

## Self-Monitoring of Blood Pressure among Adults with Hypertension

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### ABSTRACT

Hypertension is a serious medical condition associated with complications and premature death. Self-measurement of blood pressure (BP) which is a way of monitoring BP is recommended and encouraged and is effective at lowering BP. This was a hospital based descriptive cross-sectional study conducted at the Jos University Teaching Hospital (JUTH). Consenting adults with hypertension who regularly attend the Medical Out Patient Department (MOPD) clinics were recruited consecutively for the study over a six-week period. A questionnaire was used to obtain socio-demographic data from the participants. Information including the presence of complications of hypertension and comorbidities, antihypertensive medications used and three blood pressure (BP) readings in the last twelve months were gotten from the patients' folders with the average taken to determine BP control. Three hundred and fifty patients were recruited for the study among whom 230 (65.71%) were females giving a male to female ratio of 1:1.9. The mean age  $\pm$  SD of the study population was 59 $\pm$ 12 years. Less than half 156 (44.57%) of the study population practiced self-monitoring of blood pressure (SMBP) at home. Higher level of education (OR: 6.76, 95% CI 3.87-11.81), use of  $\geq 3$  antihypertensive medications (OR: 3.18, 95% CI 1.84-5.48) and good diastolic BP (OR: 0.54, 95% CI 0.30-0.98) were found to be correlates of SMBP at home. The practice of SMBP at home among our patients is low. This highlights the importance of regular patients' education on the need for SMBP at home.

**Keywords:** Blood pressure, Correlates, Hypertension, Prevalence, Self-monitoring.

### INTRODUCTION

Hypertension is a serious medical condition that significantly increases the risk of heart, brain and kidney diseases with a global estimation of 1.13 billion people having this condition which is a major cause of premature death; two-thirds of these people live in low and middle income countries.<sup>1</sup> The prevalence of

hypertension in Nigeria is estimated to be 28.9% in a meta-analysis.<sup>2</sup> One of the ways of reducing the burden of hypertension is regular monitoring of blood pressure (BP).<sup>1</sup> Self-measurement of blood pressure which is a way of monitoring BP has been recommended by the European Society of Hypertension and the European

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Society of Cardiology.<sup>3</sup> The Nigerian Hypertension Society also recommends self-monitoring of blood pressure at home, emphasizing the use of automated machines that use arm cuff and also the need for regular calibration of the device.<sup>4</sup> Self-monitoring of blood pressure (SMBP), where individuals measure their own blood pressure, usually in a home environment, can improve BP control and is an increasingly common part of hypertension management.<sup>5</sup> It provides multiple measurements of BP, tackles the issue of white coat hypertension and predicts the risk of cardiovascular events better than conventional office measurements.<sup>6</sup> In a study conducted in Finland, Niiranen and colleagues<sup>7</sup> reported that home BP values provide prognostic information about cardiovascular risk and total mortality above and beyond the office BP and they concluded that home BP measurement offers specific advantages more than conventional office measurement. Sheppard and colleagues<sup>8</sup> in the United Kingdom (UK) also found that SMBP was effective at lowering BP and this was observed regardless of the number of hypertension-related co-morbidities present.

In a study in the primary health care system in the UK,<sup>9</sup> 30.7% of patients with hypertension practiced SMBP at home. In this study<sup>9</sup> it was reported that younger patients, patients with diabetes who monitor their blood glucose and patients from the minority group monitored their blood pressure at home. In a study done on the knowledge and attitude of patients with hypertension on SMBP in Nigeria, 54.7% of the participants were aware of SMBP while 88% said it was important.<sup>10</sup>

In this study, we set out to determine the prevalence and correlates of self-monitoring of blood pressure at home among adults with hypertension attending the Medical Out-Patient Department (MOPD) of the Jos University Teaching Hospital (JUTH)

## MATERIALS AND METHODS

This descriptive cross sectional study was carried out among adults with hypertension attending the Medical Out Patient Department (MOPD) of the Jos University

Teaching Hospital (JUTH). JUTH is a tertiary institution located in Plateau State, North central zone of Nigeria. Approval for the study was obtained from the Ethics Committee of JUTH in October 2020 with a reference number of JUTH/DCS/REC/127/XXXI/2286. A verbal and written consent was also obtained from every participant before enrollment into the study. All information gotten was treated with confidentiality.

