Effectiveness of Telemedicine: Videoconferencing for Low-Income Elderly with Hypertension

Hanna Choi, RN, MSc, and Jeongeun Kim, RN, PhD, INS

College of Nursing, Seoul National University, Seoul, South Korea.

Abstract

Objectives: Develop educational materials and a classification system for remote consultations and home-based healthcare through videoconferencing, manage the blood pressure of patients through a ubiquitous-health (u-health) service, and identify its effects on the blood pressure and level of depression of the service recipients (i.e., low-income elderly patients with hypertension). **Materials and Methods:** This study is a nonequivalent control group pre-test-post-test, quasi-experimental study. Low-income essential hypertensive patients above 65 years of age living in public rental housing were our target group. They were divided into two groups: an experimental group of 25 who had received blood pressure monitoring as well as inbound-outbound remote video consultation and a control group of 24 who received blood pressure monitoring through u-health equipment but no other management. In total, 16 sessions were conducted twice a week for 8 weeks. **Results:** (1) The hypothesis that there would be a difference in the level of depression between the control group and the experimental group who received the u-health service was rejected because of the lack of a significant statistical difference ($t = -0.142$, $p = 0.889$). However, there was a significant difference before and after the service in the experimental group ($t = 2.49$, $p = 0.021$). (2) Concerning the second hypothesis—that there would be a difference in systolic and diastolic blood pressure between the control group and the experimental group—there was a statistically significant decrease in systolic blood pressure ($F = 10.26$, $p = 0.003$), but diastolic blood pressure showed no significant difference ($F = 2.802$, $p = 0.101$). Thus, the hypothesis was partially adopted. (3) The third hypothesis stated that the rates of sleep ($p = 0.012$) and hobbies ($p = 0.036$) as aspects of a healthy lifestyle in the experimental group would be significantly higher than those of the control group. **Conclusions:** These findings confirm that the u-health nursing service via videoconferencing made a measurable contribution to a healthier lifestyle by reducing systolic blood pressure levels compared with those who were only monitored for high blood pressure. Therefore, this service is recommended as part of a hypertension management regimen for low-income elderly people as an effective means of nursing intervention.

Key words: ubiquitous-health nursing, hypertension, depression, blood pressure, low-income elderly, telemedicine

Introduction

According to the World Health Organization's statistics in 2012,¹ around one-third of the world's population—and more than half in some African countries—suffer from hypertension. Because of the steadily aging population and the consequent increase in chronic diseases, hypertension comprises the highest portion of chronic disease in Korea (56%). Among all deaths due to apoplexy and cardiovascular diseases, hypertension is known to be responsible for 51% and 45%, respectively.²

The cost to treat cardiovascular disease, one of the most critical factors related to the total treatment cost at clinics, shows very high correlation with spending on hypertension—which is a risk factor for cardiovascular disease. This requires careful observation.¹

The low-income bracket in Korea, like in developing countries in which people lack proper diagnostic opportunities, lacks access to medical services because of their financial circumstances, a lack of interest in healthcare, and their inability to go to the hospital on their own—especially in the case of elderly living alone.³ The number of low-income elderly residents has increased steadily each year, reaching 1.04 million in 2010 in Korea. There is a desperate need for preventive measures and continuous medical care in this population.⁴ Depression among low-income elderly people who are experiencing financial and health difficulties is another rising issue. Depression causes changes in the autonomic nervous system, which increases the possibility of cerebrovascular disease as a consequence of the decreased blood flow.⁵ In addition, patients with depression tend to dismiss medical prescriptions and recommended improvements of unhealthy habits. In one study in this area, it was found that hypertensive patients with depression are 2.3–2.7 times more likely to suffer from apoplexy than those without depression.⁶

Hypertension, sometimes called the “disease of habit,” can be prevented and managed through adequate lifestyle adjustments. Experts repeatedly emphasize the importance of managing this chronic disease by decreasing blood pressure (BP) through healthy habits. This is true in all stages of hypertension treatment.⁷ Proper management of related behavior—obviously without the side effects that follow other medications or treatments—is an effective means of treating hypertension.

