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ORIGINAL ARTICLE

Blood pressure differences between office and home settings among Japanese normotensive subjects and hypertensive patients

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This study attempted to clarify the differences in blood pressure (BP) between the office (clinic) and home settings in patients with controlled, sustained, masked or white-coat hypertension. The following formula was used: office mean systolic BP (omSBP) – mean morning home SBP (mmhSBP)/office mean diastolic BP (omDBP) – mean morning home DBP (mmhDBP). The paired *t*-test was used for statistical analysis. The omSBP – mmhSBP/omDBP – mmhDBP calculation yielded the following results: among normotensive subjects, $-1.1 \pm 11.2/-1.7 \pm 8.5$ mm Hg (mean SBP and mean DBP were higher at home than in the office; $n = 451$, $P = 0.038$ in SBP, $P = 0.000$ in DBP); in controlled hypertensive patients, $-0.42 \pm 10.9/-2.2 \pm 8.2$ mm Hg ($n = 1362$, $P = 0.160$ in SBP, $P = 0.000$ in DBP); among sustained hypertensive patients, $5.6 \pm 14.7/0.048 \pm 9.9$ mm Hg ($n = 1370$, $P = 0.000$ in SBP, $P = 0.857$ in DBP); in masked hypertensive patients, $-15.3 \pm 12.9/-9.3 \pm 9.5$ mm Hg ($n = 1308$, both $P = 0.000$); and among white-coat hypertensive patients, $23.7 \pm 13.2/8.2 \pm 9.1$ mm Hg ($n = 580$, both $P = 0.000$). Our results showed a difference of 5 mm Hg in SBP among sustained hypertensive patients, as recommended by the Japanese Society of Hypertension Guidelines for the Management of Hypertension; however, in other hypertensive patient types, the differences in SBP and DBP between office and home measurements differed by >5 mm Hg. Office and home BP measurements should be interpreted cautiously, keeping in mind the clinical setting.
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Keywords: blood pressure difference; home blood pressure; hypertensive patient types; normotensives; office blood pressure

INTRODUCTION

Several home blood pressure (BP)-based studies have been reported, and the target levels for BP at home are $<135/85$ mm Hg in hypertensive patients and $<125/75$ mm Hg in hypertensive patients with diabetes mellitus according to the Ohasama Study[1,2] and observational studies conducted using HOMED-BP (Hypertension Objective Treatment Based on Measurement by Electrical Devices of Blood Pressure).[3,4] Similarly, in the Japanese Society of Hypertension Guidelines for the Management of Hypertension (JSH 2014), the target home BP for young, middle-aged and early-phase elderly patients is $<135/85$ mm Hg, and the target home BP for diabetic patients is $<125/75$ mm Hg.[5] There is little evidence for why the target levels of home systolic BP (SBP) and diastolic BP (DBP) are 5 mm Hg lower than clinical SBP and DBP, considering the differences in BP when using a home-based diagnosis of hypertension;[2] however, an appreciable disparity in BP measurements obtained at the office (clinic) and at home is occasionally noted. In addition, patients with masked hypertension show opposite BP differences between the office and home settings, and both the SBP and DBP are higher than those in the office. To clarify the BP differences in clinical practice, we studied the differences in BP in normotensive subjects and hypertensive patients according to a hypertensive classification of controlled, sustained, masked and white-coat hypertension.

METHODS

Participants

We requested medical practitioners of 17 927 clinics or hospitals in Japan who were members of the Japanese Medical and Dental Practitioners for the Improvement of Medical Care (JMDPIMC) to participate in this study. The study period was from 10 December 2012 to 10 March 2013. The protocol of this study was approved by the ethical review board of the Kanagawa Association of Medical and Dental Practitioners and was registered on a clinical trial registration site UMIN-CTR (University Hospital Medical Information Network-Clinical Trials Registry).[6]

Data collection

We asked the practitioners of JMDPIMC to report the mean office BP and pulse rate (PR) along with 3 consecutive days of morning and night BP and PR

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measurements collected in the patient's home, recorded by the patient. BP and PR were analyzed using office mean (om) BP and PR, same morning home BP and PR before visiting the office, previous night BP and PR before visiting the office, mean morning home (mmh) BP and PR and mean night home BP and PR. The mean BP and PR at home were calculated using 2–3 measurements. The BP measurements were performed using the auscultation method with mercury or aneroid sphygmomanometers or automatic oscillometric BP devices. In addition, we classified hypertensive patients into four groups according to the differences between office and home BP measurements: controlled, sustained, masked and white-coat hypertensive patients. Differences were calculated using the following formula: office mean systolic BP (omSBP) − mean morning home SBP (mmhSBP)/office mean diastolic BP (omDBP) − mean morning home DBP (mmhDBP).

