most common cause of death in Korea, with a mortality rate of 50.3 people per 100 000 [2]. Once a stroke occurs, 15–20% of patients die and 10% fully recover, while the remaining 70–75% experience a wide range of problems (such as motor, sense, cognition, or language dysfunction) depending on the area of the brain affected [3]. These problems subsequently result in a social and economic burden that will also increase rapidly as the population ages. Furthermore, the number of patients who received inpatient and outpatient care for cerebral infarction, the total related medical expenses, and the percent of the total expense allocated for stroke medical care is increasing. For example, in 2005, 334 000 people received care costing a total of 260.6 billion won, 1.44% of which was allocated for stroke care (432 000 people, 865 billion won, 2.21%) [4].

Even if stroke patients recover, there is a high risk of relapse, and complications (such as problems performing activities of daily living and depression) may occur. Therefore, one of the most important goals of nursing is to prevent stroke occurrence [5]. To prevent stroke from occurring, stroke risk factors in at-risk subjects should be controlled and the diseases causing stroke should be managed [6].

Stroke risk factors can be categorized as either biomedical risk factors (precursor diseases) or health behavioral risk factors. Biomedical risk factors include hypertension, diabetes, hyperlipidemia, dyslipidemia, and atrial fibrillation, while health behavioral risk factors include drinking and smoking, lack of physical activity, high salt intake, and obesity. Moreover, it is important to manage health behavioral risk factors because they are also risk factors for underlying diseases that accompany stroke and complicate recovery [7]. To identify stroke risk factors in Korea, the 4th and 5th National Health Nutrition Survey was used to examine the risk factors among subjects aged 40–79 years old and to evaluate the mediating health risk behaviors and precursor diseases associated with stroke. Socio-demographic characteristics including sex, age, education level, and occupation were also collected. The health risk behavior variables included subjective health status, stress level, drinking, exercise, and precursor disease factors such as the presence or absence of hypertension, hyperlipidemia, or diabetes [8].

According to a study that tested educational booklets targeting disease-related knowledge, health behaviors, activities of daily living, and depression to promote the early rehabilitation of patients with acute ischemic cerebrovascular diseases, health behavior and activities of daily living significantly increased in the experimental group when compared to the control group [9]. Another study found that self-care and health-promoting behaviors increased significantly after stroke patients completed a self-efficacy promotion program, while another study found similar results on blood pressure, depression, and functional status [10]. Furthermore, a web-based education program designed for patients and their families that aimed to prevent secondary occurrence of stroke reported that health knowledge and health promotion behaviors increased after patients completed the program [6].

As shown above, the main program contents in current stroke rehabilitation and secondary prevention programs are education [11–13], exercise [14], and self-help [15]. However, although treatment is administered after stroke onset, stroke is highly likely to cause a physical disability due to immediate damage or reoccurrence. Therefore, it is necessary to prevent stroke from occurring. However, few studies have evaluated stroke prevention programs for at-risk elderly who live at home.

Several complex factors cause stroke; therefore, a complex program targeting education, nutrition, and exercise is necessary to manage and prevent stroke. Thus, this study evaluated a nursing intervention to prevent stroke in at-risk elderly living at home.

Material and Methods

Subjects

This study targeted elderly people living at home residing in E province with 1 or more stroke risk factors, including high blood pressure, diabetes, hyperlipidemia, obesity, smoking, or drinking. One hundred people who listened to a description of the purposes of the study and subsequently agreed to participate in this study were selected as subjects. Five people in the experimental group were excluded from the data analysis because their program attendance rate was less than 80%. Two people in the control group were excluded from the analysis because they did not complete the follow-up survey. Therefore, the final analysis was restricted to 93 participants, 45 in the experimental group and 48 in the control group. The general characteristics of the subjects are listed in Table 1.

Those who had more than 1 stroke risk factor, even if not diagnosed with stroke, who could understand the educational program, and who could participate in physical activity, were eligible

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Table 1. General characteristics of the subjects (*N*=93).

