Control of Blood Pressure as Measured at Home and Office, and Comparison with Physicians’ Assessment of Control among Treated Hypertensive Patients in Japan: First Report of the Japan Home versus Office Blood Pressure Measurement Evaluation (J-HOME) Study

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The Japan Home versus Office Blood Pressure Measurement Evaluation (J-HOME) study was conducted to measure the control of blood pressure (BP) as evaluated by home BP measurement among 3,400 patients with essential hypertension (mean age: 66 years; females: 55%) receiving antihypertensive treatment in primary care settings in Japan. The purpose of this first report was to compare characteristics of BP control as measured at home and in the clinic (office) and define their association with BP control as evaluated by physicians. Mean systolic/diastolic BP (SBP/DBP) values were 140/82 mmHg for home BP and 143/81 mmHg for office BP. BP levels were not adequately controlled among approximately 60% of the patients, according to reference values described in the national guidelines (office BP: ‘140/90 mmHg; home BP: ‘135/85 mmHg). Even among patients evaluated by physicians as having excellent or fairly good BP control, office and home SBP values were insufficiently controlled in approximately 50%. Although the tendency was more remarkable among older patients, whose recommended target BP levels are higher than those of middle-aged patients in the Japanese Hypertension Society 2000 criteria, office and home BP values were not adequately controlled in approximately 50% of the middle-aged patients whose BP control was evaluated as good. Our findings suggest that an important reason why home and office BP values are not adequately controlled is that physicians approve relatively higher BP levels under treatment, even among middle-aged patients. (Hypertens Res 2004; 27: 755–763)

Key Words: hypertension/drug therapy, home blood pressure, office blood pressure, physicians’ practice patterns, practice guidelines
Introduction

Self-measurement of blood pressure (BP) at home (home BP), a technique that makes it possible to obtain multiple measurements under well-controlled conditions, is more reliable than conventional (office) BP measurement, since it avoids both observer and regression dilution biases and eliminates the white-coat effect (1–3). Previous cross-sectional studies and a prospective cohort study have also shown that home BP measurement has a stronger predictive power for target organ damage, morbidity, and mortality than has conventional BP measurement (4–8). It has also been shown that home BP measurement is the best method for evaluating the BP-lowering effect of antihypertensive agents in clinical trials (9).

Because of the above benefits, home BP measurement is now widely practiced in developed countries. Several national and international guidelines also recommend its use for better management of hypertension (10–12). Although two population studies have examined BP control as measured at home, the number of treated hypertensive patients in these cohorts was not sufficient to allow detailed analysis according to the subjects’ characteristics (13, 14). Only two studies have examined the characteristics of BP control based on home BP level among hypertensive patients receiving antihypertensive medication (15, 16).

A large proportion of hypertensive patients on antihypertensive medication have inadequate office BP control (17–24), even though safe and effective therapies for hypertension are readily available, and the importance of obtaining optimal BP control through the use of these therapies is increasingly recognized. Efforts to understand poor BP control have usually focused on patient adherence to therapy and patient characteristics associated with nonadherence. Recently, it has been shown that clinician practices are very important (25–31) and that some physicians are satisfied with poor office BP control (32, 33). However, despite the increasing importance of home BP measurement, no study has examined the association between BP control as measured at home and physicians’ evaluation of BP levels.

The Japan Home versus Office BP Measurement Evaluation (J-HOME) study was conducted to measure the control of BP as evaluated by home BP measurement among essential hypertensive patients receiving antihypertensive treatment in primary care settings in Japan, where approximately 30 million home BP measuring devices have been distributed (34). The purpose of the present analysis was to identify characteristics of BP control based on home and office BP measurement and define their association with the physicians’ evaluation of BP levels in this population of treated hypertensive patients.

Methods

Patients

In March 2003, 7,354 physicians randomly selected from all over Japan were invited to take part in this project. Of the 1,477 who agreed to participate, 751 collected data for the study. By the end of August 2003, 3,586 patients who gave their informed consent to participate in the study were enrolled. Sixty-six were excluded since their BP levels were within normal range without antihypertensive medication. An additional 120 were excluded since insufficient data on BP values or patient characteristics were provided. The study population thus consisted of 3,400 patients.

Home BP Measurements

Patients were asked to measure their BP once every morning within 1 h of waking, in the sitting position after more than 2 min of rest, before taking antihypertensive drugs and to record the results over 2 weeks, as specified by the Japanese guidelines for home BP measurement (3). They used electronic arm-cuff devices that operate on the basis of the cuff-oscillometric method and that had been validated and approved by the Ministry of Health, Labor, and Welfare, Japan. The mean of all measurements was calculated for each patient and used for the analysis. Uncontrolled hypertension based on home BP (home hypertension) was defined as home systolic BP (SBP) ≥135 mmHg and/or diastolic BP (DBP) ≥85 mmHg. These values were based on several guidelines (1–3).