Currently, however, most hypertension patients are taking medications from prescriptions they receive every 1 or 2 months as the only source of disease management. This situation is due to the short interaction time with their doctors and the difficulties in starting and maintaining good habits such as proper exercise, a good diet, and stress management, all of which would be effective methods to manage risk.⁷

Therefore, the current healthcare system, focused on instant medication and treatment, is often criticized as being unsuitable for chronic diseases, which require thorough management over a long period of time. Such a need for alternative therapeutic treatments was recognized a long time ago by the international society.⁸

Ubiquitous-health (u-health) service, in light of the current need for more accessible treatments at a lower social cost, is seen as possibly able to complement the current healthcare system and increase its flexibility.⁹

Such a service may require time and financial commitment in its initial stages, for instance, to purchase equipment and educate service providers and recipients. In the long run, however, it will save time and money by decreasing the number of hospital visits and the rate of hospitalization and by encouraging patients to follow their prescriptions and recommendations, via increasing the frequency of visits thorough teleconferencing. Many studies claim that the application of such a service is financially feasible because, although chronic diseases such as hypertension require long-term management, BP measuring devices and communication devices such as the computer and the smartphone and the software to run these devices are all becoming easier for patients to use and understand. Therefore, fewer people would require education over time.^{10–12}

Previous u-health service development efforts focused on measuring and transmitting data—a type of one-way technology. However, this led to a lack of advances related to the provision of user-specific information to empower the user to manage his or her health. In particular, research on interactive u-health nursing services and symptom-specific services is very rare. Thus, more intensive research in the area is necessary.

The present study was conducted to provide primary data on the feasibility of a u-health nursing service as a type of extended management service to low-income hypertension patients at a reduced cost.

A well-organized classification system of symptoms and a systematic u-health service would allow users to receive consistent service over long periods of time. It would also instill in service providers the confidence that, with the adoption of new technology, they can efficiently provide coherent service. It would not only raise the satisfaction level of both the recipient and the provider of the service, but also contribute to developing a more effective medical service system.^{13,14}

Materials and Methods

RESEARCH OBJECTIVES

By developing educational materials and a classification system for remote consultations and managing the BP of patients through a u-health service, to identify its effects on the BP and level of depression of the service recipients (i.e., low-income elderly patients with hypertension).

DEFINITIONS

1. *Teleconferencing.* Teleconferencing in this article refers to patients receiving feedback on BP measurements and BP management as well as information on depression and other

health issues from u-health nurses through the u-health management monitor at their homes.

2. *BP monitoring.* In this research, patients are educated so that they can measure their own BP periodically at home or in public areas or the intensive care place in the senior citizens' center using a u-health device. The measurements are sent to servers, and the condition of the patient is analyzed through a clinical decision support system (CDSS). The results—classified into color codes of green, yellow, and red based on the condition of the patient—are sent to the patient and to the patient's healthcare provider. The numerical measurement results are regularly monitored by a u-health nurse.

PROTOCOL DEVELOPMENT

To develop a u-health nursing service for low-income elderly patients with hypertension, because of the lack of a consultation system specific for low-income elderly people, the following process, which includes a literature review and a survey, was used to develop a classification system for high-frequency signs and symptoms and educational material to encourage behavioral changes.

Identifying the major symptoms: analyzing and listing the major symptoms of hypertension and utilizing the educational material. From June 12 to June 28, 2012, key words such as “low-income elderly,” “tele-health,” and “hypertension” were searched for in both Korean and foreign search engines, including the KoreaMed, Kmbase, RISS, Google Scholar, Cochrane, Embase, PubMed (Medline), and Scopus databases, to find services that manage the habits of low-income elderly patients with hypertension. Results that seemed appropriate for elderly Korean people (11 articles, 2 educational brochures from regional governments, and 3 Web sites) were selected. Based on the results, a list of contents to manage signs and symptoms common in low-income elderly was created.

Need assessment: survey on high-frequency symptoms. Given that the literature review does not include the level of demand related to social economic state by patients, we conducted a survey on hypertension patients who were either members of a senior club or residents (above 65 years of age) of permanent rental housing in Seoul from July 1 to July 27, 2012. Patients who were excluded were those with life expectancy below 3 years due to illness such as terminal organ failure, severe cancer, or acute infectious illness (e.g., novel influenza) and those with mental illness. In total, 159 patients were surveyed by four nurses who had received the same training and education. The survey consists of questions centering on general characteristics as well as open-ended questions in which a nurse asks about symptoms that occur most frequently and those that cause the greatest level of pain. The respondents answered verbally.

Primary service protocol development: an additional literature review and a classification step (listing). An additional literature review of the symptoms and educational contents newly found in the demand analysis was conducted to classify them into a list.

Final protocol development: expert recommendations. Afterward, we consulted three nurses and three professors of nursing to determine which symptoms and signs would be included in the final version.

PARTICIPANTS

We enrolled male and female hypertension patients older than 65 years of age who were taking an antihypertensive drug, who currently resided in the Permanent Rental Apartments for the low-income in Seoul, and who understood the purpose of the research and agreed to participate in the research in written form.

