

Research Article

# Effectiveness of the Home-Based Blood Pressure Monitoring Guiding Tools in Increasing the Knowledge About Self-Blood Pressure Monitoring and Early Diagnosis of Hypertension at Home

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## Abstract

*This paper presents the effectiveness of the developed home-based blood pressure monitoring guidebook and web application in increasing the knowledge about self-blood pressure monitoring and early diagnosis of hypertension at home. Both rapid review and quasi-experimental designs with pre-posttest assessment designs were used, using a quantitative approach. In rapid review, out of 1,356 studies, 21 met the inclusion criteria. The review identified diet, exercise, alcohol limitation, smoking cessation, stress management, and sleep as key factors in hypertension prevention and control. Based on these findings, a guidebook and a digital tool (web application) were developed. A paired sample t-test showed a significant increase in participants' knowledge of blood pressure control at home after using the tools ( $M=1.1261$ ,  $SD=0.09232$ ) compared with before ( $M=0.0676$ ,  $SD=0.0676$ ),  $t(14) = 42.569$ ,  $p < 0.001$ . The study also found that self-measured blood pressure monitoring at home aids early diagnosis, with 4% of participants identified as hypertension stage 2, 3.4% as stage 1, and 14.1% as pre-hypertensive.*

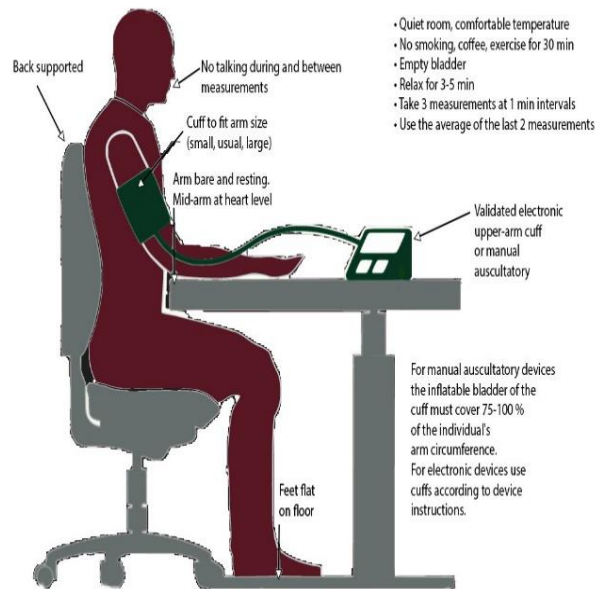
**Keywords:** Hypertension, Blood Pressure, Control of Blood Pressure, a Guidebook, and Web Application

## Introduction

Hypertension is a significant public health issue in the world. According to WHO, an estimated 1.28 billion adults aged 30–79 years worldwide have hypertension, two-thirds of whom live in low- and middle-income countries; 46% of adults with hypertension are unaware of their condition, and less than half (42%) are diagnosed and treated [1]. Self-BP measurement at home is a validated approach for out-of-office BP measurement, shown to reduce BP and improve BP control, especially when combined with cointerventions [2]. Out-of-office BP (OBP) measured using ambulatory BP monitoring (ABPM) or home BP monitoring (HBPM) is recommended by major international guidelines [3,4]. Accurate BP measurement is essential for

diagnosis and management of hypertension [5]. One study found that one week of HBP monitoring may be the most effective approach for diagnosing hypertension [6].

Another study found that self-monitoring reduces clinic BP regardless of the number of hypertension-related comorbidities, especially in individuals with obesity or stroke when combined with high-intensity interventions [7]. HBPM is particularly valuable because it allows multiple measurements in a patient's normal environment, helps detect hypertension phenotypes like white coat and masked hypertension, and has superior prognostic value compared to office BP readings [8].