Office BP Measurements

Patients’ BP values were measured twice consecutively in the sitting position after a rest of at least 2 min at each normal visit. Physicians or nurses used the auscultation method with a mercury or aneroid sphygmomanometer, or the cuff-oscillometric method with electronic arm-cuff devices that had been validated and approved by the Ministry of Health, Labor, and Welfare, Japan. The average of four measurements at two visits in the period of home measurements was defined as the office BP value for each patient and used for the analysis. Uncontrolled hypertension based on office BP (office hypertension) was defined as office SBP ≥140 mmHg and/or DBP ≥90 mmHg, according to criteria recommended by several guidelines (10, 11).

Data Collection and Analysis

Physicians’ evaluations of their patients’ home and office BP values were assessed by a self-administered questionnaire as “poor,” “fairly good,” or “excellent” control. No reference values for normal and hypertensive levels based on home or
office BP were mentioned in the questionnaire. The questionnaire also collected information on patient characteristics.

Data are shown as the mean ± SD. Variables were compared by using Student’s t-test, χ² test, or analysis of variance (ANOVA) as appropriate. A p value less than 0.05 was accepted as indicative of statistical significance. All statistical analyses were conducted with the SAS package (Version 8.2; SAS Institute Inc., Cary, USA).

Results

Baseline Characteristics

Table 1 shows the baseline characteristics of the subjects. The mean age of the participants was 66 ± 11 years and the proportion of females was 55%. Fourteen percent of the patients were classified as current smokers. A history of cerebrovascular disease was identified in 9%, ischemic heart disease in 8%, diabetes in 14%, hypercholesterolemia in 40%, and high uric acid in 12% (Table 1).

The mean duration of antihypertensive treatment was 30 ± 43 months. The average number of antihypertensive drugs was 1.7 ± 0.9. Drug therapy was prescribed as follows: one drug, 49%; two-drug combinations, 35%; three-drug combinations, 12%; four or more drugs, 4% (Table 1). The most commonly prescribed agents were Ca-channel blockers (70%), followed by angiotensin II receptor blockers (44%) and angiotensin converting enzyme inhibitors (17%) (Table 1).

BP Values and BP Control in Relation to Patient Age

Mean SBP/DBP values were 140 ± 14/82 ± 10 mmHg for home and 143 ± 14/81 ± 9 mmHg for office BP. Both home and office SBP values increased with age, and DBP values decreased with age (Fig. 1). The average number of home BP measurements was 13. Office BP was measured by the auscultation method with a mercury (75%) or aneroid sphygmomanometer (3%), or the cuff-oscillometric method with electronic arm-cuff devices (22%).

Patients with properly controlled SBP and DBP accounted for 34% of all patients according to the criteria based on home BP values (SBP < 135 mmHg and DBP < 85 mmHg), and 42% according to the criteria based on office BP values (office SBP < 140 mmHg and DBP < 90 mmHg). Those with properly controlled SBP accounted for 40% of all patients according to home BP values (SBP < 135 mmHg) and 44% according to office BP values (SBP < 140 mmHg). Those with properly controlled DBP accounted for 65% according to home BP values (DBP < 85 mmHg) and 84% according to office BP values (DBP < 90 mmHg).

The proportion of patients with properly controlled home SBP and DBP decreased with increasing age from 37% among those aged less than 50 years to 27% among those aged 80 years or older (Fig. 2). The proportion of patients with properly controlled home SBP decreased with age, while that of patients with properly controlled home DBP increased with age (Fig. 2). Similar associations were observed for office BP (Fig. 2).
BP Values and BP Control as Evaluated by Physicians

Of the 3,400 patients, physicians’ evaluations of the home and office BP values were available for 3,043 (90%). There were no differences in BP values or major characteristics between those with physicians’ evaluations and those without. Home SBP and DBP values were significantly lower among patients evaluated as having “fairly good control” \(<135/85\) mmHg and “excellent control” \(<128/88\) mmHg than among those evaluated as having “poor control” \(>154/96\) mmHg (Fig. 3). Similarly, the proportion of patients with properly controlled home SBP and DBP was significantly higher among patients evaluated as having “fairly good control” (25%) and “excellent control” (76%) than in patients evaluated as having “poor control” (2%), although home SBP and DBP values were not properly controlled in 75% and 24% of the patients evaluated as having “fairly good control” and “excellent control” (Fig. 3). Such associations were similarly observed for office BP values (Figs. 3, 4).

BP Values and BP Control as Evaluated by Physicians

Home BP Values and BP Control by Age Group among Those Evaluated as Having “Excellent” or “Fairly Good” Control

Home SBP values increased and DBP values decreased with age (Table 2). The proportion of patients with properly controlled home SBP and DBP decreased with age from 50% of patients aged less than 60 years to 37% of those aged 80 years or older (Table 2). The same association was observed for SBP and DBP considered separately (Table 2).

Office BP Values and BP Control by Age Group among Those Evaluated as Having “Excellent” or “Fairly Good” Control

Similarly, office SBP values increased and DBP values decreased with age (Table 3). The proportion of patients with properly controlled office SBP and DBP decreased with age from 50% of patients aged less than 60 years to 45% of those aged 80 years or older (Table 3). The proportion of patients with properly controlled SBP increased as the target SBP
levels became higher (Table 3). SBP was controlled below 150 mmHg in 83% of patients aged 70 to 79 years, and below 160 mmHg in 94% of those aged over 80 years (Table 3). In contrast, DBP control improved with increasing age (Table 3).