Subjects were required to have been diagnosed, according to Hypertension Joint National Committee 8 (2011) standards, as stage 1 or 2, received medication for over a year, and not changed medication for the past 3 months.

When the BP measurement exceeded 140/90 mm Hg, measurements were repeated twice after a 2-min gap until the difference between the measurements was below 5 mm Hg. The first measurement was discarded. Individuals with the last two measurements exceeding 140/90 mm Hg were chosen for the research after hypertension possibilities were explained to them.

Conditions for exclusion were patients with a life expectancy below 3 years due to illness such as terminal organ failure, a severe form of cancer, or acute infectious illness (e.g., novel influenza), those with mental illness, and those with hearing problems.

Based on level of significance ($\alpha=0.05$), the power of the test ($\beta=0.2$ power of the test 80%) and the effect size ($d=0.5$), the size of the sample ($n=21$) was chosen according to the recommendation table in *Statistical Power Analysis for the Behavioral Science* by Cohen.¹⁵ However, the number of samples had to be increased by 10% because of the anticipated dropout rate. Thus, in total, 50 people—the experimental and the control group—were recruited in the course of 2 weeks.

DATA COLLECTION, MEASURES, AND ANALYSIS

The patients were either visited in their homes or asked to come to a public place such as a senior citizen center. The objective of the research was explained to the patients by visiting nurses; the research guidebook and u-health device were shown to the participants, and measurements to insure their eligibility were carried out by trained, licensed nurses. Those who were eligible and who agreed to the terms of the research signed a consent form. Information on payment was given to them, and an agreement paper regarding the use of personal information was signed.

To provide personalized intervention, the patients were shown how to use the equipment and were asked to repeat the process. When bio-information or a survey required a re-measurement due to personal circumstances of the patients, an appointment was made to conduct the necessary measurements. After the health condition of each patient was scanned through a survey, appointments were made to install Internet service and the equipment. When a patient decided to opt out of the research anytime during the process, his or her request was acted on as quickly as possible.

The equipment operators visited the residential area of the patients during the following week to install the necessary Internet service and u-health device. During the same period of time, nurses visited them to explain the functions provided by the equipment, such as body measurements, videoconferencing, and the health videos that were provided. After the process, from the booting of the computer to the transmission of information, was explained, the patients were asked to repeat the measurement process to ensure that they understood the entire procedure. The process of training was repeated if they failed to use the equipment properly. The nurses also checked the residential environment, including the ventilation and drainage systems.

The experimental group received remote consultation twice a week. The consultation was mainly related to BP monitoring, which included a BP check, drug intake data, and clarification of events that may have affected their BP. Trouble areas were also monitored to provide customized management and to support them emotionally in an effort to mitigate depression. The control group received no further mediation after the installation of the equipment and the initial training.

After the research period, the changes were surveyed and measured. The equipment was collected afterward. The data collection and mitigation period of the research was August 17, 2013–October 28, 2013.

BP measurement. An A&D (Saitama, Japan) UA-767 Plus BT-C BP monitor was used to measure the systolic and diastolic BP (mm Hg). When a person follows the instructions on the screen, systolic and diastolic measurements are displayed on the screen of the u-health device. At the same time, the results are sent to the server and saved in a database by an IEEE 11073 standard communication manager program according to the standard Bluetooth® (Bluetooth SIG, Kirkland, WA) communication protocol. Accumulated data are also accessible on the portal Web site.

Depression. The Geriatric Depression Scale Short Form–Korea version was used to measure depression. The units to assess depression for senior citizens developed by Sheikh and Yesavage¹⁶ were modified to suit Koreans. This led to a split-half reliability of 0.94.¹⁷ This tool is composed of 15 questions. Its “yes” (0)/“no” (1) scheme allows a range of 1–15. The negative questions (1, 5, 7, 11, and 13) were inverted. In this measurement system, results in the range of 10–15 signify severe depression requiring diagnosis, 5–9 is considered mild depression, and below 4 is normal. The credibility, or Cronbach’s alpha, for this tool was 0.90. This value was 0.85 in the present study.

Healthy lifestyle. Adjusted versions of “Healthy Lifestyles” by Breslow and “Lifestyle Behavior” by Greenberg were used in this study.¹⁸ The following aspects were surveyed and analyzed: six habits from “Healthy Lifestyles”—smoking, drinking, exercise, sleep hours, breakfast, and snacking—and behaviors from “Lifestyle Behavior”—including health checks, a habit of relaxing, eating balanced meals, drinking too much coffee, and hobbies (stress management)—were used. Bad habits were given a “0,” and good ones were scored with a “1.”