Statistical analysis

Statistical analyses were carried out using Student's *t*-test (paired *t*-test and nonpaired *t*-test), one-way analysis of variance, *post hoc* multiple comparisons tests and χ^2 test in PASW (SPSS) ver. 18 (Chicago, IL, USA). All values are expressed as mean ± s.d., and *P*-values of <0.05 were considered significant.

RESULTS

The patient population included 6525 patients and consisted of 5631 hypertensive patients, 847 normotensive subjects and 47 unknown subjects from 349 clinics or hospitals throughout Japan; 4620 hypertensive patients and 451 normotensive subjects were also included in the analysis. The remaining 1407 cases were excluded from analysis because of a lack of data in both hypertensive patients and normotensive subjects or a diagnosis of diabetes mellitus and/or chronic renal disease in normotensive subjects. The BP and PR differences between the office and home measurements were described based on the comparison between office measurements and mean morning home measurements (calculated with 2–3 home measurements). Figure 1a shows the differences between the omBP and mmhBP values, and Figures 1b,c and d show scatter charts demonstrating the correlations between omSBP and mmhSBP in all hypertensive, controlled and sustained hypertensive patients, respectively. Significant correlations were found among all hypertensive, controlled hypertensive and sustained hypertensive patients. In all hypertensive patients, the regression equation was as follows: y (mean morning home SBP) = 0.263 × (office mean SBP)+100.5 mm Hg. The coefficient of correlation (*r*) was 0.329 ($n=4620$, $P=0.000$). In controlled hypertensive patients, the regression equation was as follows: y (mean morning home SBP) = 0.172 × (office mean SBP) +103.4 mm Hg, and *r* was 0.243 ($n=1362$, $P=0.000$). In sustained hypertensive patients, the regression equation was as follows: y (mean morning home SBP) = 0.252 × (office mean SBP)+108.1 mm Hg, and the *r* was 0.275 ($n=1370$, $P=0.000$).