Three hundred and fifty consenting patients on regular clinic follow-up for hypertension who met the study criteria were recruited over a six-week period from October 20<sup>th</sup>, 2020. Sample size was calculated using a formula<sup>11</sup> and a prevalence rate of 30.7%<sup>9</sup> was used. Patients were recruited using the convenient sampling method where consecutive subjects satisfying the inclusion criteria (age  $\geq$  18 years on follow up for hypertension attending MOPD of JUTH) were enrolled. Patients not regular on their clinic visits (less than 3 visits in the last 12 months) were excluded. Also excluded were patients with pregnancy induced hypertension and those on clinic follow-up for less than twelve months. A questionnaire was used to obtain data in an interviewer format. Data obtained included socio-demographic data. The presence of complications of hypertension, presence of comorbidities, number of anti-hypertensive medications used and three blood pressure readings during their clinic visits in the last twelve months were gotten from the patients' folders. The average of the blood pressure readings was calculated to determine blood pressure control. A systolic value of  $> 140$  mmHg and diastolic value of  $> 90$  mmHg was defined as poor BP control.

Data analysis was done using EPI- Info version 7.2.2.6 (CDC Atlanta, Georgia USA) statistical software. Quantitative variables were summarised using mean and standard deviation (SD). Categorical variables were expressed using frequencies and percentages. The student t-test was used to compare means. Where the expected frequency of a cell was  $< 5$ , Fisher's exact test was used. Chi Square ( $X^2$ ) test was used to test the

significance of association between categorical variables. Variables with P values  $\leq 0.25$  were entered into a multiple logistic regression model to determine their independent association with SMBP. In all cases, P-value of  $<0.05$  was considered statistically significant.

## RESULTS

A total of 350 persons with hypertension were recruited for the study. The age range was 27-95 years with the mean  $\pm$  SD being  $59 \pm 12$  years. Males were older with a mean  $\pm$  SD of  $62 \pm 12$  years and that of the females was  $58 \pm 12$  years. This difference was statistically significant ( $P = 0.006$ ). There were more females (230; 65.71%) with the male to female ratio of 1:1.9. Only 137 (39.14%) participated in any form of physical exercise

with 35 (10%) and 3 (0.86%) taking alcohol and smoking cigarette respectively. Majority 195 (55.71%) had higher level of education defined as more than six years of education (ie secondary education and above) in this study with 150 (42.86%) having diabetes mellitus. Duration of hypertension ranged from 1- 45 years with a median (range) of 10.0 (1-45) years. The presence of comorbidities apart from Diabetes mellitus was found in 96 (27.43%) of individuals with 92 (26.29%) having one or more complications of hypertension. Most of the participants had good blood pressure control; 218 (62.29%) patients had a systolic blood pressure of  $\leq 140$ mmHg with 262 (74.86%) having a diastolic blood pressure of  $\leq 90$ mmHg. Less than half 121 (34.57%) of the study population used  $\geq 3$  antihypertensive medications. See Table 1

