HOME BLOOD PRESSURE MONITORING IN AN ETHNICALLY DIVERSE INNER-CITY CARDIOLOGY PRACTICE

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Objectives: To evaluate home blood pressure monitoring (HBPM) in an inner city cardiology practice.

Design: Retrospective study.

Setting: Inner city cardiology practice.

Patients: Consecutive patients were evaluated for hypertension and had ≥8 home blood pressure recordings during 2–4 weeks while clinically stable on a medical regimen.

Main Outcome Measures: Blood pressure differences, blood pressure load, defined as %HBPM systolic blood pressure readings >140 and/or diastolic blood pressure readings >90 mm Hg.

Results: 55 patients, (33 female, age 62±12.5 years). Office systolic, diastolic and mean BPs were higher than HBPM values (147±19 mmHg vs 139±17 mmHg, *P*=<.0001), (86±10 mm Hg vs 79±10 mm Hg, *P*<.0001), and (106±11 mm Hg vs 99±10 mmHg, *P*<.0001) respectively. Office and home pulse pressure (PPs) were similar (61±17 mm Hg vs 60±17 mm Hg, *P*=.42). Office and home PPs were more strongly correlated (r=.78, *P*<.0001) than were systolic (r=.51, *P*<.0001), diastolic (r=.51, *P*<.0001). Blood pressure load increased in a step-wise manner with increasing office blood pressure, 7.5% for patients with office blood pressure <120/80 mm Hg to 73.5% in patients with office blood pressure>160/100 mm Hg (*P*=.02). Office BPs showed 10/55 patients were normal or controlled (blood pressure <140/90 mmHg) and 45 were high or uncontrolled (blood pressure ≥140/90 mmHg). HBPM reclassified 2/10 patients as high/uncontrolled whereas 17/45 patients became normal/controlled.

Conclusions: Office systolic and diastolic BPs are 7–8 mm Hg higher than home recordings in ethnically diverse patients. Office and home PPs are more strongly correlated than systolic, diastolic or mean arterial BPs. Blood pressure load is related to office BPs. HBPM reclassified approximately one third of the patients. HBPM appears useful in managing minority populations with hypertension. (*Ethn Dis*. 2008;18:37–41)

Key Words: Hypertension, Ethnicity, Home Blood Pressure Monitoring

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INTRODUCTION

Hypertension is more prevalent and severe in African Americans and more frequently causes target organ injury in this population.[1] Over the past decade, the measurement of blood pressure by patients using automated devices has grown in the clinical and research settings.[2,3] Using proper techniques, home blood pressure monitoring (HBPM) is accurate and reliable.[4,5] When measured at home, higher blood pressures predicted increased cardiovascular disease risk[6–8] and are correlated with left ventricular mass and carotid intimal medial thickness.[9,10] Accordingly, HBPM has been proposed to evaluate patients with white coat hypertension, to guide titration of medical therapy, and to enhance adherence to therapy.[11,12] Clinical experience with HBPM has been reported in patients from Japan, Germany, Spain, Belgium, and Sweden.[13–18] Despite the greater prevalence of hypertension in minority populations, surprisingly few studies have addressed the utility of HBPM in ethnically diverse populations in the United States. The objective of the present study was to compare HBPM with office blood pressure monitoring in an inner-city cardiology practice.

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METHODS

We retrospectively studied 55 consecutive patients who were evaluated for management of hypertension by a single cardiologist in an academic cardiology practice in Brooklyn, New York. During their initial visit, patients were instructed to measure and record their blood pressures and heart rates along with the date and time, at variable times once to twice daily using the right arm. Patients were instructed in the use of their particular sphygmomanometer by a physician assistant and were observed to ensure they understood how to use the device. Patients owned a variety of aneroid sphygmomanometers. BPs were measured at the same time (within several minutes) in the office using the office BP cuff and the patient's own sphygmomanometer to be to be certain of the accuracy of the patient's sphygmomanometer. Patients were excluded if either systolic or diastolic blood pressure differed from office measurements by ≥5 mm Hg. The patients were instructed to not record the first two days' blood pressure readings and to start recording on day three if they felt comfortable. Patients were asked to

record at least one morning and one evening blood pressure. They were reevaluated two to four weeks later. The individual HBPMs were checked against sphygmomanometry performed in the office. Patients were included if they had ≥8 blood pressure recordings taken during a two- to four-week time period while clinically stable on a constant medical regimen.