Statistical analysis. Statistical Package for Social Science (SPSS) version 19.0 for Windows was used to analyze the data: (1) Descriptive statistics—frequency analysis, mean, and standard deviation—were used to examine the general characteristics of the patients and their depression and systolic/diastolic BP levels. (2) The homogeneity of the two groups and the effects of the protocol were analyzed by a *t* test and a chi-squared test, respectively; pre-test–post-test differences were verified by Fisher's exact test, a *t* test, and an analysis of covariance. (3) The level of statistical significance in this research was set at $p < 0.05$. Cronbach's α for each tool used to measure dependent variables was calculated to verify the credibility of each tool.

Results

DEVELOPMENT OF THE U-HEALTH NURSING SERVICE

In order to survey the difficulties experienced by patients above 65 years of age, four trained nurses conducted a survey from July 1 to July 27, 2012. Eighty-five respondents (54.8%) were 65–75 years of age, 64 (40.3%) were 75–85 years of age, and 10 (6.9%) were older than 85 years of age. The education level of 84 of the patients (85.5%) was below middle school; 90.5% were jobless. One hundred two (64.1%) lived alone, 16 (10.1%) lived with their spouse, and 41 (25.8%) lived with their children.

A demand analysis was conducted to identify actual difficulties experienced by the patients. Four symptoms of hypertension—headache, difficulty in breathing, fatigue, and dizziness—were identified through a needs assessment. Meanwhile, the literature indicates additional symptoms, including heart acceleration, sight problems, nasal bleeding, and chest pain. These symptoms were added to the list of symptoms, for eight in total. Six other investigated symptoms of hypertension—feeble health, blackouts followed by stomachache, fever, neck pain, numbness, and tingling—were also added to the list, making the total 14. Thus, in total, 17 factors were developed: three hypertension-related illnesses, eight symptoms, and six related symptoms.

EFFECTIVENESS OF TELEMEDICINE

User characteristics and homogeneity. Out of a total of 49 respondents, 32 were female (65.3%), and 17 were male (34.7%). Their average age was 72.2 years, with 26 people (53.1%) in the age bracket of 70–79 years, making it the largest group. Thirteen of them (28.6%) had received no formal education, 15 (30.6%) had graduated only from primary school, and 11 had graduated from middle school (26.5%). Because 32 patients (85.7%) had an academic background below middle school, many of them had difficulty even when asked to write their names on the consent form. There were 31 single household dwellers, 7 couples, and 11 respondents who were living with their children. These numbers show they were not receiving proper care on the whole. Forty-four of them (88.9%) did not have employment; in fact, only one in the experimental group and four of the control group had a job. Accordingly, their financial conditions were very poor. Thirty-one were living on less than 300,000 won per month. Seven of them spend around 300,000–500,000 won per

month, and 11 required 500,000–1,000,000 won per month. None reported requiring more than 1,000,000 won per month.

In the results of a homogeneity analysis of the general characteristics through a chi-squared test and Fisher's exact test, there were no differences found between the experimental and the control group. Thus, the two groups were homogeneous in terms of their characteristics, as shown in *Table 1*.

Table 1. Homogeneity Test of General Characteristics ($n = 49$)

CHARACTERISTIC	FREQUENCY (%)			χ^2	<i>P</i>
	EXPERIMENTAL (<i>N</i> = 25)	CONTROL (<i>N</i> = 24)	TOTAL (<i>N</i> = 49)		
Gender					
Male	8 (32)	9 (37.5)	17 (34.7)	0.16	0.690
Female	17 (68)	15 (62.5)	32 (65.3)		
Age (years)					
60–69	10 (40)	8 (33.3)	18 (36.7)	2.62	0.324 ^a
70–79	11 (44)	15 (62.5)	26 (53.1)		
> 80	4 (16)	1 (4.2)	5 (10.2)		
Educational level					
Illiteracy	4 (16)	10 (37.5)	14 (28.6)	6.10	0.162 ^a
Elementary school	11 (44)	4 (16.7)	15 (30.6)		
Middle school	6 (24)	7 (20.8)	13 (26.5)		
High school or above	4 (16)	3 (12.5)	7 (14.3)		
Status of living together					
Living alone	18 (72)	13 (54.2)	31 (63.3)	4.45	0.118 ^a
With spouse	1 (4)	6 (25)	7 (14.3)		
With spouse, children	6 (24)	5 (20.8)	11 (22.4)		
Status of residence					
5 years	4 (16)	1 (4.2)	5 (10.2)	2.33	0.437 ^a
5–10 years	2 (8)	1 (4.2)	3 (6.1)		
10–20 years	19 (76)	22 (91.7)	41 (83.7)		
Job					
Yes	1 (4)	4 (16.7)	5 (10.2)	2.14	0.189 ^a
No	24 (96)	20 (83.3)	44 (88.9)		
Income (won per month)					
< 300,000	18 (72)	13 (54.2)	31 (63.3)	4.45	0.118 ^a
300,000–500,000	1 (4)	6 (25)	7 (14.3)		
500,000–1,000,000	6 (24)	5 (20.8)	11 (22.4)		
> 1,000,000	0	0	0		

^aBy Fisher's exact test.

