Self-Measure Office Blood Pressure (SMOBP) and Home Blood Pressure Monitoring (HBPM) for white coat effect diagnosis among hypertension patients

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Abstract

Background: Hypertension is a critical factor in the deaths over the world among those who have cardiovascular diseases such as coronary artery disease, stroke, and chronic kidney disease.
Purpose: This study aims to investigate the diagnosis capability of the white coat effect in hypertensive patients whose blood pressure was not on target.
Methods: This study is an analytical study. Data were collected from 19 uncontrolled hypertension patients at Bang Si Thong health promoting hospital from August to December 2022. The geographic data are presented in the descriptive statistic terms of mean, difference, and standard deviation. The research outcome was analyzed by paired t-test.
Results: The research results showed blood pressure measurement by SMOBP was more valuable in terms of statistical significance than Daytime HBPM (134±8.21 vs 125.5±6.74 p<0.001), while it was statistically significantly lower than Office-measured (148.15±10.33 vs 134±8.21 p<0.001), and there were participants whose blood pressures were going as a targeted by SMOBP 55% and HBPM 80%.
Conclusion: Self-Measure Office Blood Pressure [SMOBP] can eliminate some of the white coat effect, but it could not be used instead of Home Blood Pressure Monitoring [HBPM] for the diagnosis of white coat hypertension. The SMOBP might be a choice for patients who have the white coat effect in socioeconomically disadvantaged areas.

Keywords: home blood pressure monitoring, self-measure office blood pressure, white coat effect, white coat hypertension

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Introduction

Hypertension is a critical factor in the deaths of more than 8.5 million people all over the world who have cardiovascular diseases such as coronary artery disease, stroke, and chronic kidney disease (Zhou et al., 2021). The current situation in countries of high socioeconomic status is that the prevalence of controlled blood pressure patients has drastically decreased, while in low to moderate socioeconomic status countries, such as those in South Asia, East Asia, and Southeast Asia, it is found that there is higher prevalence (Zhou et al., 2021). The most common type of hypertension is isolated systolic hypertension (The SPRINT Research Group, 2015; Stanaway et al., 2018; Tsai et al., 2021). This systolic blood pressure is an important factor in predicting complications from high blood pressure (The SPRINT Research Group, 2015; Flint et al., 2016; Tsai et.al., 2021).

The prevalence of hypertensive patients in Thailand in 2021 according to the Ministry of Public Health database is 6,623,048 people out of the population of 65,083,814, which equals 10.17% (Health Data Center, 2021). The major problem with hypertension treatment in Thailand has to do with the number of patients who cannot control their high blood pressure, which totals

2.5 million people, or 37.74% of the hypertensive patients in the country (Sukonthasarn et al., 2019). The patients cannot control their blood pressure well for many reasons, such as lack of awareness of how important it is to know about this disease, as well as non-adherence. Another important reason is the white coat effect which is found in 30% of hypertension patients (Ramli, Halmey and Teng, 2008).

The white coat effect is a status where blood pressure is higher than normal, but only when the patients come to the healthcare office, after which it will return to normal. This occurred in 15% to 30% of subjects with an elevated office blood pressure (O'Brien et.al, 2000; 2013). The important predictor for white coat effect was perceived level of stress (MacDonald et al., 1999; Bolade Dele-Ojo et al., 2019). This leads to blood pressure interpretations that are false positives. A recent study found that the protocol might come from a mind factor between the patients and medical personnel during blood pressure measurement (Pickering, Gerin and Schwartz, 2002). The process used to diagnose the white coat effect was home blood pressure monitoring (HBPM) for 3–7 days (8) or 24hr ambulatory blood pressure monitoring (ABPM) (Unger et al., 2020). However, due to the socioeconomic status of some patients, they could not afford to buy a sphygmomanometer to be used at home so if they have not received a diagnosis they will receive the medicine according to need and there may be more side effects of antihypertensive drugs, and it did not worth the health economics (Salazar et al., 2018). As the retrospective study found, blood pressure measurements taken in healthcare offices without any medical controller by automated office blood pressure (AOBP) of BpTRU ® (an automatic blood pressure monitor and average calculation) can eliminate the white coat effect and blood pressures were not different from blood pressure measurements by 24-hour ambulatory blood pressure monitoring (Myers et al., 2012).