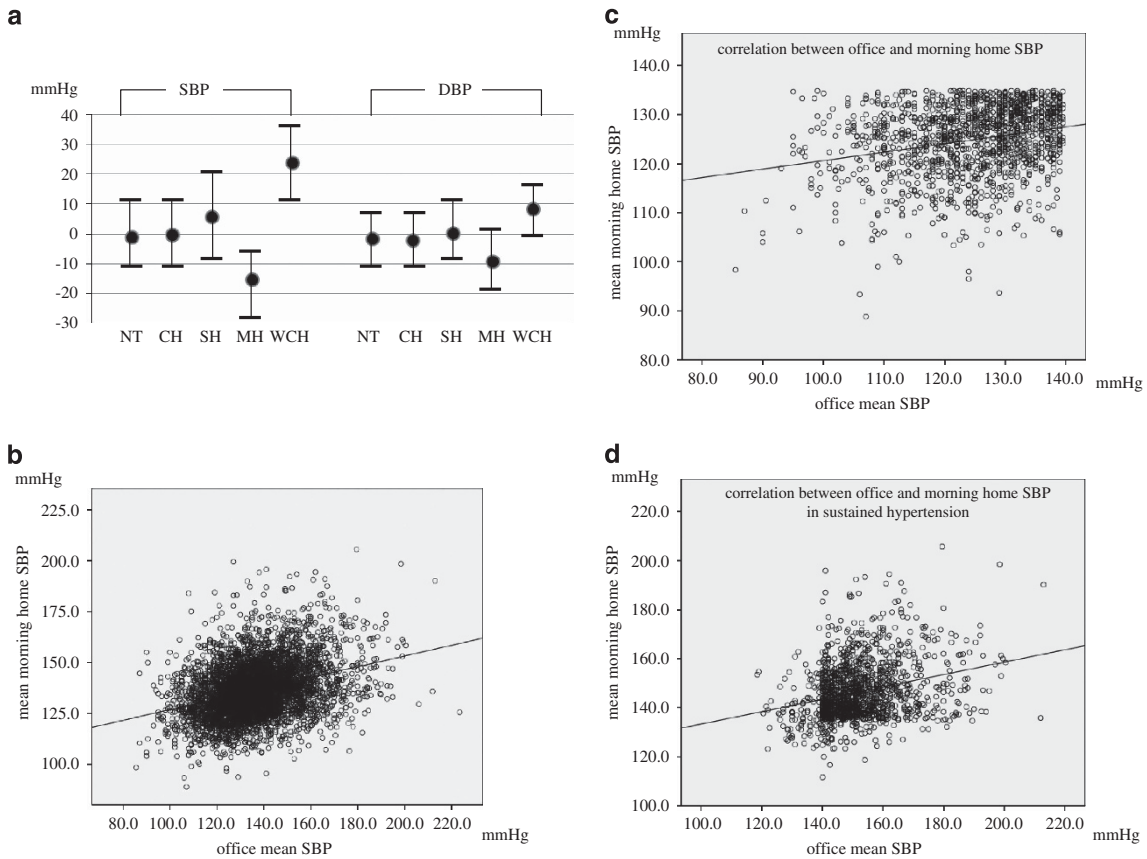

Figure 1 (**a**) Differences between office mean BPs and mean morning home BPs among normotensive subjects and four types of hypertensive patients. Each value shows mean ± s.d. (**b**) Scatter chart between office mean and mean morning home SBP in all hypertensive patients. (**c**) Scatter chart between office mean and mean morning home SBP in controlled hypertensive patients. (**d**) Scatter chart between office mean and mean morning home SBP in sustained hypertensive patients. BP, blood pressure; CH, controlled hypertensive patients; DBP, diastolic blood pressure; MH, masked hypertensive patients; NT, normotensive patients without associated diabetes mellitus or chronic kidney disease; SBP, systolic blood pressure; SH, sustained hypertensive patients; WCH, white-coat hypertensive patients.

BP and PR differences between office and home measurements in normotensive subjects without diabetes mellitus or chronic kidney disease

We examined the BP differences in 633 normotensive subjects. The definition of a 'normotensive' subject was a subject exhibiting an office SBP of <140 mm Hg and an office DBP of <90 mm Hg who had not been diagnosed with hypertension and was not receiving antihypertensive drugs. Furthermore, in this group, we included patients without a diagnosis of diabetes mellitus or chronic kidney disease. The mean age in the normotensive groups was 52.3 ± 15.7 years (n = 618). Overall, 111 males and 516 females were included; the sex of 6 subjects was unknown. The omSBP was 115.2 ± 12.4 mm Hg, the mmhSBP was 116.3 ± 12.8 mm Hg, and the difference between office and home measurements, that is, omSBP − mmhSBP, was − 1.1 ± 11.2 mm Hg, a significant difference (n = 451, P = 0.038, paired t-test). The omDBP was 70.1 ± 8.5 mm Hg, and the mmhDBP was 71.8 ± 9.1 mm Hg. The omDBP − mmhDBP was − 1.7 ± 8.5 mm Hg, a significant difference (n = 451, P = 0.000, paired t-test). The office mean PR (omPR) was 72.2 ± 10.0 beats per min (b.p.m.), the mean morning home PR (mmhPR) was 68.9 ± 9.2 b.p.m., and omPR − mmhPR was 3.4 ± 8.6 b.p.m. The mean PR was significantly higher at the office than at home (n = 447, P = 0.000, paired t-test).

Significant differences were observed in age, omSBP, omPR, mmhSBP and mmhPR between male and female subjects (P = 0.000 for age, omSBP, omPR, mmhSBP and mmhPR; nonpaired t-test) as well as in omDBP and mmhDBP (P = 0.001 for both omDBP and mmhDBP, nonpaired t-test, Table 1).

BP and PR differences between the office and home settings in hypertensive patients

Controlled hypertensive patients. The definition of controlled hypertension was an omBP of <140/90 mm Hg and an mmhBP of <135/85 mm Hg. The mean age of the controlled hypertensive group was 67.8 ± 10.5 years (n = 1319). Overall, 526 patients were

Table 1 Differences between office and home blood pressure and pulse rate in normotensive subjects without associated diabetes mellitus and chronic kidney disease (paired *t*-test) and differences between males and females (nonpaired *t*-test)

(a) Difference between office and home blood pressure and pulse rate

	Office mean BP and PR	*Home BP and PR*	*Difference*	P-*value*
Office mean BP and PR vs. morning home BP and PR				
SBP (n=449)	115.2 ± 12.4	115.9 ± 13.5	− 0.71 ± 12.0	0.208
DBP (n=449)	71.0 ± 8.5	71.4 ± 9.8	− 1.3 ± 9.1	0.003
PR (n=446)	72.3 ± 10.0	68.6 ± 9.6	3.7 ± 8.8	0.000
Office mean BP and PR vs. night home BP and PR				
SBP (n=386)	115.9 ± 12.2	114.6 ± 13.7	1.3 ± 12.7	0.041
DBP (n=386)	70.4 ± 8.6	69.1 ± 9.5	1.3 ± 9.2	0.007
PR (n=382)	72.1 ± 10.1	69.6 ± 8.9	2.4 ± 10.2	0.000
Office mean BP and PR vs. mean morning home BP and PR				
SBP (n=451)	115.2 ± 12.4	116.3 ± 12.8	− 1.1 ± 11.2	0.038
DBP (n=451)	70.1 ± 8.5	71.8 ± 9.1	− 1.7 ± 8.5	0.000
PR (n=447)	72.2 ± 10.0	68.9 ± 9.2	3.4 ± 8.6	0.000
Office mean BP and PR vs. mean night home BP and PR				
SBP (n=395)	115.9 ± 12.2	114.2 ± 11.9	1.6 ± 11.1	0.003
DBP (n=395)	70.4 ± 8.6	69.5 ± 8.6	0.83 ± 8.2	0.046
PR (n=391)	72.1 ± 10.1	69.6 ± 8.2	2.6 ± 9.3	0.000