The results of a homogeneity test results of systolic/diastolic BP and depression levels in the experimental and control groups before the u-health service are shown in Table 2. The BP result (a statistically significant difference) shows that they are not homogeneous ($t=3.61$, $p=0.001$). Meanwhile, the depression level was not significant and was thus homogeneous ($p=0.184$).

The results of the homogeneity test of 'Healthy lifestyle s' did not show statistically significant values, proving that the experimental and the control group are homogenous, as shown in Table 3.

BP outcome. The hypothesis that there would be a difference in systolic and diastolic BP between the control group and the experiment group was partially adopted. An analysis of covariance was conducted to confirm the effect of telemedicine for BP because the BP of the two groups was not homogeneous. The difference of resulting systolic BP between the control and experimental groups was statistically significant: 118.79 ± 2.505 mm Hg and 131.51 ± 2.655 mm Hg ($F=10.26$, $p=0.003$), respectively, in revised BP. The difference in diastolic BP was not statistically significant, however: 76.50 ± 10.785 mm Hg and 75.30 ± 4.945 mm Hg ($F=2.802$, $p=0.101$), respectively (Table 4). The respective systolic and diastolic BP values decreased significantly from 142.36 ± 13.39 mm Hg and 82.16 ± 10.68 mm Hg in pre-test to 123.54 ± 13.65 mm Hg and 76.5 ± 10.78 mm Hg in post-test ($p=0.001$ and $p=0.028$, respectively), resulting in decreases of 18.82 ± 3.80 mm Hg and 5.66 ± 12.11 mm Hg, respectively, in the experimental group. The diastolic BP of the experimental group and diastolic/systolic BP of the control group showed no significant difference ($F=2.802$, $p=0.101$) ($p=0.20$ and $p=0.24$, respectively) (Tables 4 and 5).

Depression outcome. The hypothesis that there would be a difference in the level of depression between the control group and the experimental group (which received the u-health service) was

Table 2. Homogeneity Test of Blood Pressure and Depression

PARAMETER, GROUP	MEAN ± SD	T	P
SBP			
Experimental group (n= 25)	142.36 ± 13.39	4.90	<0.001 ^a
Control group (n= 24)	122.87 ± 15.43		
DBP			
Experimental group (n= 25)	82.16 ± 10.68	3.61	0.001 ^a
Control group (n= 24)	72.82 ± 7.85		
Depression			
Experimental group (n= 25)	9.32 ± 3.92	1.35	0.184
Control group (n= 24)	7.75 ± 4.22		

^a $p < 0.01$ indicates a significant difference.

DBP, diastolic blood pressure; SBP, systolic blood pressure; SD, standard deviation.

Table 3. Homogeneity Test of Healthy Lifestyle

CHARACTERISTIC	FREQUENCY (%)		χ^2	P
	EXPERIMENTAL GROUP (N= 25)	CONTROL GROUP (N= 24)		
No smoking				
Yes	21 (84)	20 (83)	0.001	1 ^a
No	4 (16)	4 (17)		
Less drinking				
Yes	17 (68)	17 (71)	0.05	0.830
No	8 (32)	7 (29)		
Exercise				
Yes	11 (44)	13 (54)	0.51	0.477
No	14 (56)	11 (46)		
Sleeping				
Yes	11 (44)	12 (46)	0.18	0.674
No	14 (56)	12 (54)		
Breakfast				
Yes	17 (68)	21 (88)	2.67	0.171 ^a
No	8 (32)	3 (12)		
Less snack				
Yes	21 (84)	15 (63)	2.90	0.114 ^a
No	4 (16)	9 (37)		
Check-up				
Yes	11 (44)	15 (63)	1.68	0.256
No	14 (56)	9 (37)		
Rest				
Yes	23 (92)	19 (79)	1.65	0.247 ^a
No	2 (8)	5 (21)		
Balanced diet				
Yes	8 (32)	8 (33)	0.01	0.921 ^a
No	17 (68)	16 (67)		
Less coffee				
Yes	20 (80)	20 (83)	0.01	1 ^a
No	5 (20)	4 (17)		
Hobby				
Yes	8 (32)	8 (33)	0.01	0.921
No	17 (68)	16 (67)		

^aBy Fisher's exact test.