In the primary care context of the Sub District Health Promoting Hospital in Thailand, which serves a population group of lower socioeconomic status, some of the patients do not have blood pressure monitors at home and they would not receive any diagnosis of white coat effect. So, if the patients can do blood pressure measurements by themselves when they do not have any appointments at the hospital and do not have any healthcare providers to observe by using the BpTRU ®, they will eliminate the white coat effect, but there is limited information on this blood pressure. Thus, there is a question whether self-blood pressure measurement or self–measured office blood pressure (SMOBP) can help diagnose the white coat effect in hypertension patients.

Research Objectives

To compare the difference in SBP mean between SMOBP and Daytime HBPM

To search for the capability of HBPM to diagnose white coat effect

Materials and Methods

Design

This study is an analytical study.

Sample and setting

The target population was hypertension patients who took medical care at Bang Si Thong Sub District Health Promoting Hospital. The sample determination used SBP mean and SMOBP standard deviation compared with HBPM. Data were collected from 17 populations in the pilot study, and were replaced according to a formula of two dependent means comparison and found that SBP means of SMOBP was 134.52 mmHg SD ±8.87 mmHg SBP, Daytime HBPM mean was 125.52 mmHg SD ±7.22 mmHg and tested two-sided with significance equal to 0.05 and power was equal to 0.90, the ratio of SMOBP and HBPM was 1:1, calculated total patients were 17 people, loss to follow up determination increased 10% which included 19 people. Essentially, the population is too small because of the limitation of economic status and availability of the hypertension patients, all populations willing to participate and having to use their own equipment such as sphygmomanometer for measuring their blood pressure. Therefore, there are only 19 persons who can participate in the whole process of this study.

The inclusion criteria consisted of hypertension patients whose blood pressure did not meet the target of the 2019 Thai guidelines on the treatment of hypertension. Criteria also included those who could communicate, read, and write in Thai, were willing to participate in this research, and were age 18 or older.

The exclusion criteria consisted of those patients who were in a state of hypertensive urgency or emergency, those with secondary hypertension such as chronic kidney disease, hyperthyroidism, pregnancy, and patients who do not have the white coat effect.

Variable

Independent variable

Self-Measure Office Blood Pressure (SMOBP) and Home Blood Pressure Monitoring

Dependent variable

White Coat Effect Diagnosis

Instruments

The blood pressure monitoring was Omron® of HEM-7117

Ethical consideration

This research was considered and approved by the Ethics Committee, Nonthaburi Provincial Public Health Office, certificate no. 8/2565 on July

Table 1. General Information (n=20)

Topic	n (%)
Sex	
Male	9 (45)
Female	11 (55)
Age (years old), mean (±SD)	60.55±10.72
Body weight (kilogram), mean (±SD)	69.44±14.80
Height (centimeters), mean (±SD)	159.90±11.59
Body Mass Index (kilogram/meter2), mean (±SD)	26.89±3.47
Smoking	1 (5)
Hypertension Medication	20 (100)
Diabetes Mellitus	2 (10)
Hyperlipidemia	16 (80)

**Significant level p<0.01

Table 2. Office-measured, SMOBP, Daytime HBPM mean, mean difference

	Office – measured	SMOBP	Daytime HBPM
SBP (SD)	148.15±10.33	134.00±8.21	125.50±6.74
DBP (SD)	85.05±10.37	79.45±6.52	75.60±7.93
Mean difference (SBP)(±SD)			
Office – SMOBP	14.15±8.85 [5.93,11.07]		p<0.001**
SMOBP – HBPM	8.50±5.48 [10.24,18.06]		p<0.001**
Office – HBPM	22.65±9.23 [18.33,26.96]		p<0.001**
Mean difference (DBP)(±SD)			
Office – SMOBP	5.60±7.62 [2.03,9.17]		p=0.004**
SMOBP – HBPM	3.85±5.66 [1.19,6.50]		p=0.007**
Office – HBPM	9.45±10.39 [4.58,14.31]		p<0.001**

Table 3. Number of the Participants who achieved the Goal by Hypertension Measurement

	Office – measured	SMOBP	Daytime HBPM
Number of the Participants who achieved Goal (%)	0 (0)	11* (55)	16 (80)

* Participants who achieved Goal by SMOBP with Daytime HBPM

25th, 2022. The sample population consisted of 20 individuals above age 18, who were hypertension patients and whose blood pressure had not achieved the target, and who were in the control area of Bang Si Thong Sub District Health Promoting Hospital. The researcher informed the participants about the rationale of the study before the research and asked for written consent. Information about the participants will remain secure and undisclosed. Finally, the researcher recorded the participant's data, which were then saved in a locked cabinet for a year, at which time it will be destroyed.