(b) Sexual differences	*Male*	*Female*	P-*value*
Age	59.7 ± 17.1 (n=107)	50.8 ± 14.9 (n=507)	0.000
Office mean			
SBP	121.0 ± 9.8 (n=111)	114.5 ± 12.6 (n=516)	0.000
DBP	72.9 ± 8.7 (n=111)	69.8 ± 8.7 (n=516)	0.001
PR	69.5 ± 10.5 (n=110)	73.2 ± 9.6 (n=511)	0.000
Mean morning home			
SBP	123.8 ± 11.4 (n=69)	114.9 ± 12.5 (n=378)	0.000
DBP	75.1 ± 8.9 (n=69)	71.2 ± 9.1 (n=378)	0.001
PR	65.1 ± 8.1 (n=69)	69.5 ± 9.2 (n=376)	0.000

Abbreviations: BP, blood pressure (mm Hg); DBP, diastolic blood pressure (mm Hg); PR, pulse rate (beats per min); SBP, systolic blood pressure (mm Hg).
Morning home BP and PR are measurements in home of same morning before visiting office; night home BP and PR are measurements in home of previous night before visiting office; mean morning home BP and PR are 2–3 consecutive day measurements of morning in home just before visiting office; mean night home BP and PR are 2–3 consecutive day measurements of night in home just before visiting office; night indicates previous night before visiting office.

male, 825 were female and the sex was unknown for 11 patients. The omSBP was 124.4 ± 10.2 mm Hg, the mmhSBP was 124.8 ± 7.2 mm Hg, the omDBP was 71.5 ± 8.7 mm Hg and the mmhDBP was 73.7 ± 7.1 mm Hg. The values for omSBP − mmhSBP/omDBP − mmhDBP were − 0.42 ± 10.9/ − 2.2 ± 8.2 mm Hg ($n = 1362$, $P = 0.160$ in SBP, $P = 0.000$ in DBP, paired *t*-test). The mean DBP was higher in the home than in the office, but the mean SBP was not significantly different between the office and the home. The omPR was 71.7 ± 10.3 b.p.m., the mmhPR was 67.4 ± 8.9 b.p.m., the omPR − mmhPR was 4.3 ± 8.7 b.p.m. and the omPR was significantly higher than the mmhPR ($n = 1330$, $P = 0.000$, paired *t*-test).

There were significant differences in omPR, mmhSBP and mmhDBP between male and female patients ($P = 0.004$ in omPR, $P = 0.001$ in mmhSBP and $P = 0.004$ in mmhDBP, nonpaired *t*-test), but age, omSBP, omDBP and mmhPR showed no such significant differences (nonpaired *t*-test, Table 2).

Sustained hypertensive patients. The definition of sustained hypertension was an omBP of ⩾ 140/90 mm Hg and an mmhBP of ⩾ 135/85 mm Hg. The mean patient age in the sustained hypertensive group was 69.8 ± 10.6 years ($n = 1329$). Overall, 667 patients were male, 692 were female and the sex was unknown for 11 patients. The omSBP was 152.1 ± 12.8 mm Hg, the mmhSBP was 146.5 ± 11.7 mm Hg, the omDBP was 82.9 ± 11.5 mm Hg and the mmhDBP was 82.8 ± 9.8 mm Hg. The omSBP − mmhSBP/omDBP − mmhDBP were 5.6 ± 14.7/0.048 ± 9.9 mm Hg. The difference in SBP was significantly higher in office measurements than in home measurements ($n = 1370$, $P = 0.000$, paired *t*-test), but the difference in DBP was not significant. The omPR was 72.7 ± 11.8 b.p.m., the mmhPR was 67.9 ± 9.6 b.p.m. and the omPR − mmhPR was 4.8 ± 9.6 b.p.m.; furthermore, the office PR was significantly higher than the home PR ($n = 1322$, $P = 0.000$, paired *t*-test).

There were significant differences in age, omDBP, omPR and mmhDBP between male and female patients ($P = 0.001$ in age,

Table 2 Differences between office and home blood pressure and pulse rate in controlled hypertensive patients (paired *t*-test) and differences between males and females (nonpaired *t*-test)