Blood pressure load was defined as the percentage of home blood pressure measurements either >140 mm Hg systolic or >90 mm Hg diastolic.[19] All home blood pressure measurements were averaged. The pulse pressure was calculated as the systolic minus the diastolic pressure. To determine the relationship between office blood pressure and blood pressure load, patients were divided into the following categories on the basis of office blood pressure readings: those with both systolic blood pressure (SBP) <120 mm Hg and diastolic blood pressure (DBP) <80 mm Hg, either SBP 120–139 mm Hg or DBP 80–89 mm Hg, either SBP 140–159 mm Hg or DBP 90–99 mm Hg, or either SBP ≥160 mm Hg or DBP ≥100 mm Hg. Cardiovascular risk factors and clinical characteristics were obtained from patient charts. Body mass index was calculated as weight in kilograms divided by the square of height in meters. Creatinine clearance was calculated by applying relevant data to the Cockcroft-Gault formula.[20] This study was approved by the Hospital's Institutional Review Board.

Statistics

All values are expressed as mean ± standard deviation (SD). Continuous data were compared using Wilcoxon rank and Kruskal-Wallis analysis of variance (ANOVA) tests. Univariate associations between study variables were analyzed using Spearman correlation coefficients. All statistical analyses were conducted using the Statistical Package for Social Sciences (SPSS) 11.0 software (SPSS Inc., Chicago, Ill, USA). A P value <.05 was considered statistically significant.

Table 1. Patient characteristics

Characteristic	% or Mean ± Standard Deviation
Age (years)	62.4±12.4
Female	63%
Race	
African American	75.4%
Caucasian	11.8%
Hispanic	9.8%
Asian	2%
Prior hypertension	92%
Diabetes	29.4%
History smoking	33.3%
Hyperlipidemia	72.5%
Height (inches)	65.4±3.7
Weight (pounds)	184±38
Body mass index (kg/m^2)	30.7±8.4
Creatinine clearance (cc/min/m^2)	58±20
Office systolic blood pressure (mm Hg)	148±20
Office diastolic blood pressure (mm Hg)	86±10

RESULTS

We examined 33 women and 22 men, mean age 62±12.5 years (Table 1). Most patients were African American (74.5%). Office SBP, DBP, and mean arterial blood pressure were significantly higher than home recorded values. Office and home pulse pressures were similar. Office and home pulse pressures were more strongly correlated than were SBP, DBP, and mean arterial blood pressure. Blood pressure load increased in a stepwise manner with increasing office blood pressure (Figure 1). Blood pressure load was 7.5% for patients with office blood pressure <120/80 mm Hg, 31.3% in patients with office blood pressure 120–139/80–89 mm Hg, 47% in patients with office blood pressure 140–159/90–99 mm Hg, and 73.5% in patients with office blood pressure >160/100 mm Hg (P=.02). Of the 55 patients, office readings showed 10 patients with normal or controlled blood pressure (<140/90 mm Hg) and 45 with high or uncontrolled blood pressure (≥140/90 mm Hg). With HBPM, 2 of 10 patients were reclassified as uncontrolled and 17 of 45 patients were reclassified as controlled. Most (65.5%) patients remained in the same blood pressure category for both office and recorded home pressures. Systolic and diastolic blood pressure differences were similar for men and women and did not differ with age.

Compared to non-African Americans, the African American group had higher office SBP, office mean blood pressure, home DBP, and home mean blood pressure. Home and office pulse pressures were similar between the two groups. The difference between office and home SBP appeared higher in African Americans than in non-African Americans; however, this finding was not statistically significant. Differences between office and home DBP, pulse pressure, and mean blood pressure were also similar between the two groups.

