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Effects of a hypertension management program by Seongcheon primary health care post in South Korea: an analysis of changes in the level of knowledge of hypertension in the period from 2004 to 2009

In Han Song[1], Sang-A Kim[2] and Woong-Sub Park[3]*

[1]Graduate School of Social Welfare, Yonsei University, Seoul, Republic of Korea, [2]Department of Silver Welfare, Dong Seoul College, Seongnam, Republic of Korea and [3]Department of Preventive Medicine and Public Health, College of Medicine, Kwandong University, Gangneung, Republic of Korea

*Correspondence to: W.-S. Park. E-mail: wspark@kd.ac.kr

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Abstract

The objective of this study was to examine the effects of a hypertension management program provided by a primary health care post located in a distant rural area in South Korea on the level of knowledge of hypertension. The panel data consisted of a total of 319 people or the entire population aged above 40 years of five villages located in Goseong-gun, Gangwon province, South Korea. Preliminary interviews were conducted with all the residents prior to their enrollment in the health care post's hypertension management program. After 5 years of program operation, follow-up interviews were carried out with the same population. A total of 207 participants who completed both interviews were used in the final analysis. First, only the hypertensive group who participated in the program exhibited a significant difference in the level of knowledge. Second, educational level was associated with the level of knowledge in the entire group. Third, the effects of the program differed by gender, with men demonstrating more significant variations in knowledge upon participating in the program. For effective use of resources, considering that the effects of a hypertension education programs worked differently for groups, more customized hypertension management programs need to be targeted at each group to improve the effectiveness of hypertension education programs.

Introduction

As a result of an unprecedented pace of aging, South Korea is witnessing a rapid surge in the number of cardiovascular patients and is thereby burdened with commensurately increasing medical costs. According to 2007 statistics on cause of death, the main cause was malignant neoplasm (cancer) with 137.5 deaths per 100 000 persons, followed by cerebrovascular disease with 59.6 deaths and ischemic heart disease with 29.5 deaths. What is notable is that the number of people who died of ischemic heart disease in 2007 rose by 115% compared with 1997. It is a well-established fact that the main trigger of such vascular diseases is high blood pressure, highlighting it as one of the primary causes of death. However, the problem goes undetected in around half the number of those who have the illness due to its relative lack of subjective symptoms. A cross-national study shows that there are no significant differences in prevalence, awareness, treatment and control of hypertension between developed and developing countries, suggesting that there is a low level of awareness, treatment and control of the ailment in almost all nations [1].

Many countries around the world have listed hypertension a major illness and made strenuous efforts to lower its occurrence rate [2]. In particular, the United States established the National High Blood Pressure Education Program in 1972 with an aim for early detection, prevention and treatment

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of the disease [3]. As a result of such efforts, the percentage of adult patients who are aware of their conditions and take regular medication has increased, raising the level of control over the illness [4]. In South Korea, the government has embarked on a similar initiative in 2001: it set goals for prevention and management of high blood pressure based on existing research and expert opinions and launched a national high blood pressure management task force in order to address the problem at the governmental level. The Korean government also initiated public awareness campaigns and education programs in the same year and launched systematic interventions for effective prevention and management of hypertension, designating public primary health care posts as major centers for hypertension management programs. In addition, a number of studies have been carried out to support those programs.

Most research on high blood pressure management programs in South Korea has focused on changes in patterns of hypertension management behavior in light of the fact that blood pressure is effectively controlled through lifestyle changes combined with proper medication [5]. In general, both studies on the relationship between management patterns and blood pressure and studies on patients and their lifestyle changes and biological indices have been conducted with local residents [6]. Jeong *et al.* [7] carried out a hypertension self-care promotion program with patients in order to investigate the effects of the program on biophysical indices, awareness and changes in self-care practice of the patients. Eom *et al.* [8] provided an education program to patients who used a primary health care post and identified changes in their awareness, attitudes and self-care practice. Go *et al.* [9] analyzed the effects of a self-care program offered through visiting nurse services on awareness, blood pressure changes and self-care of patients. Ahn [5] grouped patients into several types based on their knowledge level, attitude and practice and then investigated the characteristics of each type. Finally, Jeon [10] reported on the status of management of the illness among rural villagers within the jurisdiction of the health care post. Most of these previous studies provided basic information as well as policy and/or practical implications needed for hypertension prevention and management programs targeting patients. However, their participants were limited to patients, the verification of the effects of program was carried out without control groups or the control groups were also restricted to patients. As a result, the effects of prevention programs between non-patient and patient groups failed to be compared.