Table 4. Analysis of Covariance of Postintervention Systolic and Diastolic Blood Pressures

SOURCES	SS	DF	MS	F	P
SBP					
Pre-test	1,247.344	1	1,247.344	9.757	0.003 ^a
Condition	1,311.047	1	1,311.047	10.255	0.003 ^a
Error	5,752.988	45	127.844		
Total	756,937.010	48			
DBP					
Pre-test	6.618	1	6.618	0.095	0.759
Condition	195.007	1	195.007	2.802	0.101
Error	3,131.762	45	69.595		
Total	280,030.030	48			

^a $p < 0.01$ indicates a significant difference.

DBP, diastolic blood pressure; MS, Mean Square; SBP, systolic blood pressure; SS, Sum of squares.

rejected because the lack of a significant statistical difference in the post-test as a homogeneity analysis indicated no differences between the two groups ($t = -0.14$, $p = 0.89$) (Table 6). However, there was a significant difference before and after the intervention in the experimental group ($t = 2.49$, $p = 0.021$).

Healthy lifestyles outcome. According to the analysis of the “healthy habits” of the experimental and control groups after the test, there was a significant difference in sleep patterns and hobbies (methods of managing stress), as shown in Table 7. The experimental group, which received the u-health nursing service, showed an increased value for “sufficient amount of sleep” (7–8 h), from 44% ($n = 11$ respondents) to 57% ($n = 13$). The control group, on the other hand, showed a significant drop ($p = 0.037$) from 46% ($n = 12$) to 21%

Table 5. Comparison of Blood Pressure (Pre-test–Post-test) Within a Group

GROUP, BP	PRE-TEST	POST-TEST	T	P
Experimental group ($n = 25$)				
SBP (mm Hg)	142.36 ± 13.39	123.54 ± 13.65	6.82	0.001
DBP (mm Hg)	82.16 ± 10.68	76.5 ± 10.78	2.34	0.028
Control group ($n = 23$)				
SBP (mm Hg)	122.87 ± 15.43	126.35 ± 13.04	−1.32	0.200
DBP (mm Hg)	72.82 ± 7.85	75.30 ± 4.95	−1.21	0.240

Data are mean ± standard deviation values.

BP, blood pressure; DBP, diastolic blood pressure; SBP, systolic blood pressure.

Table 6. Comparison of Depression Between the Groups

VARIABLE	EXPERIMENTAL GROUP ($N = 22$)	CONTROL GROUP ($N = 24$)	T	P
Depression	7.63 ± 3.66	7.83 ± 5.21	−0.141	0.889

Data are mean ± standard deviation values.

($n = 5$), thus showing a statistically significant difference ($p = 0.012$). The value for “hobby” increased from 32% ($n = 8$) to 65% ($n = 15$) for the experimental group, but fewer people had hobbies after the test in the control group, with the values showing a reduction from 33% ($n = 8$) to 8% ($n = 2$). This difference was also statistically significant ($p = 0.036$).

Discussion

The nursing service was provided twice a week for 8 weeks, from August 23 to October 19, and three people dropped out for reasons like “lack of time to use the device” and “hospitalization” during the research, making the total number 22.

HEALTHY LIFESTYLES

Data pertaining to sleeping habits ($p = 0.012$) and hobbies ($p = 0.024$) by the experimental and control groups changed significantly after the trial. The experimental group, who received only the BP check, showed a significant decrease ($p = 0.037$) in the “sufficient amount of sleep” values, from 46% ($n = 12$) to 21% ($n = 5$). This change is thought to have occurred because of the measurement schedule in the morning, which could have interrupted their original sleeping pattern.

For hobbies, most of the patients initially had no particular hobby because of their physical and social restraints and their lack of information. However, there were changes when the experimental group was introduced to social and physical activities that could enhance their health and improve their lives emotionally and socially without additional costs. However, there was a significant decrease ($p = 0.036$) in the control group. When the subjects were asked why they stopped, the answers were signs of helplessness, such as “for no reason” and “I cannot continue the hobby given my living standards.”

An analysis of the pre-test/post-test difference showed that there is a significant difference in the values for smoking ($p = 0.024$) and health checks ($p = 0.014$). However, the control group showed no significant change in their “Healthy Lifestyles” scores.