(a) Difference between office and home blood pressure and pulse rate

	Office mean BP and PR	*Home BP and PR*	*Difference*	P-*value*
Office mean BP and PR vs. morning home BP and PR				
SBP (1350)	124.4 ± 10.2	125.0 ± 9.3	− 0.59 ± 12.2	0.074
DBP (1350)	71.5 ± 8.8	73.7 ± 8.0	− 2.2 ± 8.8	0.000
PR (1317)	71.6 ± 10.3	67.5 ± 9.7	4.1 ± 9.3	0.000
Office mean BP and PR vs. night home BP and PR				
SBP (1228)	124.4 ± 10.2	121.0 ± 12.1	3.4 ± 14.4	0.000
DBP (1228)	71.6 ± 8.8	69.9 ± 8.9	1.6 ± 10.1	0.000
PR (1204)	71.5 ± 10.4	69.5 ± 9.9	2.0 ± 10.1	0.000
Office mean BP and PR vs. mean morning home BP and PR				
SBP (1362)	124.4 ± 10.2	124.8 ± 7.2	− 0.42 ± 10.9	0.160
DBP (1362)	71.5 ± 8.7	73.7 ± 7.1	− 2.2 ± 8.2	0.000
PR (1330)	71.7 ± 10.3	67.4 ± 8.9	4.3 ± 8.7	0.000
Office mean BP and PR vs. mean night home BP and PR				
SBP (1263)	124.4 ± 10.2	121.7 ± 10.5	2.7 ± 13.3	0.000
DBP (1263)	71.5 ± 8.8	70.4 ± 8.1	1.1 ± 9.3	0.000
PR (1238)	71.5 ± 10.4	69.4 ± 9.0	2.1 ± 9.3	0.000

(b) Sexual differences	*Male*	*Female*	P-*value*
Age	68.4 ± 10.7 ($n = 509$)	67.5 ± 10.4 ($n = 802$)	0.142
Office mean			
SBP	124.2 ± 10.3 ($n = 526$)	124.6 ± 10.1 ($n = 825$)	0.477
DBP	72.0 ± 8.6 ($n = 526$)	71.2 ± 8.8 ($n = 825$)	0.108
PR	70.6 ± 10.7 ($n = 519$)	72.3 ± 10.1 ($n = 819$)	0.004
Mean morning home			
SBP	125.7 ± 7.0 ($n = 526$)	124.3 ± 7.3 ($n = 825$)	0.001
DBP	74.4 ± 7.2 ($n = 526$)	73.3 ± 6.9 ($n = 825$)	0.004
PR	67.7 ± 9.4 ($n = 519$)	67.3 ± 8.5 ($n = 807$)	0.388

Abbreviations: BP, blood pressure (mm Hg); DBP, diastolic blood pressure (mm Hg); PR, pulse rate (beats per min); SBP, systolic blood pressure (mm Hg).
Morning home BP and PR are measurements in home of same morning before visiting office; night home BP and PR are measurements in home of previous night before visiting office; mean morning home BP and PR are 2–3 consecutive day measurements of morning in home just before visiting office; mean night home BP and PR are 2–3 consecutive day measurements of night in home just before visiting office; night indicates previous night before visiting office.

$P = 0.005$ in omDBP, $P = 0.000$ in omPR and $P = 0.000$ in mmhDBP; nonpaired *t*-test), but the omSBP, mmhSBP and mmhPR were not significantly different (nonpaired *t*-test, Table 3).

Masked hypertensive patients. The definition of masked hypertension was an omBP of $<140/90$ mm Hg and an mmhBP of $\geqslant 135/85$ mm Hg. The mean age of the masked hypertensive patients was 69.1 ± 10.7 years ($n = 1270$). The patients included 612 males, 689 females and 7 patients of unknown sex. The omSBP was 127.3 ± 9.1 mm Hg, the mmhSBP was 142.7 ± 9.9 mm Hg, the omDBP was 72.8 ± 9.3 mm Hg and the mmhDBP was 82.1 ± 9.2 mm Hg. The omSBP − mmhSBP/omDBP − mmhDBP was $-15.3 \pm 12.9/-9.3 \pm 9.5$ mm Hg, and the home SBP and DBP were significantly higher than the office measurements ($n = 1308$, both $P = 0.000$, paired *t*-test). The omPR was 72.0 ± 11.1 b.p.m., the mmhPR was 67.7 ± 9.8 b.p.m. and the omPR − mmhPR was 4.3 ± 8.9 b.p.m.; the office PR was significantly higher than the home PR ($n = 1277$, $P = 0.000$, paired *t*-test).

There were significant differences in age, omPR and mmhDBP between male and female patients ($P = 0.003$ in age, $P = 0.001$ in omPR and $P = 0.000$ in mmhDBP, nonpaired *t*-test), but the omSBP, omDBP, mmhSBP and mmhPR were not significantly different (nonpaired *t*-test, Table 4).