Meanwhile, the third Korean National Health and Nutrition Examination Survey in 2005 suggested that more selective and focused strategies are required in order to raise awareness and treatment rates among the less educated and among rural villagers in their 40s or older, given the high occurrence rate of the disease and its apparent link to cardiovascular diseases. It also pointed out that sustained care at the state level should be provided in combination with well-established prevention and management programs [11].

In reality, rural areas, which in general have a larger senior population but fewer medical services compared with urban areas, are short of programs designed to help patients self-manage their illness and change their lifestyle [12]. In particular, the disease tends to go unnoticed, with over 95% of geriatric hypertension in rural areas being relatively symptomless essential hypertension [7]. In this regard, it seems desirable for public health care organizations to put in place hypertension prevention and management programs along with medical check-up systems for early detection of the illness in rural areas with limited access to medical services.

This research used panel data spanning 5 years in order to look into the effects of hypertension management programs offered by public primary health care posts, which are major health care stations in rural areas of South Korea, as well as the differences by socio-demographic variables and between non-patient and patient groups. It attempts to present rationales behind the need for hypertension management programs at rural public health care posts as well as policy implications for more effective management of the illness.

Materials and Methods

Research design and hypotheses

The objective of this study was to investigate the effects of a hypertension management program provided by a primary health care post in a distant rural area on the level of knowledge of hypertension. The data consisted of the entire population aged above 40 years of five villages located in Goseong-gun, Gangwon province, South Korea. This study used an intervention control group repeated measures experimental design, in which all the residents in the five villages in Seongcheon were subject to initial measurement of knowledge of hypertension in 2004 before they decided whether to participate in a hypertension management program or not. Preliminary interviews were conducted with all the residents prior to their enrollment in the health care post's hypertension management program. After 5 years of provision of the hypertension prevention and management program, another measurement was conducted as a posttest with the same population with an aim to determine any significant differences in variations in the level of knowledge of the illness between program participants and non-participants both in normotensive and hypertensive groups.

The assumptions in this research were as the following: first, the level of knowledge of high blood pressure among program participants both in normotensive and hypertensive groups would increase compared with non-participants. Second, the variations in the level of knowledge of hypertension among hypertensive participants would be larger than among normotensive participants. Third, the effects of the hypertension management program would vary by socio-demographic variables.

Research participants

Seongcheon public health care post in Goseong-gun, Gangwon province, South Korea is installed in a distant rural area located at least 30 min away by car from the nearest medical facility. It has a trained nurse to provide basic medical services. The villages that Seongcheon health care post covers are located at the northern tip of the east side of generally under-developed Gangwon province. Most of the villagers are farmers or fishermen and 14.6% of them are aged 65 years or older. It is the only medical facility within its jurisdiction [13].

From April 21 through May 10 in 2004, preliminary home visit interviews were conducted with a total of 319 villagers aged 40 years or over who were residing in 183 households in five villages within the jurisdiction of Seongcheon primary health care post. In the first home visit interviews conducted in 2004, the Seongcheon primary health care post found that the awareness and treatment rates of high blood pressure among villagers within its jurisdiction were low and that the lifestyles of the hypertensives were inappropriate. Then, a health education program was offered to those who volunteered to participate. The organization set a 5-year hypertension management program and launched individual and group health education programs (Table I).

The villagers who were diagnosed with high blood pressure in the preliminary examination were put on a regular medication schedule after being registered in the hypertension register and management system. The hypertensives in this research refer to those who were diagnosed with hypertension in the preliminary examination.

Five years later, in 2009, another set of home visit interviews were carried out with the same population. Afterward, the panel data for a total of 207 villagers who participated in both the 2004 and 2009 interviews were compiled and subjected to the final analysis. In the 2009 interviews, the interviewees were asked if they had participated in the hypertension management program in the previous 5 years and those who responded yes to that question were defined as program participants. Figure 1 shows the participant flow.