Data collection

Data collection for this research was done in two parts. The first part was for general information, which included gender, age, weight, height, BMI, underlying disease (diabetes, hyperlipidemia), smoking, and alcohol consumption history. The second part included the blood pressure of SMOBP, HBPM, and Office-measured.

The process of data collection began with 1) the researcher wrote a letter to ask for a space to be used courtesy of Bang Si Thong Sub District Health Promoting Hospital. 2) The process involved knowledge sharing and training on correct blood

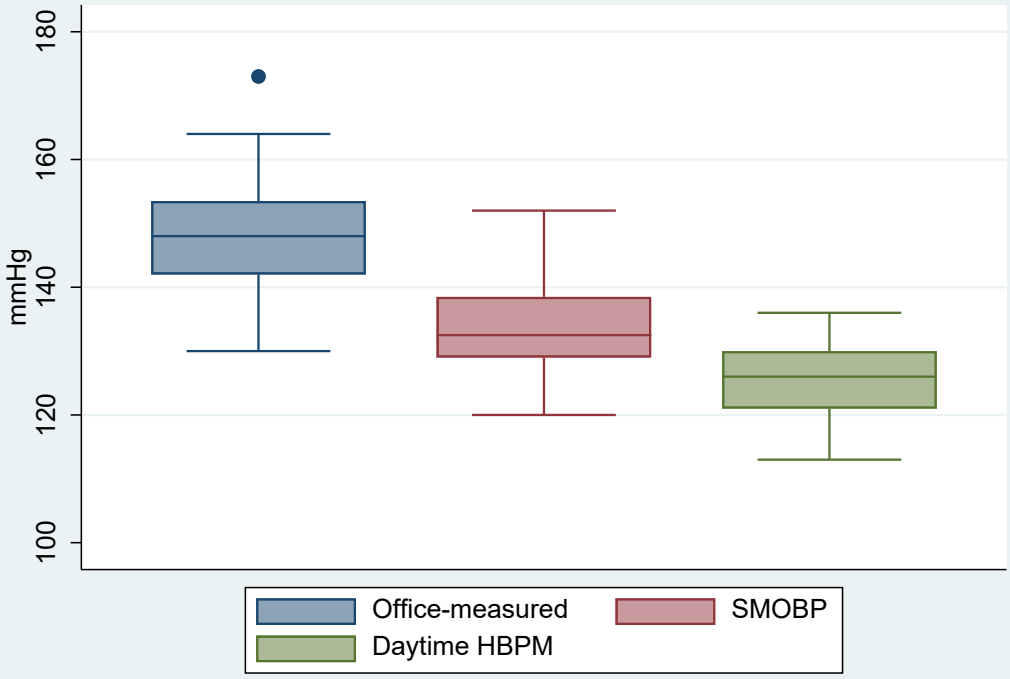

Fig1. Box plot for SBP of Office-measued, SMOBP, and Day-time HBPM

pressure measurement by nurses and to include patients who met the criteria of this research and give a recommended brochure of blood pressure measurement.

Data analysis

This research data were analysed using version 16.1 of Stata/MP. The general data were presented by frequency distribution, percentage, mean determination, and standard deviation. The comparison of the difference in blood pressure means used the statistic of paired t-test and set the statistical significance at $p<0.05$.

Intervention

The participants had to do HBPM two times per period and record their results on a document in the morning and before going to bed. Before doing their blood pressure measurement, the participants were instructed to sit for rest for at least five minutes, wear comfortable clothes, urinate before the measurement, use their non-dominant arm for the measurement, and not speak during the measurement either. This included making an appointment for the participants to continually do blood pressure measurements at Bang Si Thong Sub District Health Promoting Hospital in the daytime for four days and follow up to gather data. The blood pressure monitoring was using Omron® of HEM-7117.

Results

This research involved 20 participants and took place from August 2022 to December 2022. The characteristics of the participants' data (Table 1) showed a male:female radio of 1:1.22, the average age was 60.55±10.72 years old, the body mass index (BMI) was obese, 95% were non-smokers, and the average blood pressure by each method and the corresponding result are shown on Table 2. In comparing the difference of SBP mean measured by three methods, it was found that Office-measured was more statistically significant than SMOBP (148.15±10.33 vs 134±8.21 $p<0.001$), and SMOBP was more statistically significant than Daytime HBPM (134±8.21 vs 125.5±6.74 $p<0.001$). When comparing the difference of DBP mean measured by the three methods it was found that Office-measured was more statistically significant than SMOBP (85.05±10.37 vs 79.45±6.52 $p=0.004$), and SMOBP was more statistically significant than Daytime HBPM (79.45±6.52 vs 75.6±7.93 $p=0.007$). Moreover, participants who measured blood pressure by SMOBP got blood pressure that was going as target(8) were 11 people (55%) and of those who measured blood pressure by Daytime HBPM there were 16 people (80%) from all participants whose blood pressure was not going as target (Table 3).