**Figure 1: Position for blood pressure measurement**

| Category                                      | Systolic (mmHg) |        | Diastolic (mmHg) |
|---|-----------------|--------|------------------|
| Normal Bp                                     | <130            | And    | <85              |
| High normal Bp                                | 130-139         | And/or | 85-89            |
| Grade 1 hypertension                          | 140-159         | And/or | 90-99            |
| Grade2 hypertension                           | 160-179         | And/or | 100-109          |
| Grade 3 hypertension (Emergency hypertension) | ≥180            | And    | ≥111             |

**Table 1: Classification of Hypertension Based on Office Blood Pressure (BP) Measurement**

#### Classification of Hypertension Based on Office Blood Pressure (BP) Measurement

##### Alternative hypothesis

The developed a home-based blood pressure monitoring guidebook and web application significantly increase the knowledge about self-blood pressure monitoring and early detection of hypertension diseases.

##### Null Hypothesis

The developed home-based blood pressure monitoring guidebook and web application do not significantly increase the knowledge about blood pressure monitoring and early detection of hypertension diseases.

##### METHODS

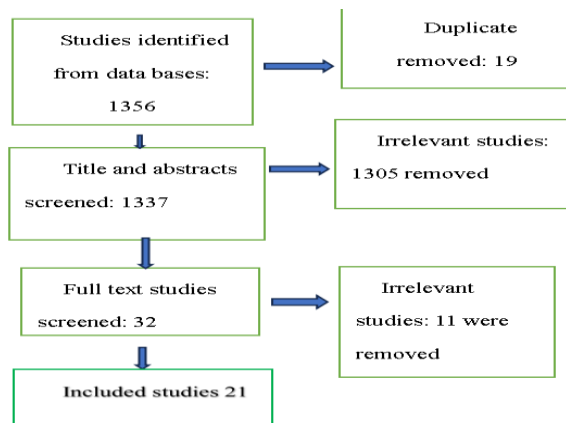
Both rapid review and quasi-experimental designs with pre-post test assessment designs were used, using a quantitative approach. A rapid review was conducted to map and synthesize current literature about preventive and control measures and activities for high blood pressure for designing a guidebook and a web application wireframe. In contrast, the Quasi-experimental with pre-posttest design was used to evaluate the effectiveness of a

guidebook and web application in increasing the knowledge about self-blood pressure monitoring and control at home. The target population for this study was households grouped in 14837 villages in Rwanda, and the sample size of 153 families in one village was obtained using multistage random sampling, while the convenient sampling strategy was used to recruit participants in a household. A structured questionnaire and monitoring tools developed by researchers were used to collect data. Data analysis was conducted using a statistical package for social science (SPSS) version 21.

##### Results

Rapid Review, Design and Test a Home-Based Blood Pressure Control Guidebook and Web Application

Figure 1 presents the PRISMA flow diagram of studies identified and included in the review. The initial search generated 1356 studies of which nineteen duplicates were identified and removed. The remaining 1337 studies, moved to the next step consisting of titles and abstracts screening where 1305 studies were excluded. Finally, twenty-three studies underwent the full-text screening, where 21 studies were considered for the final review.



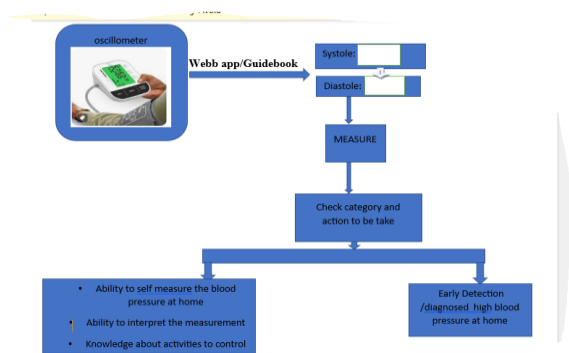
The results from the included studies were categorized into seven major categories following different activities identified in the findings of the studies as measures that could play a role in the prevention and control of high blood pressure. These categories include eating a healthy diet, getting regular exercise, limiting alcohol, not smoking, managing stress, and Get Enough Sleep.