In summary, u-health nursing made a difference in the categories of sleeping patterns and stress management compared with its absence in the control group. The education brought through the u-health program led to change from the pre-test to the post-test in smoking habits and the frequency of health checks. The service was able to bring about a meaningful change in addictive habits such as smoking through a correction and management process. The emphasis on the importance of health checks also helped patients to pay

Table 7. Comparison of Healthy Lifestyles Between the Groups

CHARACTERISTIC	FREQUENCY (%)		χ^2	<i>P</i>
	EXPERIMENTAL GROUP (<i>N</i> = 23)	CONTROL GROUP (<i>N</i> = 24)		
No smoking				
Yes	21 (91)	24 (96)	2.18	0.234 ^a
No	2 (9)	0 (4)		
Less drinking				
Yes	20 (87)	23 (96)	1.19	0.348 ^a
No	3 (13)	1 (4)		
Exercise				
Yes	16 (70)	18 (75)	0.173	0.677
No	7 (30)	6 (25)		
Sleeping				
Yes	13 (57)	5 (21)	6.33	0.012 ^b
No	10 (43)	19 (79)		
Breakfast				
Yes	22 (96)	23 (96)	0.001	1 ^a
No	1 (4)	1 (4)		
Less snack				
Yes	18 (78)	15 (63)	1.40	0.238
No	5 (22)	9 (39)		
Check-up				
Yes	18 (78)	18 (75)	0.07	0.792
No	5 (22)	6 (25)		
Rest				
Yes	20 (87)	22 (92)	0.27	0.666 ^a
No	3 (13)	2 (8)		
Balanced diet				
Yes	10 (43)	10 (42)	0.02	0.900
No	13 (57)	14 (58)		
Less coffee				
Yes	21 (91)	20 (83)	0.67	0.666 ^a
No	2 (9)	4 (17)		
Hobby				
Yes	15 (65)	2 (8)	4.91	0.036 ^{a,b}
No	8 (35)	22 (92)		

^aBy Fisher's exact test.^b*p* < 0.01 indicates a significant difference.

more attention to their own health and utilize the national health check service in addition to the daily monitoring they received through u-health.

However, there was no significant change after the service provision in other "Healthy Lifestyles" components, particularly in "exercise" and "nutrition," as also found by Kim et al.¹⁹ Although arthritis and other such illnesses were given as reasons for an inability to increase the amount of exercise, the main cause of the continuing malnutrition despite all of the education they received from the u-health nurses was financial difficulty, which forced them to depend on free lunches from senior citizen centers or to skip meals. Even when they realized the importance of a proper meal, there was neither money nor a person to provide it. The lack of a change in the "rest" factor was closely related to a sense of helplessness and depression.

Based on these findings, we recommend more education in areas where little change was noted. In addition, systematic support by the government is necessary in areas where individual effort due to the low income levels is scarcely possible.

An overview of current healthcare service usage shows that the frequency of the use was in the order of a home visiting service, chronic disease management service, long-term care insurance for the aged, home healthcare, and welfare facilities for the disabled. Remote videoconferencing, which can increase the frequency of contact, would contribute greatly to extending a nursing service for the long-term care of those with chronic diseases.

In the comparison analysis by Kim²⁰ of two groups with and without regular health checks from a health promotion center, males, married couples, and people with higher income and with more education had regular health checks more often (*p* < 0.001). This finding implies that there is a socioeconomic difference that manifests in the amount of healthcare one receives. However, there was no significant difference in healthy lifestyle. This shows that the checking one's health through a health examination—easily done with funding—and improving one's healthy lifestyle—relatively more time consuming—are different issues.

The findings above imply that a u-health service is applicable to both low- and high-income patients who need long-term support and regular checks to encourage a healthy lifestyle. However, further research to assess whether the service is applicable to those in different income brackets and groups with different levels of education must be conducted before the effect of the service can be confirmed and/or generalized.

DEPRESSION

The depression check results for the low-income hypertension patients showed values of 9.32 ± 3.92 for the experimental group and 7.75 ± 4.22 for the control group. From the data, we could infer that the depression level of the low-income senior citizens is somewhere between mild and severe. The depression level of the experimental group decreased significantly after the service (*p* = 0.021). It increased in the control group, but the rise was statistically insignificant (*p* = 0.461). Thus, post-verification shows that difference between the two groups is insignificant (*p* = 0.889).

Nonetheless, other positive changes such as better perceptions of health management and better facial expressions were noted after the test. Interest in new health information led to higher satisfaction, as the participants improved their habits and received mental consultations. The patients showed increasing dependency on and faithfulness to the mediating nurse, often expressing their gratitude for the consultations they received. They also shared more about their lives. Such an effect was verified through the depression scores ($p=0.021$)

Previous studies investigated how groups of different ages—termed stage 1 and 2—react to the same hypertension program.^{21,22} In the present study, the respondents were also divided into stage 1 of age 65–75 years ($p=0.339$) and stage 2 of 76–85 years ($p=0.924$). The results, however, showed no significant difference among young-old and old-old elderly people and utilization of the u-health service.