Discussion

This research showed that SMOBP was more statistically significant than Daytime HBPM which was different from previous research (Myers et al., 2012; Filippovsky et al., 2016) because of the type of sphygmomanometer and the limitation of place. The

sphygmomanometer used for previous research was a blood pressure monitor that could continuously measure blood pressure five times and automatically determine the mean. The participant was also alone in a private room while data for this research were collected from an automatic blood pressure monitor. The patient had to press a start button before measurement each time. The participants also had to measure their blood pressure in an area provided by the Sub District Health Promoting Hospital which was nearby an open area with some external disturbance. Meanwhile, it was found that SMOBP got statistically significant blood pressures that were lower than Office-measured blood pressures because this method could eliminate interfering factors, such as worry or excitement about medical services, venepuncture, talking about treatment plans with healthcare providers, and because SMOBP requires no observation from any healthcare providers, which conformed to the previous research (Myers et al., 2012; Franklin et al., 2013; Filipovský et al., 2016; Salazar et al., 2018). Since the COVID-19 pandemic, there has been an increase in the use of telemedicine, where the results may be automatically sent to clinicians for review and inform treatment strategies for managing hypertension. Therefore, self-monitoring of blood pressure into digital health technologies has been potential to enhance the delivery of healthcare for the individual patients (Patrizia et al., 2023).

In conclusion, this research revealed that three methods of blood pressure measurement were statistically significant and resulted in different blood pressures ($p < 0.01$). The cause is likely due to different perceived level of stress, and this condition is least common in HMPM, SMOPM, and Office-measured BP, respectively. Office-measured was associated with the highest blood pressure level and next was SMOBP and Daytime HBPM, respectively. Both SBP and DBP showed the result that SMOBP cannot be used instead of HBPM for the diagnosis of white coat hypertension because it cannot reduce all white coat effects. This is because, within this process of blood pressure measurement, the participants must press a start bottom each time by themselves, which was different from BpTRU®, and the place of measurement might also be a factor in the white coat effect. For research accuracy, the researcher trained all hypertension patients to measure their own blood pressure by digital sphygmomanometer before allowing them back home and monitoring by themselves. The patients' blood pressure checks for with the standard and hypertension guidelines included identifying their name, the same position in the several times, take while relaxed, and not immediately self-measure after activity.

In addition, this research was a cross-sectional study which utilized a short-period blood pressure measurement, and it cannot see the clear blood pressure trend over the long term. Although the SMOBP cannot eliminate all surplus blood pressure when using blood pressure to consider the fixed target in the guidelines on the treatment of hypertension (8), it was found that there were 11 people (55%) whose blood pressure was at target from all 20 of the participants and of those whose blood pressure was not at the target when measured by Office-measured, 11 participants were in the Daytime HBPM group and 16 people (80%) were as per target; this method might be a useful choice for hypertension patients in the area that has socioeconomic status problem.

This study has a strong point that it is a compared study in the same population group, so it is proper in comparison, decreasing bias and confounder between the study group and it is a study of Sub District Health Promoting Hospital context which was easy to access by the population in the area and it might be useful for the area that has a socioeconomic status problem. One limitation of this study is that the place of the blood pressure measurement was separated and as the limitation of place, it might have had an external confounder, the period to follow up with the participants was short, and the data were collected from only one area, so it cannot be generalised across the wider population. However, the study showed that SMOBP can reduce some white coat effects, so the results of this study support blood pressure measurement by SMOBP to for the populations in areas of low socioeconomic status in the primary care context. Moreover, if there is more external confounder control, extending the period to follow up with the participants, and increasing the area for data collection might help this blood pressure measurement method decrease the white coat effect.

Conclusion

The self-measure office blood pressure (SMOBP) method can reduce the white coat effect but is not equivalent to the home blood pressure measurement (HBPM). The conclusion of this study is, therefore, not to recommended use of this blood pressure method instead of HBPM. However, SMOBP may be considered in areas with economic constraints. Further studies may clarify the benefits of this method of measuring blood pressure.

Declaration of Interest

The authors have no conflicts of interest associated with the material presented in this paper.

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