**Table 1; Univariate analysis and characteristics of the study population**

Variables	Total	SMBP Yes	SMBP No	p-value
Age, years, mean $\pm$ SD	59 $\pm$ 12			
Age, $<65$ years	232 (66.29)	113 (48.71)	119 (51.29)	0.03
Females	230 (65.71)	103 (44.78)	127 (55.22)	0.91
Level of education $> 6$ years	195 (55.71)	120 (61.54)	75 (38.46)	$<0.0001$
Exercise	137 (39.14)	69 (50.36)	68 (49.64)	0.08
Alcohol	35 (10)	17 (48.57)	18 (51.43)	0.62
Cigarette smoking	3 (0.86)	0	3 (100)	0.26
Duration of hypertension, $<10$ years	134 (38.29)	61 (45.52)	73 (54.48)	0.78
Number of antihypertensive medications used, $\geq 3$	121 (34.57)	68 (56.20)	53 (43.80)	0.001
Presence of diabetes mellitus	150 (42.86)	66 (44)	84 (56)	0.85
Presence of comorbidities	96 (27.43)	43 (44.79)	53 (55.21)	0.96
Presence of complications of hypertension	92 (26.29)	39 (42.39)	53 (57.61)	0.62
DBP $\leq 90$ mmHg	122 (46.56)	122 (46.56)	140 (53.44)	0.20
SBP $\leq 140$ mmHg	218 (62.29)	99 (45.41)	119 (54.59)	0.68

*SMBP-Self-monitoring blood pressure, level of education  $> 6$  years - secondary education and above, DBP- Diastolic blood pressure, SBP- Systolic blood pressure*

Self-monitoring of blood pressure at home was reported in 156 (44.57%) patients, 103 (29.43%) were females while 53 (15.14%) were males. Among those that practiced SMBP at home, most 114 (92.31%) used automated machine with 38 (24.36%) using manual and 4 (2.56%) using both manual and automated devices. Majority 51 (32.69%) of the patients that practiced SMBP at home checked their blood pressure weekly with 47 (30.13%) checking it monthly. Seventeen (10.90%) and 11 (7.05%) checked theirs twice weekly and daily respectively. Only a few 20 (12.82%) of those who practiced SMBP at home had their devices checked by their doctors. Almost all 152 (97.44%) of those who practiced SMBP at home used arm cuffs with only 4 (2.56%) using wrist cuff. Majority 252 (73.71%) of the study population were aware of SMBP. One hundred and ninety-four (55.43%) of the study population did not

practice SMBP at home. Among the reasons given for not practicing SMBP, cost of the device ranked high 77 (39.69%), followed by not knowing the importance of SMBP 57 (29.38%) and being unaware of SMBP 53 (27.32%). Other reasons included not knowing how to operate the machine 6 (3.09%) and anxiety 1 (0.52%).

Univariate analysis showed that age ( $P = 0.03$ ), exercise ( $P = 0.08$ ), number of antihypertensive medications used ( $P = 0.001$ ), level of education ( $P = <0.0001$ ) and good diastolic blood pressure ( $P = 0.20$ ) were associated with SMBP at home. See Table 1

On multivariate analysis, the number of antihypertensive medications used (OR: 3.18, 95% CI 1.84-5.48), level of education (OR: 6.76, 95% CI 3.87-11.81) and good diastolic blood pressure (OR: 0.54 95% CI 0.39-0.98) were found to be independent correlates of SMBP at home. See Table 2

**Table 2: Independent correlates of self-monitoring of blood pressure**

Variables	OR (95% CI)	p-value
Age, <65 years	1.3310 (0.7536- 2.3505)	0.32
Exercise	1.1886 (0.7296-1.9365)	0.49
Number of antihypertensive medications used $\geq 3$	3.1800 (1.8439-5.4845)	<0.0001**
Level of education > 6 years	6.7610 (3.8714-11.8074)	<0.0001**
Diastolic blood pressure $\leq 90$ mmHg	0.5447 (0.3033-0.9782)	0.04**

\*\* Independent correlates of self-monitoring of blood pressure, level of education > 6years - secondary education and above

## DISCUSSION

Self-monitoring of BP at home is an increasingly common part of hypertension management and is effective at lowering BP.<sup>5,8</sup> In this study, we looked at the prevalence and correlates of SMBP at home among patients with hypertension. The key findings in this study is that less than half (44.57%) of the patients practiced SMBP at home with the correlates of SMBP being higher level of education, good diastolic blood pressure and the use of three or more antihypertensive medications.

