The Impact of Short Message Service (SMS) Reminder and Home Monitoring on Blood Pressure Control in Hypertension Patients: A Case Study of Two Primary Health Care Facilities in Banyumas Regency

Laksmi Maharani[1], Hening Pratiwi[1], and Ika Mustikaningtias[1]
[1]*Department of Pharmacy, Faculty of Health Sciences, Jenderal Soedirman University, Jl. Soeparno, Karangwangkal, Purwokerto, Banyumas Regency, Central Java Province, Indonesia*

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Abstract: The use of antihypertensive drugs is an effective strategy to reduce blood pressure. Several studies suggest that an intervention like SMS reminders and home monitoring programs may be effective for improving patient's adherence and, as a result, controlling the blood pressure in hypertensive patients. This study aimed to determine the role of SMS reminders and home monitoring in lowering patient's blood pressure. A pre- and post- intervention design were conducted at two primary healthcare facilities in Banyumas Regency from May to June 2018. Thirty patients were recruited, and they received a one-month intervention of daily SMS and home visits by a research assistant once in two weeks. The primary measurable outcome was the improvement of blood pressure control between the control and the intervention groups. The data were analyzed using a paired T-test at a significance level of 0.05. The result showed that the systolic blood pressure in the control group was less improved than the intervention group (-2.4 and -6.43, respectively). The diastolic blood pressure improved by -3.1 and -0.04, but these results could not be explained. The systolic blood pressure decreased significantly in the intervention group ($p<0.05$). When compared with the absence of intervention, the combination of SMS reminders and home blood pressure monitoring were more effective in lowering the systolic blood pressure in hypertension patients.

1 INTRODUCTION

Hypertension is a chronic condition with high prevalence (30-45%) worldwide (Filipovský *et al.*, 2014). In Indonesia, hypertension affects 25.8% of the total population (Ministry of Health of Republic of Indonesia, 2013). The treatment for hypertension involves lifestyle change and antihypertensive drug (Filipovský *et al.*, 2014).The use of antihypertensive drugs is an effective strategy to reduce blood pressure and prevent further cardiovascular and renal complications, but it requires patient adhering to treatment. Patients' adherence to antihypertensive drug therapy is less than 50% in developing countries (Suffoletto and Muldoon, 2017).

There are many strategies to improve patients' adherence to antihypertensive therapy, such as pharmacist interventions, patient educational programmes, and peer assistance program (Abughosh *et al.*, 2016; Margolis *et al.*, 2013; Su *et al.*, 2014). Peer assistance is one of the low-cost programs that gives a high impact on a patient's blood pressure control (Haidari *et al.*, 2016). The peer support includes telemonitoring, home visits, and group training (Haidari *et al.*, 2016; Semper, 2015; Su *et al.*, 2014; Yasmin *et al.*, 2016). Weekly SMS service for 12 months significantly reduces the systolic blood pressure baseline by -2.2 mmHg (Bobrow *et al.*, 2016) and increases adherence to the prescribed antihypertensive therapy (Yasmin *et al.*, 2016).

While several previous studies suggest that either SMS reminder or peer assistance program as a single intervention may be effective for controlling blood pressure in hypertensive patients, none of them combined the two methods.

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2 MATERIALS AND METHOD

2.1 Design, Setting, and Patients

The measurements of the pre- and post-intervention blood pressure were conducted at two primary healthcare facilities in Banyumas Regency from May to June 2018. Thirty patients were recruited, and they received a one-month intervention of daily SMS and home visits by the research assistant once in two weeks. The subjects were selected from 150 hypertensive patients purposively using a set of inclusion criteria. The inclusion criteria were patients diagnosed with hypertension and treated with at least one antihypertensive drug who had the willingness to participate in the study and the ability to receive and read SMS, attended primary healthcare facilities regularly, lived in an accessible home, and consumed no traditional medicine supplements to control their hypertension. Out of the 150 patients, only 30 patients met these inclusion criteria.

The research assistants who delivered the SMS and monitored the blood pressure during the home visits were selected from the undergraduate pharmacy students of Jenderal Soedirman University. They were trained to use the automatic blood pressure monitor properly and send SMS in the right time with the right template.

The trial was approved by the Medical and Health Research Ethics Committee, Faculty of Medicine, Gadjah Mada University, Indonesia with the Approval No. KE/FK/0570/EC/2018. All participants were provided with written informed consent, and the trial was conducted according to the Declaration of Helsinki in 2008.

2.2 Intervention

All eligible subjects (n=30) had their blood pressure measured using the Omron Automatic Blood Pressure Monitor HEM 8712 to obtain their blood pressure baseline. The research assistants recorded the address and mobile phone number of the subjects, as well as their antihypertensive drug prescription. After four weeks of no intervention, their blood pressure was measured again to examine the effect of self-treatment. Then, the intervention commenced. The subjects received daily SMS from the research assistants ten (10) minutes before and after the time to take their antihypertensive drugs. The research assistants also called them weekly to check if they had any complaints or health issues. A home visit by the research assistant to measure the blood pressure of the subject was organized and conducted every two weeks. After four weeks, the intervention was concluded, and the subjects had their blood pressure measured again. The flowchart of the study is illustrated in Figure 1. The primary expected outcome was the improvement of the systolic and diastolic blood pressures in the intervention group (after a four-week intervention) compared with the control group (four weeks of self-treatment and before the start of the intervention).