DISCUSSION

This study found blood pressure obtained by HBPM to be 7–8 mm Hg lower than office recorded values in an ethnically diverse population evaluated at an inner- city academic cardiology practice. HBPM resulted in approximately one third of patients being reclassified according to blood pressure

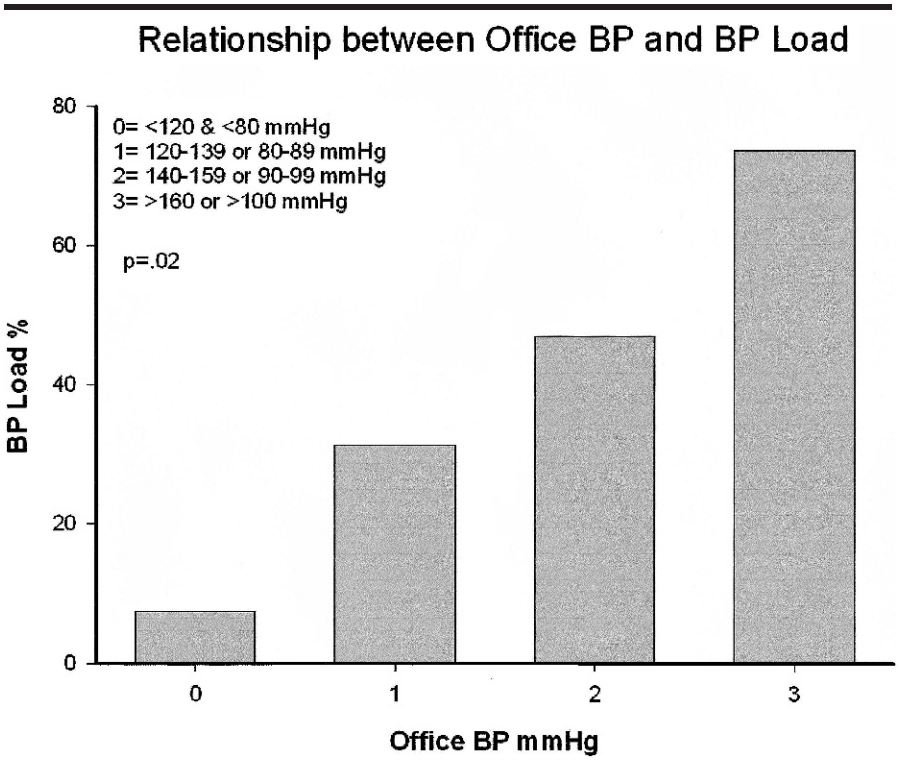

Fig 1. Relationship between office BP and BP load

status, most of whom were downgraded from high or uncontrolled blood pressure to normal or controlled blood pressure status.

Home blood pressure monitoring by patients has dramatically risen over the past decade. In one study, HBPM had superior reproducibility over clinic or ambulatory blood pressure monitoring, suggesting the use of HBPM may be better for clinical assessment of hypertension and may improve the accuracy of antihypertensive drug trials.[21] Most of our patients were African American (75.4%). A number of studies have shown African Americans have lower rates of awareness, treatment, and control of blood pressure than do other racial groups.[22–24] The Third National Health and Nutrition Examination Survey found lower blood pressure control in African Americans associated with male sex, younger age, and infrequent physician contact.[25] This suggests more frequent BP measurements may be important to achieve optimal BP control. Although suboptimal blood pressure control is multifactorial, in the multiethnic study of atherosclerosis, African American ethnicity was significantly associated with treated but uncontrolled hypertension after controlling for socioeconomic factors.[26] Despite the high prevalence of hypertension in African Americans and other minorities in the United States, few studies have addressed the utility of HBPM in these patients.

This study found blood pressure obtained by HBPM to be 7–8 mm Hg lower than office recorded values in an ethnically diverse population evaluated at an inner- city academic cardiology practice.