		Experimental group (n=45) M±SD/n(%)		Control group (n=48) M±SD/n(%)		*p*
Age		70.11±3.69		69.58±4.33		.530
Gender*	Male	3	(6.7)	1	(2.1)	
	Female	42	(93.3)	47	(97.9)	.351
Disease	No	14	(31.1)	7	(14.6)	.082
	Yes	31	(68.9)	41	(85.4)	
Medications	No	14	(31.1)	7	(14.6)	.082
	Yes	31	(68.9)	41	(85.4)	
Exercise	No	28	(62.2)	39	(81.3)	.063
	Yes	17	(37.8)	9	(18.8)	
Smoking	No	45	(100.0)	47	(97.9)	.999
	Yes	0	(0.0)	1	(2.1)	
Drinking	No	45	(100.0)	45	(93.8)	.243
	Yes	0	(0.0)	3	(6.3)	

* Fisher's exact test.

for inclusion in the program. Those who had heart disease or were required by their doctors to restrict physical activity were excluded from the study. All protocols and procedures were approved by the Institutional Review Board of Sahmyook University, and all subjects signed a statement of informed consent.

The G*Power 3.1.2 program was used to calculate the required sample size. Based on the results of previous studies, the required sample size was 100 participants (45 in each group) when the expected effect size was 0.6, the power was 0.80, and the alpha was 0.05. This calculation also accounted for the dropout rate.

Outcome measures

Obesity

Body mass index (BMI) was calculated by measuring the height (m) and weight (kg) (Inbody 4.0, Korea) and dividing weight by height squared.

Serum lipids

Participants were instructed to fast from 9:00 p.m. the day before to ensure that the subjects obtained a 12-h fasting state prior to blood samples. At 9:00 a.m. on the day of examination, 20 ml of blood was taken from the forearm vein and centrifuged for 10 min at 3000 rpm. The serum was then analyzed for total cholesterol, triglycerides, high-density cholesterol, and low-density cholesterol using a blood analyzer (DT60 II, Jonson & Johnson, USA).

Blood pressure

Resting blood pressure was measured in both the left and right upper-arm (TENSOVAL, Heidenheim, Germany) and measured in the upper arm on the higher side. The first measurement was not recorded. Two additional measurements were taken at 2-min intervals and the average was used as the blood pressure value.

Blood sugar

Participants were instructed to fast from 9:00 p.m. the day before to ensure that a 12-hour fasting state was obtained. Fasting blood samples were taken from the fingertip at around 9:00 a.m. on the day of the examination. The sample was placed on a reagent sheet and inserted into a blood sugar measuring device (Accu CHEK, Korea).

Procedures

To develop and evaluate this stroke prevention program for the elderly living at home, we: 1) analyzed the contents and

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Table 2. Contents of the stroke prevention program for the at-home elderly.