This study protocol received approval from the local health care post in Gosung-gun and Kwandong University School of Medicine, and informed consent was obtained from all participants.

Research tools

A 23-question hypertension knowledge measurement tool developed by Jeon [10] was used to measure the level of knowledge of high blood pressure

Table I. *Structure of hypertension management program offered in five villages covered by Seongcheon primary health care post, 2004–2009*

	Title	Content	Number of sessions	Total number of participants per year
Health Education	Detection and management	Individual blood pressure checks and counseling through home visits and patient's visit to the health care agency	Once a year	1521
	Group education on chronic diseases	Each village was visited to provide education on hypertension	69 times over a 5-year period	746
	Quiz games on hypertension	Each village was visited to help improve self-care practices through a quiz game on hypertension	9 times (in 2008 and 2009)	181

Interviews on the level of knowledge of hypertension among all residents aged above 40 years were conducted as pretests before starting the program in 2004. After completing the program in 2009, follow-up interviews were carried out with the same population as posttests. Those who completed both initial and follow-up interviews (pretest and posttest) were included in the analysis. The scores were obtained from the 23-question hypertension knowledge measurement tool (Appendix 5).

(Appendix 5). This research tool was devised based on the data published by the National Hypertension Center of the Ministry of Health and Welfare with an aim to determine the level of knowledge of hypertension. The tool was selected for this research after three professors at the department of preventive medicine at a medical college located in Gangwon-do and doctors at health care posts in Gangwon-do reviewed the appropriateness of the questions in light of the purpose of the study. The 23-question measurement tool assigns 1 when the answer is right and 0 when wrong. The Chronbach's alpha reliability coefficient of the tool was 0.85.

Data analysis

SAS 10.0 was used for data analysis. First, general characteristics of the normotensive and hypertensive groups were identified. Second, the possibility of confounding variables was examined by investigating the variations in the level of knowledge of hypertension among the participants by socio-demographic variables including program participation. Third, the gaps in the variations caused by program participation or non-participation were investigated by socio-demographic variable in order to reveal the effects of the program and the possibility of interactions between socio-demographic variables. Fourth, a multivariate regression analysis was carried out with an aim to control the effects of confounding variables and analyze the interactions between variables. Analysis models established for this study are a basic model that does not include interaction variables and therefore controls only the effects of confounding variables, an extended model that includes all the variables that interact with program participation or non-participation and an optimal model established by including in the basic model only the interaction variables that produce maximum corrected r^2. For the purpose of a multivariate regression analysis, age and education were converted into dichotomous variables: less than 65 years old and 65 years old or older and less than junior high school education and junior high school education or above.

Results

General characteristics of the sample

Of 207 participants included in the final analysis, 151 persons (72.9%) participated in the program (Table II). Major general characteristics of program participants were as the following: people in their