White-coat hypertensive patients. The definition of white-coat hypertension was an omBP of $\geqslant 140/90$ mm Hg and an mmhBP of $<135/85$ mm Hg. The mean age of the white-coat hypertensive patients was 68.5 ± 10.6 years ($n = 566$), and the patients included 195 males and 385 females. The omSBP was 150.3 ± 11.9 mm Hg, the mmhSBP was 126.5 ± 6.4 mm Hg, the omDBP was 82.2 ± 10.5 mm Hg and the mmhDBP was 74.0 ± 7.2 mm Hg. The omSBP − mmhSBP/omDBP − mmhDBP was 23.7 ± 13.2-/8.2 ± 9.1 mm Hg. Both omSBP and omDBP were significantly higher

Table 3 Differences between office and home blood pressure and pulse rate in sustained hypertensive patients (paired *t*-test) and differences between males and females (nonpaired *t*-test)

(a) Difference between office and home blood pressure and pulse rate

	Office mean BP and PR	*Home BP and PR*	*Difference*	P-*value*
Office mean BP and PR vs. morning home BP and PR				
SBP (1357)	152.1 ± 12.7	146.9 ± 13.3	5.2 ± 15.7	0.000
DBP (1357)	82.8 ± 11.5	83.0 ± 10.5	−0.24 ± 10.6	0.411
PR (1311)	72.7 ± 11.8	68.1 ± 10.2	4.7 ± 9.9	0.000
Office mean BP and PR vs. night home BP and PR				
SBP (1222)	152.0 ± 12.8	137.3 ± 15.5	14.8 ± 18.8	0.000
DBP (1222)	82.8 ± 11.4	76.9 ± 11.2	5.9 ± 11.8	0.000
PR (1178)	72.5 ± 11.7	70.1 ± 10.4	2.4 ± 11.0	0.000
Office mean BP and PR vs. mean morning home BP and PR				
SBP (1370)	152.1 ± 12.8	146.5 ± 11.7	5.6 ± 14.7	0.000
DBP (1370)	82.9 ± 11.5	82.8 ± 9.8	0.048 ± 9.9	0.857
PR (1322)	72.7 ± 11.8	67.9 ± 9.6	4.8 ± 9.6	0.000
Office mean BP and PR vs. mean night home BP and PR				
SBP (1261)	152.1 ± 12.8	137.3 ± 13.7	14.8 ± 17.4	0.000
DBP (1261)	82.8 ± 11.5	76.8 ± 10.2	6.0 ± 10.8	0.000
PR (1217)	72.5 ± 11.8	70.1 ± 9.7	2.4 ± 10.4	0.000

(b) Sexual differences	*Male*	*Female*	P-*value*
Age	68.8 ± 10.4 (n=648)	70.7 ± 10.6 (n=671)	0.001
Office mean			
SBP	151.6 ± 12.7 (n=667)	152.5 ± 12.8 (n=692)	0.220
DBP	83.7 ± 11.2 (n=667)	82.0 ± 11.7 (n=692)	0.005
PR	71.2 ± 11.7 (n=661)	74.1 ± 11.5 (n=689)	0.000
Mean morning home			
SBP	146.8 ± 11.8 (n=667)	146.2 ± 11.7 (n=692)	0.314
DBP	83.9 ± 9.7 (n=667)	81.7 ± 9.8 (n=692)	0.000
PR	67.7 ± 10.0 (n=645)	68.0 ± 9.1 (n=672)	0.573

Abbreviations: BP, blood pressure (mm Hg); DBP, diastolic blood pressure (mm Hg); PR, pulse rate (beats per min); SBP, systolic blood pressure (mm Hg).
Morning home BP and PR are measurements in home of same morning before visiting office; night home BP and PR are measurements in home of previous night before visiting office; mean morning home BP and PR are 2–3 consecutive day measurements of morning in home just before visiting office; mean night home BP and PR are 2–3 consecutive day measurements of night in home just before visiting office; night indicates previous night before visiting office.

Table 4 Differences between office and home blood pressure and pulse rate in masked hypertensive patients (paired *t*-test) and differences between males and females (nonpaired *t*—test)

(a) Difference between office and home blood pressure and pulse rate

	Office mean BP and PR	*Home BP and PR*	*Difference*	P-*value*
Office mean BP and PR vs. morning home BP and PR				
SBP (1298)	127.3±9.1	142.4±11.3	−15.0±13.9	0.000
DBP (1297)	72.8±9.3	82.0±10.0	−9.1±10.1	0.000
PR (1263)	72.0±11.1	67.9±10.4	4.0±9.1	0.000
Office BP and PR vs. night home BP and PR				
SBP (1190)	127.2±9.2	132.1±13.5	−4.9±15.2	0.000
DBP (1190)	72.6±9.4	75.2±10.3	−2.6±10.4	0.000
PR (1161)	72.0±11.2	70.1±10.6	1.9±9.9	0.000
Office BP and PR vs. mean morning home BP, PR				
SBP (1308)	127.3±9.1	142.7±9.9	−15.3±12.9	0.000
DBP (1308)	72.8±9.3	82.1±9.2	−9.3±9.5	0.000
PR (1277)	72.0±11.1	67.7±9.8	4.3±8.9	0.000
Office BP and PR vs. mean night home BP and PR				
SBP (1225)	127.2±9.2	132.9±11.9	−5.7±13.8	0.000
DBP (1225)	72.6±9.4	75.6±9.4	−3.0±9.7	0.000
PR (1196)	72.0±11.2	70.2±9.9	1.8±9.4	0.000