2.3 Data Analysis

The collected data were checked for normality using the Shapiro-Wilk test. Because all of them were distributed normally, a parametric test was used in further analysis. The paired t-test aimed to compare the changes in the systolic and diastolic blood pressures of the control group and the intervention group before and after the intervention. The outcomes were categorized as statistically significant if the resultant alpha was <0.05.

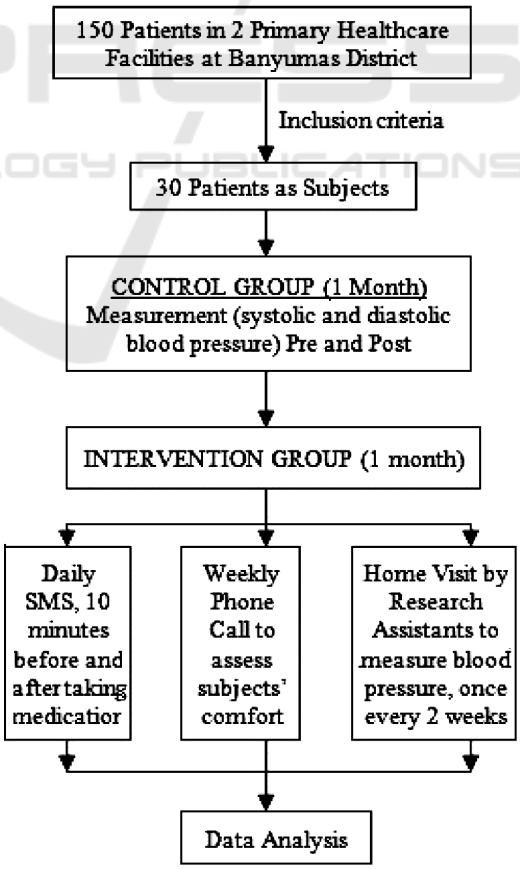

Figure 1: The flow chart of the study.

3 RESULTS AND DISCUSSION

3.1 Patients Demography

From the two primary healthcare facilities with 150 hypertension patients, only 30 patients were eligible and willing to participate in this study. Most of the patients were excluded because they had difficulty reading the SMS due to aging. The demographic characteristics of the subjects are described in Table 1.

Most of the subjects in this study were female (63%). Women have better control of blood pressure than men, but they tend to have emotional stress, which can induce and prolong the case of hypertension (Silva *et al.*, 2016). Unlike men, women have greater anti-inflammatory immune profiles that may act as a compensatory mechanism to limit increases in blood pressure (Gillis and Sullivan, 2016). However, in the Asian population, after the age of 60 years old, women likely develop hypertension but have less probability of adhering to long- term hypertension control (Choi *et al.*, 2017). In this study, most subjects were female, and some of them were over 60 years old. This demography might affect the effectiveness of the intervention because women under 60 years old might naturally be better in controlling their blood pressure.

The prevalence of hypertension in the elderly is about 60-70% (Alhawassi *et al.*, 2017). However, only 47% of geriatric patients participated in this study because most of them had difficulty reading an SMS. Forty percent of the elderly do not implement technology in their homes; therefore, providing SMS reminders for this group of patients would be unproductive (Fox and Felkey, 2014). Future research must take into account the eligibility of geriatric patients for technology-based intervention in the selection of suitable monitoring services.

Table 1: Patients demographic information.

Characteristics	Frequency (n)	Percentage (%)
Gender		
Male	11	37
Female	19	63
Age		
Adult (35-65 y.o.)	16	53
Elderly (≥ 65 y.o.)	14	47
Education Background		
Elementary School	4	13
Junior High School	6	20
Senior High School	15	51
Diploma	1	3
Undergraduate	4	13

Education is one of many factors affecting blood pressure control. Patients with a higher education level have better control of their blood pressures (Sengul *et al.*, 2016). Higher education is associated with greater health care and awareness (Tedesco *et al.*, 2001). Most of the patients in this study had a low education level (elementary and high school; 84%). Low education level is likely behind the minimum control of blood pressure that requires antihypertensive medication.

3.2 Blood Pressure Control

The research subjects were initially treated as the control group for one month. Afterward, they were parts of the intervention group for another month. There was a difference in the systolic and diastolic blood pressures of the former and the latter group. In the control group (table 2), there was a reduction in both systolic and diastolic blood pressure. The systolic blood pressure decreased by 2.4 mmHg, while the diastolic blood pressure was down by 3.1 mmHg. The diastolic blood pressure reduction was statistically significant ($p<0.05$). Being a part of a study sometimes become a burden to the patients. Some of them feel the pressure to be better in controlling blood pressure because the study process will show their hypertension management efforts. Many hypertensive patients never measure their blood pressure regularly (Sengul *et al*., 2016), but when they are included in a study, a regular measurement is inevitable. This situation might affect the measurement results of the control group's blood pressure and significantly reduce their diastolic blood pressure.