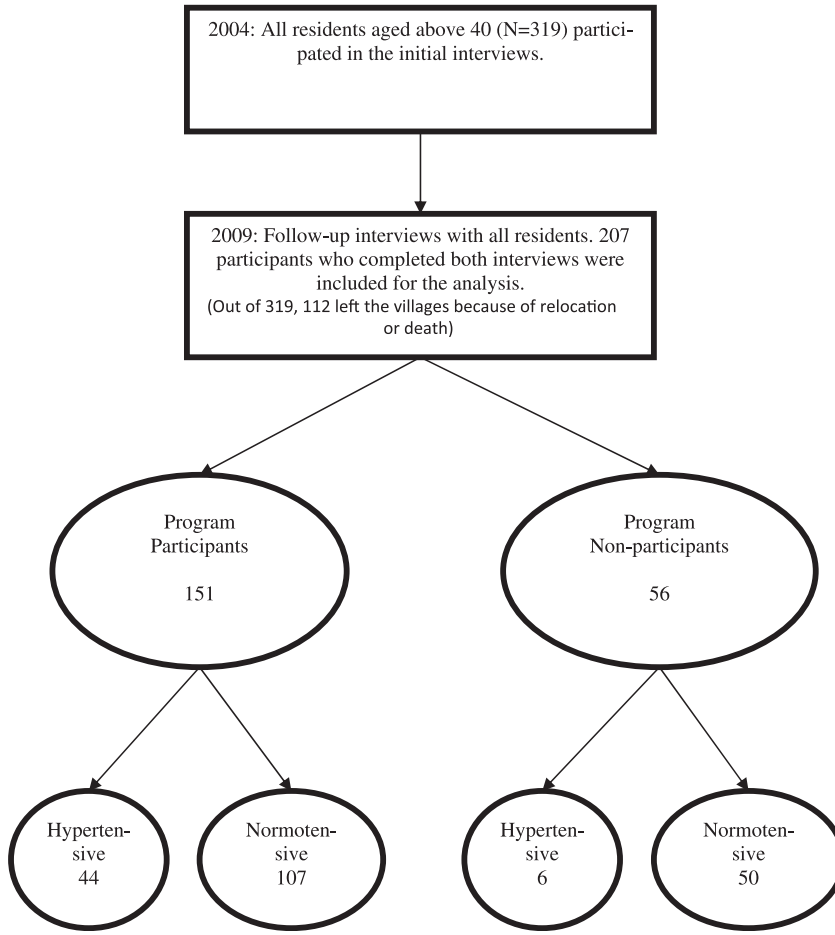

Fig. 1. Participant flow.

60s were 41.7%, women 63.6% and those with elementary school education 46.0%. 95.4% were covered by National Health Insurance. When it comes to non-participants, 64.3% were aged between 40 and 50, 60.7% men, 33.9% those with elementary school education and 96.4% covered by National Health Insurance.

In the 2004 survey, 50 individuals (24.2%) were identified as being hypertensive and 44 (88.0%) of them participated in the program, and among 150 normotensives, 107 (68.2%) participated in the program. As to general characteristics of program participants among hypertensives, 50.0% were people in their 60s, 72.7% women, 43.2% those with elementary school education and 93.2% covered by National Health Insurance. Regarding non-participants among hypertensives, 50.0% were in their 70s or older, 66.7% men and 33.3% those with elementary school education.

Among normotensives (N = 157), 46.5% were male, 57.1% had elementary school or less education and their mean age was 58.0 with a standard deviation (SD) of 10.4 in 2004. Their average diastolic blood pressure in 2004 was 119.4 (SD = 12.5), and average systolic blood pressure was 78.4 (SD = 8.5). In 2009, the average diastolic blood pressure was 125.7 (SD = 14.0), and average systolic blood pressure was 77.9 (SD = 9.3). Among hypertensives

Table II. *General characteristics of the sample*

	Normotensive (N = 157)		Hypertensive (N = 50)	
	2004	2009	2004	2009
Age, person (%)				
40–59	85 (54.1)	52 (33.1)	13 (26.0)	5 (10.0)
60–69	54 (34.4)	50 (31.9)	23 (46.0)	18 (36.0)
70–89	18 (11.5)	55 (35.0)	14 (28.0)	27 (54.0)
Gender, person (%)				
Male	73 (46.5)	—	16 (32.0)	—
Female	84 (53.5)	—	34 (68.0)	—
Education, person (%)				
No education	7 (4.5)	—	5 (10.0)	—
Literate	15 (9.6)	—	10 (20.0)	—
Elementary school	67 (43.0)	—	21 (42.0)	—
Junior high school	35 (22.4)	—	7 (14.0)	—
High school	27 (17.3)	—	7 (14.0)	—
College or above	5 (3.2)	—	0 (0.0)	—
Health insurance type, person (%)				
National Health Insurance	151 (96.2)	145 (92.4)	47 (94.0)	46 (92.0)
Other	6 (3.8)	12 (7.6)	3 (6.0)	4 (8.0)
Program participation, person (%)				
Yes	107 (68.2)	—	44 (88.0)	—
No	50 (31.9)	—	6 (12.0)	—
Age, mean ± SD (years)	58.0 ± 10.4	64.3 ± 10.3	64.3 ± 8.1	70.5 ± 8.2
Blood pressure, mean ± SD				
Diastolic	119.4 ± 12.5	125.7 ± 14.0	149.8 ± 18.1	135.5 ± 15.3
Systolic	78.4 ± 8.5	77.9 ± 9.3	93.9 ± 11.1	81.1 ± 9.3
Knowledge level, mean ± SD (points)	6.9 ± 3.0	8.9 ± 2.1	6.7 ± 3.	9.1 ± 2.0

(N = 50), 32.0% were male, 72.0% had elementary school level education or less and their mean age was 64.3 with a SD of 8.1. Their average diastolic blood pressure in 2004 was 149.8 (SD = 18.1), and average systolic blood pressure was 93.9 (SD = 11.1). In 2009, the average diastolic blood pressure was 135.5 (SD = 15.3), and average systolic blood pressure was 81.1 (SD = 9.3) (Table II).