Week	Education	Exercise	Nutrition
1	Understanding stroke – Definition and causes of stroke	Stroke prevention exercise: Introductory period – 3 times a week, 30 minutes per 1 time – Flexibility exercise	Dietary composition
2	Understanding stroke – Symptoms and management of stroke	Stroke prevention exercise: Introductory period – 3 times a week, 30 minutes per 1 time – Flexibility exercise	Low sodium diet experience
3	Risk factors of stroke – Risk factors of stroke	Stroke prevention exercise: Promotion period – 3 times a week, 35 minutes per 1 time – Flexibility exercise, balance exercise	Low sodium diet assessment per household
4	Management of stroke risk factors – High blood pressure management	Stroke prevention exercise: Promotion period – 3 times a week, 35 minutes per 1 time – Flexibility exercise, balance exercise	Low sodium diet cooking
5	Management of stroke risk factors – Diabetes management	Stroke prevention exercise: Promotion period – 3 times a week, 40 minutes per 1 time – Flexibility exercise, balance exercise, aerobic exercise	Sugar content assessment by food
6	Stroke risk factors management – Hyperlipidemia management	Stroke prevention exercise: Promotion period – 3 times a week, 40 minutes per 1 time – Flexibility exercise, balance exercise, aerobic exercise	Food exchange
7	Stroke prevention – Obesity management	Stroke prevention exercise: Stabilization period – 3 times a week, 50 minutes per 1 time – Flexibility exercise, balance exercise, aerobic exercise, muscle strengthening exercise	Carbohydrate intake reduction experience
8	Stroke prevention – Exercise	Stroke prevention exercise: Stabilization period – 3 times a week, 50 minutes per 1 time – Flexibility exercise, balance exercise, aerobic exercise, muscle strengthening exercise	Low cholesterol diet experience
9	Stroke prevention – Nutrition: Low sodium diet, low cholesterol diet	Stroke prevention exercise: Stabilization period – 3 times a week, 50 minutes per 1 time – Flexibility exercise, balance exercise, aerobic exercise, muscle strengthening exercise	Low cholesterol diet cooking
10	Stroke prevention – Drinking, smoking	Stroke prevention exercise: Stabilization period – 3 times a week, 50 minutes per 1 time – Flexibility exercise, balance exercise, aerobic exercise, muscle strengthening exercise	Stroke prevention diet table setting 1
11	Stroke prevention – Stress management	Stroke prevention exercise: Stabilization period – 3 times a week, 50 minutes per 1 time – Flexibility exercise, balance exercise, aerobic exercise, muscle strengthening exercise	Stroke prevention diet table setting 2
12	Stroke and first aid	Stroke prevention exercise: Stabilization period – 3 times a week, 50 minutes per 1 time – Flexibility exercise, balance exercise, aerobic exercise, muscle strengthening exercise	Stroke prevention cooking contest

effects of stroke prevention programs in previous studies, 2) developed our stroke prevention program, 3) implemented the program, and 4) analyzed its effects.

The program contents were based on previously conducted domestic studies [6] and consisted of stroke and nutrition education as well as exercise guidance. The 12-week program included a stroke education class once a week, a nutrition management class once a week, and exercise guidance 3 times a week. Each session lasted 50–70 min.

Each disease education and nutrition management session lasted 20 min and each exercise session lasted 30–50 min. In sessions 1–6, the theme was disease management and focused

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Table 3. Homogeneity Test of dependent variables between experimental and control group (*N*=93).

	Experimental group (n=45) M±SD	Control group (n=48) M±SD	t	p
BMI	26.22±2.64	25.57±2.63	–1.25	.215
BP (mmHg)				
SBP	127.67±13.06	127.13±19.65	0.16	.877
DBP	79.53±8.44	76.48±10.13	1.55	.124
FBS (mg/dl)	163.00±79.01	121.55±29.61	3.24	.002
SL (mg/dl)				
TC	196.84±32.64	193.21±57.89	0.37	.712
TG	172.00±73.30	184.08±78.36	–0.77	.445
HDL	50.07±11.18	47.28±15.89	0.97	.334
LDL	112.38±32.70	109.11±58.36	0.33	.742
Depression	3.89±1.61	4.58±3.33	–1.25	.236

BMI – body mass index; BP – blood pressure; SBP – systolic blood pressure; DBP – diastolic blood pressure; FBS – fasting blood glucose; SL – serum lipids; TC – total cholesterol; TG – triglycerides; HDL – high density lipoprotein; LDL – low density lipoprotein.

on high blood pressure, diabetes, dyslipidemia, and obesity (known risk factors for stroke). Health risk behavior management practice was conducted in sessions 6–11 and first aid was taught in session 12. Nutritional education and cooking classes were centered on a low sodium diet in the 1st–4th sessions while food energy, food exchange, and proper carbohydrate intake were discussed in the 5th–7th sessions, and a low cholesterol diet was the focus of the 8th–9th sessions. Stroke prevention and diet were presented in the 10th–12th sessions (Table 2).