(b) Sexual differences	*Male*	*Female*	P-*value*
Age	68.1±10.7 (*n*=592)	69.9±10.7 (*n*=673)	0.003
Office mean			
SBP	127.4±9.2 (*n*=612)	127.2±9.1 (*n*=689)	0.751
DBP	73.0±9.3 (*n*=612)	72.6±9.4 (*n*=689)	0.386
PR	70.8±11.2 (*n*=606)	73.0±11.0 (*n*=687)	0.001
Mean morning home			
SBP	143.1±10.3 (*n*=612)	142.3±9.5 (*n*=689)	0.136
DBP	83.3±9.3 (*n*=612)	81.0±9.0 (*n*=689)	0.000
PR	67.7±10.5 (*n*=596)	67.6±9.1 (*n*=678)	0.845

Abbreviations: BP, blood pressure (mm Hg); DBP, diastolic blood pressure (mm Hg); PR, pulse rate (beats per min); SBP, systolic blood pressure (mm Hg).
Morning home BP and PR are measurements in home of same morning before visiting office; night home BP and PR are measurements in home of previous night before visiting office; mean morning home BP and PR are 2–3 consecutive day measurements of morning in home just before visiting office; mean night home BP and PR are 2–3 consecutive day measurements of night in home just before visiting office; night indicates previous night before visiting office.

Table 5 Differences between office and home blood pressure and pulse rate in white-coat hypertensive patients (paired *t*-test) and differences between males and females (nonpaired *t*-test)

(a) Difference between office and home blood pressure and pulse rate

	Office mean BP and PR	*Home BP and PR*	*Difference*	P-*value*
Office BP and PR vs. morning home BP and PR				
SBP (573)	150.2±11.9	126.9±7.9	23.3±13.5	0.000
DBP (573)	82.2±10.4	74.3±7.6	7.9±9.2	0.000
PR (554)	74.6±12.1	67.1±9.8	7.5±11.8	0.000
Office BP and PR vs. night home BP and PR				
SBP (528)	150.4±11.4	124.1±10.9	26.4±15.3	0.000
DBP (528)	82.0±10.4	71.2±8.7	10.9±11.1	0.000
PR (513)	74.6±12.0	69.6±10.3	5.0±12.7	0.000
Office BP and PR vs. mean morning home BP and PR				
SBP (580)	150.3±11.9	126.5±6.4	23.7±13.2	0.000
DBP (580)	82.2±10.5	74.0±7.2	8.2±9.1	0.000
PR (562)	74.6±12.1	66.9±9.2	7.7±11.4	0.000
Office BP and PR vs. mean night home BP and PR				
SBP (545)	150.4±11.8	124.7±9.5	25.7±14.7	0.000
DBP (545)	82.1±10.5	71.6±8.0	10.6±10.4	0.000
PR (533)	74.5±12.0	69.2±9.1	5.3±11.6	0.000

(b) Sexual differences	*Male*	*Female*	P-*value*
Age	67.8±11.0 (*n*=189)	68.9±10.3 (*n*=377)	0.268
Office mean			
SBP	149.8±13.1 (*n*=195)	150.5±11.2 (*n*=385)	0.526
DBP	83.6±11.5 (*n*=195)	81.4±9.8 (*n*=385)	0.026
PR	74.1±12.1 (*n*=193)	74.7±12.0 (*n*=378)	0.571
Mean morning home			
SBP	126.7±6.3 (*n*=195)	126.4±6.4 (*n*=385)	0.600
DBP	75.0±6.9 (*n*=195)	73.5±7.4 (*n*=385)	0.019
PR	67.1±10.1 (*n*=194)	66.9±8.7 (*n*=371)	0.822

Abbreviations: BP, blood pressure (mm Hg); DBP, diastolic blood pressure (mm Hg); PR, pulse rate (beats per min); SBP, systolic blood pressure (mm Hg).
Morning home BP and PR are measurements in home of same morning before visiting office; night home BP and PR are measurements in home of previous night before visiting office; mean morning home BP and PR are 2–3 consecutive day measurements of morning in home just before visiting office; mean night home BP and PR are 2–3 consecutive day measurements of night in home just before visiting office; night indicates previous night before visiting office.

than the home measurements ($n=580$, both $P=0.000$, paired *t*-test). The omPR was 74.6±12.1 b.p.m., the mmhPR was 66.9±9.2 b.p.m. and the omPR−mmhPR was 7.7±11.4 b.p.m.; the office PR was significantly higher than the home PR ($n=562$, $P=0.000$, paired *t*-test).

There were significant differences in omDBP and mmhDBP between male and female patients ($P=0.026$ in omDBP and $P=0.019$ in mmhDBP, nonpaired *t*-test), but age, omSBP, omPR, mmhSBP and mmhPR were not significantly different (nonpaired *t*-test, Table 5).