Descriptive analysis of changes in awareness, treatment and control of hypertension from 2004 to 2009

Table III shows the changes in awareness, treatment and control of hypertension among hypertensive program participants and non-participants. Among program participants, 53.3% were aware of hypertension, 51.1% received treatments among those were aware of their hypertension and 22.2% of hypertension out of those who had treatments were controlled in 2004, while 77.6% were aware of hypertension, 77.6% received treatments and 52.9% were controlled in 2009. Among program non-participants, only 20.0% were aware of hypertension, only 20.0% received treatments among those were aware of their hypertension and no hypertension status was controlled in 2004, while 31.3% were aware of hypertension, 25.0% received treatments and 12.5% were controlled in 2009 (Table III).

Bivariate analysis of variations in the level of knowledge of hypertension by variable in 2004 and 2009

When the differences in variations from 2004 to 2009 in the level of knowledge of hypertension by variable were analyzed, the variations were significantly larger among those with less than junior

Table III. *Changes in awareness, treatment and control of hypertension among program participants and non-participants in five villages covered by Seongcheon primary health care post from 2004 to 2009*

	Year	Participants (%)	Non-participants (%)
Awareness	2004	53.3	20.0
	2009	77.6	31.3
	Difference	24.3	11.3
Treatment	2004	51.1	20.0
	2009	77.6	25.0
	Difference	26.5	5.0
Control	2004	22.2	—
	2009	52.9	12.5
	Difference	30.7	12.5

high school education compared with those who were more educated both in the normotensive group ($P < 0.01$) and the hypertensive group ($P = 0.008$). Only in the hypertensive group, program participants compared with non-participants showed a significant difference in variations in the level of knowledge of hypertension ($P = 0.024$) (Table IV).

Results of a multivariate regression analysis of variations in the level of knowledge of hypertension

Regarding the basic model, the variations were significantly larger among those with less than junior high school education compared with the more educated ($P = 0.004$). Other variables, including program participation or non-participation, did not present significant differences. A similar result was obtained when the analysis included interaction variables (Table V).

When a multivariate regression analysis was performed on the basic model that does not take into account interactions between variables, limiting it to those identified as having high blood pressure in the preliminary examination, program participants demonstrated significantly larger variations compared with non-participants ($P = 0.005$). In addition, men compared with women ($P = 0.029$) and those with less than junior high school education compared with those more educated ($P = 0.002$) showed significantly larger variations. In the extended model that included all the variables interacting with program participation or non-participation, men had significantly larger variations compared with women ($P = 0.019$), program participants exhibited significantly larger variations compared with non-participants at the 0.1 significance level ($P = 0.052$) and the interaction variable between program participation/non-participation and gender was significant ($P = 0.070$). In the final model that only included in the basic model, the interaction variable between program participation/non-participation and gender, which was the most significant among interaction variables, program participants compared with non-participants ($P = 0.001$), the variations among men compared with women ($P = 0.008$) and those with less than junior high school education compared with the more educated ($P = 0.002$) were significantly large. Also, the interaction variable between program participation/non-participation and gender exhibited significance ($P = 0.050$) (Table VI).

Implications

This study used panel data spanning 5 years in order to examine the effects of hypertension management programs by a public primary health care post and how the effects differ between normotensive and hypertensive groups and by socio-demographic variables. The summary and implications of the results of the research are as the following. First, regarding participating in the program or not, the variations among program participants both in the normotensive and hypertensive groups were larger compared with non-participants. However, the difference in the variations was significant only in the hypertensive group. In conclusion, the changes in knowledge level of hypertension among the total participant group were not significantly different from the changes among non-participants; however, within the hypertensive group, the variations in the knowledge level among program participants were significantly larger compared with non-participants.