Following the results of the rapid review and Classification of Hypertension Based on Office Blood Pressure (OBP) Measurement as recommended by 2020 International Society of Hypertension Global Hypertension Lines 2020, a guidebook for self-blood pressure monitoring and control at home was designed and validated by a group of experts. A guidebook is composed of 4 steps to follow that are 1) Self blood pressure measurement at home using an automatized oscillometric device, 2) interpreting the blood pressure value and finding the blood pressure category, and 3) reading the activities to perform for blood pressure control on each blood pressure category. (copy the link below and paste

in the browser then download a guide book ): <https://self-blood-pressure-control.netlify.app/publications>

### Self-Blood Pressure Monitoring and Control

A Figure 2 indicates the web application layout. A developed Self-blood pressure monitoring and control web application presents two grids: systole and diastole. The systole grid is where the participant enters the readings of systole when measuring BP. The Diastole grid is where the participant enters the readings of diastole when measuring BP at home. It presents also two call-to-action buttons: The first call-to-action button is "MEASURE" which informs the application to categorize the measurements. The second "Blood Pressure Category and Control activities" leads the participant to the category of measured blood pressure. In addition, under the category, the participant will find and read which action is needed to control her/his blood pressure home web application output



The category should be one among the categorized blood pressure values summarized in (table 5). In addition, under the category, the users are indicated to which actions are needed to control her/his blood pressure. (Click and sign here to navigate the website: <https://self-blood-pressure-control.netlify.app/>)

the knowledge about self-blood pressure monitoring and control at home.

The Quasi-experimental with pre-posttest design to evaluate the effectiveness of a guidebook and web application in increasing

The results of the evaluation of the effectiveness of the developed a home-based blood pressure control guidebook and web application in the increasing of the knowledge about Self-blood pressure monitoring and control. and early diagnosis of hypertension at home.

| Before intervention  |           |         | After intervention |         | Difference Post-Test-Pretest (Yes) |         |
|--|-----------|---------|--------------------|---------|------------------------------------|---------|
|  | Frequency | Percent | Frequency          | Percent | Frequency                          | Percent |
| Participant ever measured the blood pressure at home                         |           |         |                    |         |                                    |         |
| Yes  | 2         | 1.3     | 149                | 100%    | 147                                | 98.7    |
| No   | 147       | 98.7    | 0                  | 0.00    |                                    |         |
| Aware of the blood pressure measurements value and category in last 3 months |           |         |                    |         |                                    |         |
| Yes  | 2         | 1.3     | 149                | 100%    | 147                                | 98.7    |
| No   | 147       | 98.7    | 0                  | 0.00    |                                    |         |
| The reason why never measured the blood pressure at home                     |           |         |                    |         |                                    |         |
| Lack of Materials  | 18        | 12.1    |                    |         |                                    |         |
| lack of knowledge  | 13        | 8.7     |                    |         |                                    |         |
| Lack of materials and knowledge  | 118       | 79.2    |                    |         |                                    |         |

**Table 1: Comparison of pretest and Post-test results for Self-measuring blood pressure at home**

Among 149 participants in pre-test only 2 (1.3%) have ever measured their blood pressure at home themselves while the majority 147(98.7%) have never measured their blood pressure at home themselves. For post- test all participant ever measured their blood pressure at home 149(100%), and they know their

blood pressure category in the last 3 months. Lack of both materials and knowledge, 118(79.2) was a major reason why the majority of participants had never measured their blood pressure at home before intervention.

| Before intervention   |           |         | After intervention |         | Difference Post test-Pretest (Yes) |         |
|---|-----------|---------|--------------------|---------|------------------------------------|---------|
|   | Frequency | Percent | Frequency          | Percent | Frequency                          | Percent |
| Awareness of activities that can control blood pressure                 |           |         |                    |         |                                    |         |
| Yes   | 17        | 11.4    | 149                | 100     | 132                                | 88.6    |
| No  | 132       | 88.6    | 0                  | 0.00    |                                    |         |
| Knowing the Activities performed purposefully to control blood pressure |           |         |                    |         |                                    |         |
| Eating healthy diet   | 13        | 8.7     | 144                | 96.6    | 131                                | 87.9    |
| Getting regular Exercises   | 4         | 2.7     | 75                 | 50.3    | 71                                 | 47.6    |
| Limiting Alcohol  | 11        | 7.4     | 98                 | 65.8    | 87                                 | 58.4    |
| Not smoking   | 3         | 2.0     | 97                 | 65.1    | 94                                 | 63.1    |
| Managing stress   | 1         | 0.07    | 63                 | 42.3    | 62                                 | 42.2    |
| Get enough sleep  | 0         | 0.00    | 88                 | 59.1    | 88                                 | 59.1    |