Each exercise session included a warm-up, a main exercise portion, and a cool down. Flexibility, balance, aerobic, and muscle strengthening exercises were conducted in the main exercise portion as time allowed. During aerobic exercise, popular songs preferred by the elderly were used as background music and the movements were choreographed to accompany the lyrics so that the participants could remember them easily. The overall program contents were reviewed by 1 cardiology ward chief nurse, 1 nurse with 22 years of experience in the community health sector, and 3 nursing professors who evaluated the abilities of the participants.

Data collection

Measures were taken at the same time for both the experimental group and the control group. The experimental group was asked to visit the public health center immediately before and after implementation of the program for measurement. The control group was measured on the same day as the experimental group but not immediately before or after implementation of the program. In order to accurately identify the drugs that the participants were taking, we asked them to bring the drugs with them on the day of measurement. Measurements and samples were taken in the following order: blood pressure, blood samples, height, and weight.

Statistical analysis

The data were analyzed using SPSS.

(1) General characteristics were analyzed using frequencies, percentages, means, and standard deviations. In addition, general characteristics of the experimental group and the control group were tested for homogeneity using a chi-square test and a t-test.

(2) A paired t-test was used to examine the differences between the baseline and follow-up surveys in the experimental and in the control group and an independent t-test was used to assess the differences between the experimental group and control group post-treatment.

Results

Homogeneity of dependent variables

No significant differences were found for BMI, blood pressure, or serum lipids between the experimental and control

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Table 4. Effect of stroke prevention program on body mass index, blood pressure, fasting blood glucose, and serum lipids (*N*=93).

	Experimental group (n=28)		t (p)	Control group (n=27)		t (p)	Pre test–Post test		t (p)
	Pre test M±SD	Post test M±SD		Pre test M±SD	Post test M±SD		Experimental group M±SD	Control group M±SD	
BMI	26.22 ±2.64	25.60 ±2.59	8.27 (<.001)	25.57 ±2.63	25.30 ±2.63	2.45 (.018)	0.62 ±0.50	0.27 ±0.75	2.65 (.010)
BP (mmHg)									
SBP	127.67 ±13.06	124.42 ±12.21	2.39 (.021)	127.13 ±19.65	124.94 ±20.07	1.30 (.201)	3.26 ±8.92	2.19 ±11.68	0.49 (.623)
DBP	79.53 ±8.44	77.21 ±7.97	1.88 (.067)	76.48 ±10.13	74.81 ±10.26	1.43 (.159)	2.33 ±8.12	1.67 ±8.06	0.39 (.700)
FBS (mg/dl)	163.00 ±79.01	134.07 ±49.03	3.79 (<.001)	121.55 ±29.61	130.66 ±34.19	–1.87 (.068)	28.93 ±50.10	-9.11 ±33.45	4.27 (<.001)
SL (mg/dl)									
TC	196.84 ±32.64	182.07 ±37.53	4.18 (<.001)	193.21 ±57.89	197.37 ±40.64	–0.48 (.635)	14.78 ±23.71	-4.16 ±60.38	1.97 (.048)
TG	172.00 ±73.30	151.02 ±60.56	2.50 (.016)	184.08 ±78.36	194.69 ±89.71	–1.17 (.247)	20.98 ±56.41	-10.60 ±62.67	2.55 (0.12)
HDL	50.07 ±11.18	52.27 ±10.69	–2.94 (.005)	47.28 ±15.89	45.77 ±15.69	1.68 (.100)	-2.20 ±5.03	1.78 ±7.93	–2.87 (.005)
LDL	112.38 ±32.70	99.60 ±37.09	3.20 (.003)	109.11 ±58.36	112.66 ±43.42	–0.39 (.697)	12.78 ±26.77	-3.55 ±62.70	1.61 (.110)

group (Table 3). However, fasting blood sugar showed significant differences by group; 163.00 mg/dl in the experimental group and 121.55 mg/dl in the control group. Therefore, all dependent variables, except blood sugar, were found to be homogeneous between the 2 groups.

The effect of the stroke prevention program on physiological variables

The experimental group BMI was significantly reduced between the baseline (26.22) and post-exposure (25.60) measurements (t=8.27, $p<.001$). Next, the differences in BMI pre- and post-exposure were compared between the 2 groups. The BMI of the experimental group decreased more than that of the control group (t=2.65, $p=.010$).