The prevalence reported in this study is similar to what was reported by Seidlerová and colleagues<sup>12</sup> in Czech Republic where a prevalence of 40% was found. The finding in this study was however lower than what was reported in the USA<sup>13</sup> where a prevalence of 53.8% was reported. This difference can be explained by the fact that the study was an online study that recruited all patients with hypertension including those not on medications and those not regular on their clinic visits while in our study, we recruited only those on

medications and regular on their clinic visits in the last twelve months. Because it was an online study, some patients that cannot afford computers and internet services and by implication self-monitoring device would have been excluded thereby increasing the prevalence of SMBP at home in this study. The prevalence in this study is higher than what was reported in a study in the UK<sup>9</sup> and Ethiopia<sup>14</sup> where prevalence rates of 30.7% and 7% were reported respectively. The study conducted in UK<sup>9</sup> was among patients attending primary health care while our study was done among patients attending specialist clinics where the patients are motivated and the importance of SMBP at home must have been emphasized. The study in Ethiopia<sup>14</sup> was not conducted in tertiary institutions where specialists' clinics exist thereby giving a lower prevalence.

The knowledge of SMBP at home in this study is high (253; 73.71%). This was corroborated in another study in Nigeria<sup>10</sup> where more than half of the population studied knew about SMBP. The knowledge was however, low in the study conducted in Ethiopia.<sup>14</sup> This can be explained by the different levels of health institutions where these studies were conducted. Patients were recruited from the tertiary health care institution in this study while in Ethiopia, it was conducted at the secondary health care institutions. Among participants who practiced SMBP at home in this study, the frequency of monitoring was low with 51 (32.69%) persons monitoring it weekly and 47 (30.13%) checking it monthly. In another study,<sup>9</sup> monthly check was more frequent. This may be as a result of lack of guidelines on the frequency of monitoring by the regulatory bodies. Majority 114 (92.31%) of all who practiced SMBP at home in this study used automated devices and 152 (97.44%) used the arm cuff. This was also corroborated in the study conducted in UK.<sup>9</sup> The reasons for not practicing SMBP at home in this study viz cost, not knowing its importance, unawareness and not knowing how to operate the device have been corroborated in another study.<sup>14</sup>

The independent correlates associated with SMBP at

home found in this study include higher level of education, higher number of antihypertensive medications use and good diastolic blood pressure. Higher level of education has been associated with SMBP at home in other studies.<sup>9,14</sup> This is not surprising because with education, knowledge is gained and so persons with higher education have the desire to know how they are doing medically, thereby practicing SMBP at home more.

The high number of antihypertensive medications used as a correlate in this study was corroborated in another study.<sup>12</sup> Higher number of medications is used among patients whose control is poor with consequent increased cardiovascular risk. Knowing that their cardiovascular risk is higher, patients in this group will be interested in their control thereby practicing SMBP at home more to reduce the risk.

The finding of good DBP as a correlate of SMBP at home in this study was not corroborated by any recent study. Even though this is not completely clear, patients with SBP  $\leq$  140mmHg in this study also practiced SMBP at home more than those with higher SBP but this was not statistically significant ( $p=0.68$ ). An explanation for this finding can be related to patients with good BP control desiring that the control is maintained with consequent reduction in cardiovascular risk prompting them to practice SMBP at home more. Another explanation may be from the point of psychology. The good blood pressure control may encourage them to be part of their care by practicing SMBP at home.

The limitations of this study include the fact that data were self-reported and so may not reflect actual practice of SMBP as participants may report what they think is acceptable. Additionally, this was a hospital based study and so findings cannot be generalized to the public.

## CONCLUSION

This study has revealed that the practice of SMBP among our patients is low. The correlates of SMBP



include higher level of education, higher number of antihypertensive medications used and diastolic blood pressure of  $\leq 90$ mmHg implying that low level of education, less number of antihypertensive medications used and poor DBP are barriers to SMBP. Patients' education on the importance of SMBP at home should therefore target those with low level of education, those with poor BP control and those on less than three antihypertensive medications. This education should be done regularly and continuously in every clinic visit to ensure the practice of SMBP at home which can help in better BP control and reduction of morbidity and mortality.

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