Reasons for failing to bring out significant differences in variations in the knowledge level of high

Table IV. *Changes in the level of knowledge of hypertension: scores obtained from the 23-question hypertension self-management tool in Seongcheon primary health care post from 2004 to 2009*

Variable		2004		2009		Changes	*t*-value	*P*
		Mean	SD	Mean	SD	(± SD)		
Normotensive, points	Program							
	Participants	6.8	3.1	8.9	2.4	2.1 (± 3.3)	−0.34	0.7343
	Non-participants	7.1	2.7	9.0	1.4	1.9 (± 3.1)		
	Age							
	40–64	7.5	2.7	9.3	1.6	1.8 (±2.9)	−1.03	0.3045
	≧65	5.6	3.3	8.0	2.8	2.4 (± 3.8)		
	Gender							
	Men	7.2	2.7	8.8	2.3	1.6 (± 2.9)	1.32	0.1902
	Women	6.7	3.2	9.0	2.0	2.3 (± 3.5)		
	Education							
	Less than junior high school	6.1	3.2	8.6	2.5	2.7 (± 3.5)	−2.65	0.0089
	Junior high school or above	8.1	2.0	9.4	1.3	1.3 (± 2.3)		
	Medical insurance, type							
	National Health Insurance	7.0	2.9	8.9	2.1	2.9 (± 3.2)	1.84	0.0673
	Other	4.8	4.1	9.2	0.8	3.4 (± 3.6)		
Hypertensive, points	Program							
	Participants	6.7	3.2	9.5	1.2	2.9 (± 3.2)	−2.32	0.024
	Non-participants	6.7	3.3	6.2	3.5	-0.5(± 4.6)		
	Age							
	40–64	7.3	3.2	9.5	1.6	2.2 (± 3.2)	−0.52	0.605
	≧65	6.0	3.1	8.8	2.3	2.8 (± 3.8)		
	Gender							
	Men	6.0	2.7	8.7	1.7	2.7 (± 3.3)	−0.29	0.777
	Women	7.0	3.3	9.4	2.0	2.4 (± 3.6)		
	Education							
	Less than junior high school	5.8	3.2	9.1	2.1	3.3 (± 3.6)	−2.76	0.008
	Junior high school or above	8.8	1.8	9.2	1.6	0.4 (± 2.3)		
	Medical insurance, type							
	National Health Insurance	6.7	3.2	9.1	2.0	2.5 (± 3.6)	−0.07	0.941
	Other	6.7	3.5	9.0	1.0	2.3 (± 3.1)		

blood pressure between program participants and non-participants in the normotensive group can be attributed to several factors: first, high blood pressure tends to go undiagnosed due to its lack of subjective symtoms; second, even when diagnosed, it is not managed well; third, as Yoon [14] explained, those with fragile health have a higher desire for disease management programs. In other words, in a situation when even the patients with high blood pressure are reluctant to change their lifestyle, unless they are suffering serious complications, as the illness progresses without symptoms, those who believe they are healthy are even less likely to be motivated to learn about the illness.

The significant changes in the knowledge level of hypertension among hypertensive program participants are in line with the results obtained by [15], who educated their subjects with information on the disease, exercise and drug compliance through a high blood pressure management program and observed an increase in the level of awareness, regular medication practice and drug compliance. Eom *et al*. [8] also reported in a study on the effects of hypertension education programs on awareness,

Table V. *Results of regression analysis of variations in changes of knowledge score of hypertension among normotensive individuals: scores obtained from the 23-question hypertension knowledge measurement tool in Seongcheon primary health care post from 2004 to 2009*

	Basic model (points)				Extended model (points)			
	Regression coefficient	Standard error	*t*-value	Significance probability	Regression coefficient	Standard error	*t*-value	Significance probability
Constant	3.77	1.38	2.74	0.001	3.42	1.41	2.44	0.016
Whether participating in the program or not	−0.23	0.54	−0.43	0.665	0.40	0.97	0.42	0.677
65 years old or older	0.43	0.56	0.78	0.437	−1.18	1.10	−1.16	0.870
Gender (men)	−0.56	0.50	−1.12	0.266	−0.62	0.98	−0.64	0.523
Less than junior high school education	1.02	0.53	1.93	0.055	2.35	0.91	2.57	0.011
National Health Insurance	−2.17	1.27	−1.71	0.090	−2.17	1.30	−1.67	0.097
Whether participating in the program or not × 65 years old or older					0.92	1.29	0.72	0.474
Whether participating in the program or not × gender (men)					0.14	1.16	0.12	0.905
Whether participating in the program or not × junior high school education or above					−1.98	1.12	−1.77	0.079
	$r^2 = 0.068$ Adjusted $r^2 = 0.037$				$r^2 = 0.088$ Adjusted $r^2 = 0.039$			

attitudes and lifestyle changes among patients that only program participants showed significant improvement in their awareness and attitudes.