In the experimental group, statistically significant differences were also found between systolic blood pressure before and after exposure to the program. Systolic blood pressure decreased from 127.67 mmHg before the experiment to 124.42 mmHg after the experiment (t=2.39, $p=.021$). However, no significant differences were found between the experimental group and control group (t=0.49, $p=.623$). In addition, differences were also seen in diastolic blood pressure in the experimental group pre-and post-exposure (79.53 mmHg to 77.21 mmHg); however, these results were not statistically significant (t=1.88, $p=.067$). Similarly, no significant differences were found between the groups (t=0.39, $p=.700$).

Fasting blood sugar also significantly decreased after program exposure in the experimental group (from 163.00 mg/dl to 134.07 mg/dl, t=0.39, $p=.700$). When examined by group, fasting blood sugar in the experimental group decreased significantly more than in the control group (t=4.27, $p<.001$).

Finally, significant differences were also found for total cholesterol in the experimental group. Total cholesterol significantly decreased from 196.84 mg/dl before program exposure to 182.07 mg/dl after program exposure (t=4.18, $p<.001$). Significant differences were also found between the experimental and the control group (t=1.97, $p=.048$). The triglyceride levels were also significantly lower after exposure to the program among participants in the experimental group (from 172.00 mg/dl to 151.02 mg/dl, t=2.50, $p=.016$) and a significant difference was found between the 2 groups (t=2.55, $p=.012$). In the experimental group, high-density phospholipid protein levels were increased significantly after the program (from 50.07 mg/dl to 52.27, t=–2.94, $p=.005$) and a significant difference was found between the experimental and control group (t=2.55, $p=.012$). Low-density phospholipid protein levels

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decreased significantly, from 112.38 mg/dl before the experiment to 99.60 mg/dl, after the experiment (t=3.20, p=.003). However, there was no significant difference between the experimental and control group (t=1.61, p=.110) (Table 4).

The effect of the stroke prevention program on psychological variables

Depression scores for the experimental group significantly decreased after exposure to the program (from 3.89 points to 2.49 points, t=5.48, p<.001). Similar results were found when the 2 groups were compared. Depression decreased significantly more in the experimental group than in the control group (t=2.79, p=.006).

Discussion

In order to prevent stroke among the at-risk group of rural, at-home elderly, we developed a 12-week stroke prevention program targeting education, exercise, and nutrition. Previous studies and a literature review indicated that these components are important factors for stroke prevention. We analyzed the effects of the program on BMI, blood pressure, fasting blood sugar, and serum lipids, as well as depression. This stroke prevention program used education to target high blood pressure, diabetes, dyslipidemia, and obesity, which are well-known risk factors for stroke. In addition, this program provided education for stroke first aid. Basic nutrition education was conducted and a low sodium/low cholesterol diet was emphasized in order to reduce sodium intake and lower cholesterol, which are known stroke risk factors. In addition, to help control diabetes, subjects received advice regarding food units and food exchange and practiced cooking. For physical activity, participants performed aerobic exercise using dance moves choreographed to preferred popular songs.

In this study, the BMI of the experimental group decreased more than in the control group after exposure to the program. Similar results were reported by the Stroke Challenge exercise program, which combined music and choreography for elderly stroke patients and found that weight, body fat, skeletal muscle mass, and abdominal fat were reduced in the exercise group exposed to the 12-week program [16]. A similar study targeting 20 elderly women aged 60 or older reported that weight, BMI, body fat, and waist/hip circumference ratio were significantly reduced after a 12-week rhythmic exercise program [17]. The BMI of elderly participants may have decreased because these stroke prevention programs increased their skeletal muscle mass while decreasing their body fat through aerobic exercise.