In summary, there was a significant change in the depression level in the experimental group, whereas no change was noted in the control group who received only BP monitoring. We suggest a further comparison test with a control group without any service whatsoever, as it may be a stretch to expect improvements from patients with severe depression only because a significant change was noted after one test in one experimental group.

BP

The homogeneity analysis conducted before the application of the u-health nursing service showed that the two groups were not homogeneous. According to an analysis of covariance test conducted after the u-health application, systolic BP showed a significant change ($F=10.26$, $p=0.003$). However, diastolic BP showed no significant difference ($F=2.802$, $p=0.101$).

There was a statistically significant change in the experimental group after the application of the service ($p=0.001$). Systolic BP decreased significantly ($p=0.028$). Meanwhile, both the systolic and diastolic BP increased insignificantly for the control group ($p=0.20$ and $p=0.24$, respectively).

In conclusion, the u-health service was more effective in controlling systolic BP, but it had no effect on diastolic BP. This research shows that the service is more effective in controlling systolic BP than a BP monitoring service only, as long as correct feedback and education are given by a u-health nurse. This finding is in line with that of Reed et al.,¹¹ who demonstrated that new technology is effective and financially feasible only with good mediation.

BP can change as the patients' conditions change, as it is the pressure exerted by circulating blood upon the walls of blood vessels. It is not uncommon to note changes in BP even while it is measured at the same time and with the same equipment. In most instances, however, the differences are in a normal spectrum and are thus not alarming. Thus, advice specific to each case with consideration of other related diseases was necessary. There were cases in which patients—those who followed the education and measurements closely—visited hospitals for additional prescriptions, because of their increased interest, who otherwise would have stopped their medication. Another phenomenon was noted: although they received a BP check and health consultation from nurses, the healthcare, in the end,

led to hospital services, as an actual diagnosis and prescription were only possible in a hospital.

Four patients dropped out: three from the experimental group and one from the control group. The reasons given by those in the experimental group were “no time to use the device” and “hospitalization.” However, the real reason was likely their dependence on a medical institution, their desire for a treatment service that encompassed diagnosis and prescription, and their lack of a sense of need for a management-oriented service. Another patient was difficult to contact because of a sudden hospitalization. The one in the control group, who followed up quite well, reported that she lived well without knowing her state of health. However, the daily measurement affected her mood at the time of the study. As a group, for people who lack proper knowledge about health and who cannot interpret measurement results, regular management through a mediator is more effective than mere measurements.

The aim of the u-health nursing service is to reduce the number of unnecessary visits to hospitals and to ensure healthy aging for ill low-income elderly people, who may not be able to afford visits to hospital or have guardians to take them. It would also help service providers by giving them more information to make proper decisions when sudden requests from patients arise. However, further research on the scope of these possibilities and a systematic means of providing information more quickly, accurately, and regularly should be considered, as issues concerning easy retrievals of personal information as well as legal responsibility issues could arise.

Conclusions

We found that a remote videoconferencing service reduced systolic BP and caused some changes in the healthy lifestyle of low-income elderly people suffering from hypertension. This shows that the u-health service as described here is more effective at helping patients create better habits and control their BP than a BP monitoring service by itself.

1. This increases the likelihood of successful delivery of health improvement interventions to traditionally hard-to-reach populations. This improvement should also consider sustainability. An appropriate action plan in consultation should be devised.
2. A limitation of the “u-health triage protocol” developed in this study is that it does not show what to prioritize when many symptoms appear at the same time. It was also not able to consider multifactor situations. Therefore, we suggest the development of a more detailed classification system for diseases and symptoms.
3. The management system used in this research was able to screen the condition of the patients, but it could not systematically classify their symptoms. Therefore, we suggest the development of a system with CDSS so as to show the assessment process automatically when a symptom is clicked on.
4. We need more detailed research on the feasibility of this u-health nursing service. For example, the service was effective

for BP, depression, and lifestyle improvements. Furthermore, research on whether the service reduced medication, transportation, and other medically related costs, including costs related to direct medical services, hospitalization, and the number of outpatient service days, should be conducted.

5. We suggest a larger sample size and more diversity as well, including those with different chronic diseases and income levels, to verify the effectiveness of u-health nursing.

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Disclosure Statement

No competing financial interests exist.

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Address correspondence to:
Hanna Choi, RN, MSc
College of Nursing
Seoul National University
The Second Research Building, Room 308
28 Yeongeon-dong
Jongno-gu, Seoul 110-299
South Korea

E-mail: hannachoi@kams.or.kr
vision229@hanmail.net

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