Second, in an analysis of variations in the knowledge level over a 5-year period viewed by sociodemographic characteristics, the knowledge level increased significantly among those with less than junior high school education in the total participant group and among men and among those with less than junior high school education in the hypertensive group. It is assumed that men and the less educated, who had showed lower knowledge level of high blood pressure before the program, have been able to learn a great deal more about the illness over the course. As to the variations by gender, there was no significant difference in the bivariate analysis; however, men demonstrated larger variations in the multivariate regression analysis. These results can be attributed to participating in the program or not and education serving as confounding variables, given that while the number of male participants was smaller than that of female participants ($P = 0.052$), more men had junior high school education or above compared with women ($P = 0.018$). When a multivariate regression analysis was performed only with program participation/non-participation, education and gender in order to look into such possibility, the variations by gender exhibited significance ($P = 0.034$).

Third, the effects of the program turned out to be affected by gender, with women showing significant variations in the level of knowledge of high blood pressure by program participation. This result is similar to the findings by Gang *et al*. [16], who obtained different results by gender when nutrition education was offered to senior participants with diabetes, another chronic disease. When the researchers measured changes in the appropriateness of diet and

Table VI. *Results of regression analysis of variations in changes of knowledge score of hypertension among hypertensive individuals: scores obtained from the 23-question hypertension knowledge measurement tool in Seongcheon primary health care post from 2004 to 2009*

	Basic model (points)				Extended model (points)				Final model (points)			
	Regression coefficient	Standard error	*t*-value	Significance probability	Regression coefficient	Standard error	*t*-value	Significance probability	Regression coefficient	Standard error	*t*-value	Significance probability
Constant	−6.11	2.85	−2.15	0.037	−11.26	5.15	−2.19	0.035	−9.42	3.20	−2.94	0.005
Whether participating in the program or not	4.28	1.43	3.00	0.005	9.78	4.88	2.00	0.052	7.79	2.22	3.51	0.001
65 years old or older	0.28	0.95	0.30	0.765	2.50	3.02	0.83	0.412	0.55	0.93	0.60	0.555
Gender (men)	2.38	1.05	2.26	0.029	8.25	3.37	2.45	0.019	7.27	2.63	2.76	0.008
Less than junior high school education	3.44	1.06	3.24	0.002	3.50	3.02	1.16	0.253	3.49	1.03	3.39	0.002
National Health Insurance	1.54	1.96	0.78	0.437	1.26	1.94	0.65	0.522	1.38	1.90	0.72	0.473
Whether participating in the program or not × 65 years old or older					−2.16	3.18	−0.68	0.500				
Whether participating in the program or not × gender (men)					−6.60	3.55	−1.86	0.070	−5.64	2.80	−2.02	0.050
Whether participating in the program or not × junior high school education or above					0.06	3.22	0.02	0.985				
	$r^2 = 0.310$ Adjusted $r^2 = 0.232$				$r^2 = 0.377$ Adjusted $r^2 = 0.255$				$r^2 = 0.370$ Adjusted $r^2 = 0.282$			