In this study, systolic blood pressure for participants in the experimental group significantly decreased after exposure to the program. However, no significant differences were observed when comparing the experimental and control group. Similar results were found in a study examining a 6-month aerobic exercise and resistance program targeting 104 elders with a mean age of 63 years [18]. The authors reported that this program resulted in a decrease in blood pressure among participants. In addition, a report by the US Joint Commission on Hypertension (JNC 7) reported that systolic blood pressure can be reduced by 4–9 mmHg through the practice of regular aerobic exercise [19].

Blood pressure may have decreased after exposure to our program because exercise may have suppressed sympathetic nerve activity by improving the regulation of the autonomic nervous system while also enhancing parasympathetic nerve activity [20]. Blood pressure may also have decreased because regular exercise (3 times a week over 12 weeks) increased blood vessel elasticity and promoted heart function, which improved the ability to control blood pressure. Changes in blood pressure may have been related to changes in diet through low sodium and low cholesterol education and practice. However, diastolic blood pressure was already in the normal range for both groups before the experiment, which may explain why the program had minimal effects on this measure. For future research to accurately verify the effects of the program on blood pressure, it may be necessary to measure blood pressure before participants take high blood pressure drugs.

In this study, fasting blood sugar significantly decreased after the experiment for participants in the experimental group. This was similar to another study that decreased blood sugar for half of the participants in a low-intensity exercise program using resistance bands targeting elders aged 65 and older [21]. In this program, participants received group education 2 times a week (60 min per session) and exercised at home 3 times a week over 12 weeks. Regular aerobic and muscle strengthening exercises may have lowered blood sugar by increasing the amount of muscle and, therefore, increasing insulin sensitivity and blood sugar storage capacity. This, in turn, increases the blood sugar removal rate while reducing the amount of insulin required to maintain normal glucose tolerance [22]. This means that both aerobic exercises and muscle strengthening exercises are needed in order to maintain normal blood sugar levels among the elderly. In addition, blood sugar may have significantly decreased because both aerobic exercise and muscle strengthening exercises were completed as part of this study.

To verify the effect of this stroke prevention program on serum lipids, we measured total cholesterol, triglycerides, high-density phospholipid protein, and low-density phospholipid protein. In the experimental group, total cholesterol and triglycerides

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decreased and high-density phospholipid protein increased after exposure to the program. Similar findings were reported in a study targeting stroke patients through exercise [23]. The study found that total cholesterol and triglycerides decreased and high-density phospholipid protein increased after conducting exercise at 50–70% of the target heart rate using a stationary bike for 12 weeks. However, another study found no significant changes in the lipid levels when 20 obese women completed a 12-week resistance training program [24]. The effects on serum lipids may not be consistent across these studies because of the type, intensity, and duration of exercise, as well as the subjects being different across the studies. In addition, the lack of improvement in serum lipids in the previous study may have been because the program focused only on exercise, whereas our study focused on education and diet as well as exercise.

Serum lipid metabolism is an important indicator for the individualized risk of diabetes, obesity, and cardiovascular diseases. Serum lipid metabolism has been shown to signal hypercholesteremia and hypertriglyceridemia, as well as insulin resistance, excess body fat, and cardiovascular diseases [25]. Exercise may reduce serum lipid levels by decreasing the synthesis in the liver and activating enzymes that breakdown cholesterol and triglycerides, as well as increasing synthetic activation of high-density phospholipid protein. Therefore, if the stroke prevention program developed in this study improved serum lipid levels, it can also prevent stroke by lowering the incidence of diabetes and dyslipidemia, which are precursor diseases of stroke.

Conclusions

Based on the results of this study, participating in a stroke prevention program enabled at-risk elderly participants who lived at home in rural areas to perform health-promoting behaviors. This study evaluated the effectiveness of a prevention program on reducing risk factors that induce stroke, not on the frequency of stroke occurrence. This program may reduce the incidence of stroke by reducing risk factors and managing stroke precursor diseases. However, longitudinal studies assessing the long-term effects of stroke prevention programs on stroke occurrence are needed. In addition, studies evaluating the effects of a prevention program on the health care costs at individual and societal levels are needed.

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