**Table 2: Comparison of pretest and Post-test results about knowledge of activities that can be performed to control blood pressure at home**

The above table shows that the awareness of the activities that can control blood pressure have increased by 87.9% after interventions. Knowledge about the activities can be performed purposefully to control blood pressure was also increased after intervention: Eating a healthy diet increased by 87.9%,

Getting regular exercises increased by 47.6%, and Limiting alcohol increased by 58.4%. Not smoking increased by 63.1%, managing stress increased by 42.2%, and getting enough sleep increased by 59.1%.

|        |  | Paired Differences |                |                 |   |         | t      | df | Sig. (2-tailed) |
|--------|--|--------------------|----------------|-----------------|---|---------|--------|----|-----------------|
|        |  | Mean               | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference |         |        |    |                 |
|        |  |                    |                |                 | Lower                                     | Upper   |        |    |                 |
| Pair 1 | Knowledge after intervention – knowledge before intervention | 1.05851            | .09631         | .02487          | 1.00518                                   | 1.11184 | 42.569 | 14 | .000            |

**Table 3: Paired Samples t-test to compare the means of self-reported awareness or knowledge about activities that can be performed to control blood pressure before and after intervention**

A paired samples t-test was performed to evaluate whether there was a difference between the means of self-reported knowledge about activities that can control blood pressure of pre-test before intervention and post-test after intervention to test the hypothesis. The results indicated that participants' knowledge

about activities that can be performed to control hypertension after intervention ( $M= 1.1261$ ),  $SD= (.09232)$  was significantly higher than participants' knowledge about activities that can be performed to control hypertension before intervention ( $M=.0676$ ), ( $SD=.0676$ ),  $t(14) =42.569$ ,  $p<.001$ .

|                      | Frequency | Percent |
|----------------------|-----------|---------|
| Normal               | 117       | 78.5    |
| Prehypertension      | 21        | 14.1    |
| hypertension stage 1 | 5         | 3.4     |
| Hypertension stage 2 | 6         | 4.0     |

**Table 4: Participant's blood pressure categories after intervention**

The average of systole and diastole of participants within 4 weeks of intervention was calculated to find out participants' blood pressure categories. The table above revealed that 4% were newly diagnosed with hypertension stage 2, five 3.4% were hypertension stage 1, fourteen point one 14.1% prehypertension, and the majority 78.5% were normal.

### Discussion

Similar to the findings of the study assessed the relationship between OBP, HBP, and ABP revealing that one week of HBP monitoring may be the best approach for diagnosis of hypertension among others [6]. The present intervention revealed that self-blood pressure measurement guided by blood pressure control Guidebook or web application at home can contribute to newly detection of high blood pressure cases and pre-hypertensive people that can help people to alert for prevention measures, getting treatment early and lead to reduction of complications associated to hypertension and reduce related morbidity and mortality. Also, these findings are in line of the study examined whether self-monitoring can reduce clinic BP in patients with hypertension-related co-morbidities and showed that self-monitoring lowers BP regardless of the number of hypertension-related co-morbidities, especially in conditions such as obesity or stroke when combined with high-intensity co-interventions [7,9].

### Conclusion

The findings evidenced that the use of an oscillometer machine and tools guiding for interpretation of readings, and providing guidance for activities to be performed to control blood pressure, increases the knowledge about self-blood pressure control at home, and increases early detection rates of hypertension diseases. Hence, it is recommended that the self-blood pressure measurement at home approach should be encouraged in all communities.

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