level of nutritional balance using the Index of Nutritional Quality (INQ) before and after the program, they found that only the INQs for calcium and riboflavin among women showed a significant increase after the program, suggesting that the effects of the program were more significant among women than among men [16]. INQ suggests balanced nutrition when it is greater than 1. While the INQ for calcium among men increased by 0.3 from 0.8 to 1.1 after the program and by 0.4 from 0.6 to 1.0 among women, only the increase among women was significant ($P < 0.05$). The INQ for riboflavin showed a similar result: it rose by 0.2 from 0.7 to 0.9 among men and by 0.3 from 0.6 to 0.9 among women, while the result was significant only among women ($P < 0.05$). In addition, research by Kim and Park [17] on the effects of 3-month online health education program on patients with diabetes found that men's cholesterol was more significantly reduced after the program compared with that of women. However, male participants in this study were younger than their female counterparts, with men aged 39.2 on average and women 42.4. As the paper failed to verify the relationship between the difference in age and the effects of education, this age difference may need to be considered in interpreting the results. Finally, according to Lee *et al.* [18], who studied gender differences in the effects of education, the biggest reasons for gender difference in education are the differences in interest and perspectives between the two sexes. Given that a number of relevant studies including this one report gender difference in effects of education, education programs reflecting gender difference are called for.

Prevention and treatment of high blood pressure is not simply a personal health issue but also an important concern in terms of a nation's health policies. However, South Korea has yet to provide high blood pressure management programs designed to help improve people's lifestyles. In particular, rural areas, in which the occurrence rate of hypertension is high due to an aging population but proper medical services are scarce, have a greater need for efficient disease management programs given its wider coverage relative to limited access to health professionals and facilities.

The key results and policy implications of this research are as the following. First, the variations in the knowledge level of hypertension exhibited by the general population who participated in the program were not significantly different from those by non-participants due to the effects of external factors other than program participation. However, the difference was significant in the hypertensive group. This means that in order to ensure more effective use of resources and cost-effective health policies, approaches customized to the level of knowledge are more desired. More intensive and focused education programs of hypertension management can be provided for hypertensive patients, and more customized health education programs need to be provided for the general population to increase the level of knowledge of hypertension.

Second, the education was more effective for women than men, implying that more customized education may be needed when targeting male hypertensives.

Finally, this research has several limitations. First, the findings of this research may not be generalized as it is limited to hypertensives who were using a health care post in a specific area. Second, due to the nature of the original program design and the limitation of the data, this study was unable to show the differences in all the areas of knowledge, awareness, treatment and hypertension control levels. Future research on these dimensions will provide better understanding of hypertension education. Third, since the program was run by a single person, it is practically impossible to differentiate the effects of the program and the effects of the program facilitator. Fourth, the interpretation of the results of this research can be limited by its small sample size: the results obtained from this sample may not be applied in a wider rural community. Also, because the number of program participants in some categories was small due to a small sample size, there was a statistical limitation in comparing groups to detect predictors for change among hypertensives and non-hypertensives. In this regard, further research on programs that have greater representation and more information with a larger number of participants and that are run by a larger number of facilitators is needed.

Conflict of interest statement

None declared.

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Appendix 1. Questions used in 2004 and 2009 interviews to identify knowledge level of hypertension.

The following questions are to measure the level of knowledge of hypertension. Please mark V where appropriate.	Yes	No	Don't Know
1. The risk of hypertension increases as you age.			
2. Men are more likely to have hypertension than women.			
3. The chances of getting hypertension go up if your parents have or had it.			
4. Overweight people are more likely than others to develop hypertension.			
5. Regular exercise can keep your blood pressure in target range.			
6. Eating a diet high in sodium increases your blood pressure.			
7. Eating a diet based on fruits, vegetables and low-fat food lowers your blood pressure.			
8. Heavy drinking lowers your blood pressure.			
9. Smoking increases the chances of medical complications and cardiovascular diseases.			
10. A relaxed and stress-free lifestyle helps lower your blood pressure.			
11. If your blood pressure is over 140/90 mmHg, you have hypertension.			
12. There are systolic pressure and diastolic pressure.			
13. Blood pressure does not change.			
14. High blood pressure always accompanies headache or dizziness.			
15. Untreated hypertension can cause problems in heart and kidney.			
16. Untreated hypertension can cause a stroke.			
17. Untreated hypertension can cause problems in eyes.			
18. An excessive exercise or a sudden strain can cause medical complications in hypertension patients.			
19. A sudden move to a cold place or switching between cold and hot tubs increases blood pressure.			
20. For hypertension patients, excessive strain when moving bowels can increase blood pressure and be a cause of complications.			
21. If your blood pressure turns normal after medication, you can stop taking medication.			
22. You should manage your hypertension throughout your whole life.			
23. Hypertension patients should take medication on a regular basis.			