**Discussion**

This nationwide survey of 3,400 patients with essential hypertension under pharmacological antihypertensive treatment demonstrated that BP levels were not adequately controlled among approximately 60% of the patients, when evaluated on the basis of the target BP levels given in the guidelines (1–3, 10, 11). Importantly, such insufficient BP control was observed not only for office BP measurement but also for home BP measurement, which has a closer association with cardiovascular outcomes than office BP measurement has. These results, consistent with the results of previous studies (13–16), indicate that the poor BP control among treated hypertensive patients is not a reflection of white-coat hypertension but indicates a true lack of sufficient BP control.

BP control was worse for the SBP than for the DBP values, and the discrepancy became apparent with increasing age. Among older patients, SBP was adequately controlled in approximately 30%, while DBP was well controlled in 80% to 90% of patients. Similar findings have been reported...
in numerous studies that investigated the control of BP as measured in the office (17–24). These results are also consistent with a population survey in Japan (35), reflecting the effects of aging on vascular compliance: well-controlled DBP in the elderly could be the result not of antihypertensive treatment but of a natural, age-dependent change.

The SBP and DBP values were significantly lower among those evaluated as having “excellent” and “fairly good” control than among those evaluated as having “poor” control. However, SBP and DBP were insufficiently controlled among 75% of those evaluated as having “fairly good” control and among 24% of those evaluated as having “excellent” control. To examine this association in detail, we calculated the proportion of controlled hypertension by age group among those evaluated as having “excellent” or “fairly good” control. For the office BP, the proportion of those with adequate SBP values decreased with increasing age when we used the office criterion of 140 mmHg. Control was largely improved by using the definition of the Japanese Society of Hypertension (JSH) (12), which recommends higher target BP levels among the elderly (70–79 years: <150 mmHg; 80+ years: <160 mmHg). SBP was controlled below 150 mmHg in 83% of patients aged 70 to 79 years, and below 160 mmHg in 94% of those aged over 80 years. These results suggest that physicians in the present study might evaluate the BP control conditions as “good” according to the recommended target BP levels in the JSH guidelines (12), even though the latest version of the guidelines describes the possibility of improving the prognosis of all age groups by reducing the SBP to below 140 mmHg (36). Although no such target levels by age group have been recommended for home BP, it is possible that the higher home BP values in the elderly patients were reflections of the JSH recommendations for controlling office BP.

For middle-aged or early elderly hypertensive patients aged less than 70 years, the JSH guidelines recommend an office SBP target level of <140 mmHg. However, both office and home BP values were adequately controlled in only half of such patients whose BP control was evaluated as “good” by their physicians. These results indicate that one of the reasons for the poor BP control is that the physicians approved the relatively high BP levels in their patients. These results are also consistent with the results of a previous study; i.e., an important reason why physicians do not treat hypertension more aggressively is that they are willing to accept elevated BP levels in their patients (32).

Most guidelines recommend measurement of home BP in the morning and in the evening when the measurement conditions are most stable. To assess the home BP control in the present study, we used home BP values in the morning measured within 1 h of waking and before taking antihypertensive drugs, since we have previously shown that morning home BP values measured in this manner are more predictive of mortality and stroke risk than casual BP values (6, 8). The stronger predictive power of the morning home BP is thought to be attributable to the fact that these values represent “trough” measurements that reflect an insufficient duration of the antihypertensive effect of drugs. It is also possible that the control of home BP may be improved if we use evening home BP. We are therefore currently investigating the control of home BP by using evening home BP values in this J-HOME population, since we also corrected the data for evening home BP.

Although many guidelines recommend that BP measurements be taken with the subject seated after an at least 5-min rest, we used a procedure to measure office BP and home BP after an at least 2-min rest according to the JSH guidelines for self-monitoring of BP at home (3), which propose more practical and generous conditions in order to ensure compliance with BP measurements. Moreover, we used the average of the first measurement on each morning as the home BP value according to the JSH guidelines (3). However, the first measurement on each occasion is reported to be higher than the average of multiple measurements on each occasion (37). The above conditions on BP measurement may be in part attributable to the higher BP values and the higher proportion of uncontrolled hypertension as assessed by office BP and home BP. It is also possible that an enhanced white-coat effect in the office and an activated sympathetic nerve activity in the morning affected the poor control of office BP and home BP, respectively.

The present study demonstrates that BP values were not adequately lowered in approximately 60% of hypertensive patients receiving pharmacological treatment. Our findings also suggest that an important reason why home and office BP values were not adequately controlled was the physicians’ approval of the high BP levels in their patients. Further studies will be needed to clarify other factors influencing BP control and physicians’ evaluation.

Appendix

The study was designed and conducted, and will be interpreted by the investigators independently of sponsors. This study was conducted by the J-HOME Study Group.

Members of the J-HOME Study Group

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