Absolute differences between office and home blood pressure measurements in the present study were higher than previously reported values in Japanese subjects.[13] Whether this relates to differences in patient populations is unknown. In the present study, African Americans constituted the majority of patients and appeared to have a higher home-office SBP difference. Although not statistically different, this may account for inter-study differences. The reason for this slightly higher home-office blood pressure difference is not known but may include cultural factors such as patient attitudes toward their healthcare providers, which was not addressed in our study. A meta-analysis of four studies from the Untied States and four from the United Kingdom did not suggest any difference in white-coat hypertension in Blacks and Whites.[27] The reclassification of blood pressure status using HBPM in one third of patients was somewhat lower than the 54% observed previously.[5] Office and home pulse pressures were more strongly correlated than were office and home SBP and DBP. Because office pulse pressure is an independent predictor of increased cardiovascular risk,[28] it would appear that pulse pressure derived by HBPM may also provide prognostic value.

Blood pressure load increased as a function of increasing office blood pressure. Blood pressure load has been proposed as a measure of blood pressure control and refers to the percentage of time in which blood pressure readings are abnormally high.[19] Although intuitive, this relationship has not been well studied. Of note, 31.3% of blood pressure readings were abnormally high in patients whose office blood pressures were between 120–139/80–89 mm Hg. The clinical significance of this finding remains uncertain. Blood pressure load has previously been derived from hourly recorded blood pressures during the course of a day using ambulatory blood pressure monitoring (ABPM). In the

present study, patients were instructed to record their blood pressures at least twice daily at variable times throughout the day, which resulted in a mean of 30 blood pressure measurements during a two- to eight-week period. Therefore, ABPM differs from home monitoring in that it includes measurements obtained while sleeping. Although the nocturnal blood pressure reduction provides additional variability in SBP and DBP, African American hypertensive patients frequently do not exhibit this reduction.[29] Few studies have addressed the use of ABPM in African Americans.[30–32]

Various schedules have been proposed for HBPM, and recent guidelines have been suggested.[33] However there is lack of consensus as to the optimal number of blood pressure measurements and schedule.[11] Three blood pressure measurements in the morning and afternoon for a minimum of five days correlates best with results of ABPM,[34] although this time-consuming regimen may not be practical. Current guidelines recommend the same threshold blood pressure values for HBPM and ABPM, but the techniques may not be equivalent. Antihypertensive treatment should be based on outcome data, but these are not yet available for HBPM.[35] Although the prognostic value of ABPM has been validated, it is uncommonly used in routine clinical practice. Self-measurement of blood pressure using automated devices has gained popularity in the clinical and research settings and has been suggested to improve patient compliance and to reduce medication costs, number of clinic visits, and cardiovascular morbidity.[11,12] Given the widespread use of self-measurement of blood pressure by patients, HBPM may ultimately have greater applicability than ABPM.

Limitations

This study is subject to the limitations of a retrospective study, and a relatively small number of patients were studied. Automatic devices were not provided directly to the patients but obtained by the patients themselves. This limitation may bias the sample toward more highly compliant patients. Patients were evaluated for hypertension management before or after treatment with medications. Although all devices were equipped with automatic inflated arm cuffs, a number of different devices were used; use of a single model might have improved the observed relationships, but all marketed devices comply with the international validation protocol requirements. Medication effects were not considered, and the prognostic value of HBPM in ethnic subgroups remains to be determined.

Despite these limitations, we found that mean SBP and DPB were 7–8 mm Hg higher in the office as compared to home recordings in an ethnically diverse patient population. Office and home pulse pressures are more strongly correlated than SBP, DBP, or mean arterial pressure. Blood pressure load is directly related to office blood pressure. HBPM resulted in reclassification of blood pressure status in approximately a third of patients. Therefore, it would appear that self-measurement of blood pressure by patients at home may be useful in managing hypertension in an ethnically diverse patient population. Home blood pressure monitoring may serve as a useful technique in clinical or epidemiologic research in ethnic populations. Whether HBPM directly affects patient adherence and compliance is not known. The effects of HBPM on clinical outcomes and its cost effectiveness also merit further study.

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Manuscript draft: Qureshi, Salciccioli, Clark, Lazar
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