Systolic blood pressure is a strong predictor of cardiovascular disease in hypertensive patients (Nair, 2016), especially in older men (Sesso *et al.*, 2000), while diastolic blood pressure is a strong predictor of risk of stroke in young adults. Patients whose diastolic blood pressures are higher than 71 mmHg are at high risk of stroke (Vishram *et al.*, 2012). Furthermore, age determines the effects of different systolic and diastolic blood pressure controls on mortality rate. Patients under 50 years old have a higher mortality rate if their diastolic blood pressure is uncontrolled, while patients over 50 years old have a higher mortality rate if their systolic blood pressure is uncontrolled (Taylor *et al.*, 2011). The elderlies tend to have a lower diastolic blood pressure, which may reduce their survival rate (Protogerou *et al.*, 2007).

Table 2: Subjects blood pressure before and after treatment.

Groups	Mean SBP (mmHg)			Mean DBP (mmHg)		
	Before	After	Δ SBP	Before	After	Δ DBP
Control	138.17	136.3	-2.4 (p 0.451)	83.67	80.57	-3.1 (p 0.039*)
Intervention	136.3	129.87	-6.43 (p 0.003*)	80.57	80.53	-0.04 (0 0.981)

SBP : Systolic Blood Pressure
DBP : Diastolic Blood Pressure
*statistically significant

In the intervention group, the subjects received daily SMS, weekly phone service, and a home visit once in two weeks to measure their blood pressure. After this treatment, there was a reduction in the systolic and diastolic blood pressure. The systolic blood pressure decreased by 6.43 mmHg, while the diastolic blood pressure decreased by 0.04 mmHg. There was a significant reduction in systolic blood pressure after the treatment. These results are inline with Bobrow *et al*. (2016) that reveal the effect of SMS reminder on patients' adherence to antihypertensive medication, i.e., patients who receive the SMS have lower systolic blood pressure than those who obtain no regular medical intervention. Peer assistance program is also found to be effective in lowering systolic and diastolic blood pressure (Haidari *et al.*, 2016). In this study, the systolic blood pressure of the intervention group was significantly lower than the control group. However, this case did not apply to the diastolic blood pressure. The reduction of the diastolic blood pressure in the intervention group was not statistically significant. It might be affected by cholesterol level.

3.3 SMS Reminder and Home Blood Pressure Monitoring Service

Peer support or assistance program is effective and efficient to achieve better control of blood pressure in hypertensive patients (Haidari *et al.*, 2016). The peer assistant can be a researcher or a family member. However, a peer assistant from family members shows a positive effect on blood pressure control, but it is no longer effective after six months (Shen *et al.*, 2017). Meanwhile, a peer assistant from the researcher community can give an additional program, like training and education about the disease and treatment, aside from supporting the adherence of said patient to the medication process (Semper, 2015). In this study, peer assistants were non-family members. This selection was expected to be beneficial for patient monitoring. They were trained to measure blood pressure and answer patient's questions about hypertension.

This study chose the SMS program as an intervention to hypertensive patients. SMS and voice calls are proved to be effective to achieve better control in patients with chronic diseases, particularly related to their adherence to medication, exercise, and diet, but these reminders only last for a short period (Yasmin *et al.*, 2016). SMS is more useful when preceded with the provision of education about hypertension to the targeted patients (Suffoletto and Muldoon, 2017). A longer blood pressure control with the SMS program can be reached by involving pharmacists in the service (Margolis *et al.*, 2013). In the future, SMS service can be an alternative for the pharmacist community to monitor their patients' medication when they cannot implement the home visit program.

4 CONCLUSIONS

The intervention using SMS reminders and home blood pressure monitoring by research assistants successfully reduced the baseline of patients' blood pressure, as well as the blood pressures after four weeks of self-treatment and before the intervention. The reduction in the control group was SBP -2.4, DBP -3.1, while the reduction in the intervention group was SBP -6.43, DBP -0.04. The systolic blood pressure decreased significantly in the intervention group ($p<0.05$), while the diastolic blood pressure decreased significantly in the control group. SMS reminders and home blood pressure monitoring by research assistants were both effective in lowering the systolic blood pressure of the samples in this study. Nevertheless, a study with a larger sample is required to confirm these results.

The limitation of this study lies in the sample size, the duration of the treatment in the control and intervention group, and the program of the home blood pressure monitoring. The sample size and the duration need to be expanded to signify the difference between the blood pressures of the control and

intervention group. The home visit in this study was limited to blood pressure monitoring only. A home visit may provide more benefits when it includes education of hypertension.

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