Mean age- and sex-related differences among controlled, sustained, masked and white-coat hypertensive patients

The mean age of each hypertensive patient type has been mentioned above. Significant differences in age were noted among these groups ($P=0.000$, one-way analysis of variance). The mean age of the sustained hypertensive patients was higher than that of the controlled hypertensive patients, whereas the mean age of the masked hypertensive patients was higher than that of the controlled hypertensive patients ($P=0.000$ and $P=0.013$, respectively, *post hoc* multiple comparison test). The proportion of each hypertensive patient type was as follows: 29.5% of the patients were controlled hypertensive patients, 29.7% were sustained hypertensive patients, 28.3% were masked hypertensive patients and 12.6% were white-coat hypertensive patients. The proportion of male patients was 38.9% in controlled hypertensive patients ($n=1351$), 49.1% in sustained hypertensive patients ($n=1359$), 47.0% in masked hypertensive patients ($n=1301$) and 33.6% in white-coat hypertensive patients ($n=580$). There was thus a significant difference in the

number of males and females among the hypertensive patient types ($P = 0.000$, χ^2 test).

DISCUSSION

Many studies have reported differences between office BP (OBP) and home BP (HBP). The OBP and self-measured HBP in a randomly selected population of Nigerians living in Abuja showed that HBP was significantly higher than OBP, with a mean difference (confidence interval) of systolic/diastolic of 3.6 (2.5–4.6 mm Hg)/2.3 (1.4–3.1 mm Hg).[7] This HBP/OBP difference was maintained in men and normotensive individuals, but in women and hypertensive participants there was no significant difference between HBP and OBP.[7] A study of self-measured BP with 162 participants in Sweden reported that the mean OBP was higher than the mean HBP (difference: $8.1 \pm 14/3.1 \pm 8.8$ mm Hg, $P < 0.0001$). Even when patients themselves measured the BP in the office, this self-measured OBP was significantly higher than the self-measured HBP.[8] Another study examined the mean difference between OBP and HBP in a general hypertensive population selected from three communities in the Beijing area. The data obtained from 200 participants showed that the office SBP and office DBP were higher than the home SBP and home DBP, respectively, and the mean differences were 3.1-/1.6 mm Hg in all participants and 6.2/1.1 mm Hg in hypertensive patients.[9] Another report from Norway[10] showed that in subjects with OBP $<140/90$ mm Hg, the HBP was 128/84 mm Hg, whereas the OBP was 130/82 mm Hg. In patients with OBP $\geqslant 140/90$ mm Hg, the HBP was 149/93 mm Hg and OBP was 157/95 mm Hg. Moreover, the difference between HBP and OBP increased with age.[10] The J-HOME study showed that the home-effect group, in whom the value of office SBP − home SBP was $\leqslant -3.1$ mm Hg, had a higher risk of cerebrovascular disease and ischemic heart disease because of family history than the office-effect group in whom the office SBP − home SBP difference was $\geqslant 8.9$ mm Hg.[11] The study of olmesartan-based treatment on home and clinic blood pressure in the elderly showed a difference in the BP measurements acquired in the office and the home that was similar to our study among the four types of hypertensive patients.[12] According to these studies, differences in BP measurements between office and home are readily apparent, although the reported magnitudes of the BP differences are dissimilar. Thus far, differences in BP measurements among the four types of hypertensive patients have not been described.

Our study showed a difference of ~ 5 mm Hg in SBP in the group of sustained hypertensive patients, consistent with the recommendations of the Japanese Society of Hypertension Guidelines for the Management of Hypertension;[5] however, among the other hypertensive patient types, the differences in SBP and DBP between the office and home differed by >5 mm Hg. Our results suggest that measurements of BP in the office and home should be interpreted cautiously among controlled, masked and white-coat hypertensive patients. We also noted significant differences in age and sex among the four hypertensive patient types, and the proportion of female patients in the white-coat hypertensive group was higher than in other hypertensive patient types, as previously reported.[11]

Study limitations

This study has certain limitations. First, we asked practitioners to instruct their patients to measure BP and PR at home in the morning and at night on 3 consecutive days immediately before visiting the clinic, but the JSH guidelines for the self-measurement of BP recommend using the average BP value measured over 5–7 days in a week for the purpose of detecting hypertension or evaluating the effects of antihypertensive medication. To enroll an adequate number of participants throughout Japan, we could not ask general practitioners to collect consecutive BP measurements over long time periods, and we accordingly asked for measurements over 3 consecutive days.

Second, it is not clear whether the office BP measurements obtained by the physicians were in accordance with the JSH guidelines because clinical practices in Japan are usually very busy. Thus, although some limitations exist regarding the interpretation of the BP evaluations, we consider that our study demonstrated actual differences between office and home measurements for BP in Japan.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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