How reliable are self-measured blood pressures taken at home?

■ EVIDENCE-BASED ANSWER

Self-measured blood pressures (SMBP) can be precise and accurate and, thus, reliably be used as an adjunct to office blood pressure measurements in selected clinical situations (strength of recommendation [SOR]: **B**, extrapolation and limited trials). Clinicians using SMBP need to be aware of the difference in normal reference ranges, with pressures greater than 135/85 mm Hg considered hypertensive.

Whether hypertensive treatment should be based primarily on SMBP is unclear, and currently undergoing study. Clinicians should recommend multiple daily measurements with a validated and standardized device, preferably equipped with memory or transmission capabilities, in order to avoid patient error in transcribing and reporting values. Wrist or finger devices cannot reliably be used (SOR: **B**, limited comparison studies).

■ EVIDENCE SUMMARY

Office blood pressure (OBP) has traditionally been used in long-term trials to describe the relationship between blood pressure and cardiovascular morbidity and mortality, as well as to establish the efficacy of antihypertensive drug therapy. A prospective randomized trial demonstrating the relationship between therapy based on SMBP to these same outcomes is in progress.[1]

Two large prospective cohort studies of the relationship between SMBP and morbidity and mortality made comparative baseline blood pressure measurements and followed the cohorts without suggestions or attempts to change management. The first was a rural population-based study with 1789 subjects (90% of the population) from Ohasama, Japan.[2] Mean follow-up was 6.6 years with less than 1% dropout rate. The second large cohort study (SHEAF trial) included patients ≥60 years old with the diagnosis of hypertension.[3] A total of 4939 cases were analyzed. Mean follow-up was 3.2 years with less than 1% dropout rate. Both studies show that each mm Hg increase in SMBP was a better predictor of cardiovascular events than an equivalent increase in OBP (**Table 1**).

Office blood pressure measurements exhibit large variability (decreased precision) and are subject to multiple biases (decreased accuracy). Self-measured blood pressures at home became common when "white-coat hypertension" was recognized to be clinically significant. It allows for a larger number of measurements for individual patients, resulting in greater precision than OBP.[4] SMBP correlates better than OBP with surrogate measures of hypertensive control, such as ambulatory blood pressure measurement[5] and left ventricular mass.[6] Thus, SMBP might some day become the gold standard for defining hypertension in the clinical setting. Meanwhile, the correlation between OBP and SMBP can be derived via three different mathematical models using data from multiple studies. The accepted cutoff for SMBP defined hypertension is 135/85 mm Hg.[7]

The THOP trial[8] was a single-blinded, randomized controlled trial of hypertensive treatment based on SMBP vs OBP. Four hundred patients were randomized to SMBP or OBP, with medication adjustments made by a blinded clinician. The trial design called for both treatment groups to be titrated to a diastolic blood pressure of 80 to 89 mm Hg. The follow-up was approximately 1 year. Graphical data indicate that both groups were equally effective in meeting the blood pressure goals outlined in the methods.

Other differences in outcomes were proportional to the known difference in normotensive reference ranges (eg, that OBP tend to run higher than SMBP). Patients in the SMBP group were put on less-intensive drug treatment and

TABLE 1

Increase in cardiovascular mortality for each 1 mm Hg increase in blood pressure

	Cox Proportional Relative Hazards Ratio [95 % CI]			
	Home systolic BP	Home diastolic BP	Office systolic BP	Office diastolic BP
Ohasama study[2]*	1.021 [1.001–1.041]‡	1.015 [0.986–1.045]	1.005 [0.990–1.020]	1.008 [0.984–1.033]
SHEAF study[3]†	1.02 [1.01–1.02]‡	1.02 [1.01–1.03]‡	1.01 [1.00–1.01]	1.00 [0.99–1.02]

*Results were adjusted for age, sex, smoking status, history of cardiovascular disease, and use of antihypertensive medication.
†Increase in cardiovascular events for each 1 mm Hg increase in blood pressure. Results were adjusted for age, sex, heart rate, smoking status, history of cardiovascular events, presence of diabetes, presence of obesity, and presence of treatment for hypercholesterolemia.
‡Statistically significant.

incurred slightly lower medical costs. SMBP patients were twice as likely to have their blood pressure medication discontinued, possibly indicating SMBP helped to identify white-coat hypertension.

■ RECOMMENDATIONS FROM OTHERS

In addition to diagnosing white-coat hypertension, World Health Organization/International Society of Hypertension Guidelines Committee has recommended that home blood pressure measurement is useful in the following circumstances:[9]

• unusual variability of blood pressure over the same or different visits

• office hypertension in subjects with low cardiovascular risk

• symptoms suggesting hypotensive episodes

• hypertension resistant to drug treatment.

Standardization and validation protocols are available from the Association for the Advancement of Medical Instrumentation,[10] European Hypertension Society,[11] or the British Hypertension Society (available at www.hyp.ac.uk/bhs/bp_ monitors/automatic.htm). Relatively few of the hundreds of available blood pressure measurement devices available

meet these criteria. The most current Association for the Advancement of Medical Instrumentation standards are labeled as ANSI/AAMI-SP10:2002/A1:2003 standards. **Table 2** lists some devices that meet the various protocols. Devices in this market change rapidly, so buyers should confirm the device they are evaluating meets current standards.

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TABLE 2

Devices that meet standards for home BP measurement

SMBP device suitable for home use	Validation protocol
A&D-767	BHS
A&D-779	International Protocol
A&D-787	International Protocol
OMRON M5-I	International Protocol
OMRON 705IT	International Protocol
OMRON 705 CPII	International Protocol
OMRON MIT	BHS
Microlife 3BTO-A	BHS
Microlife 3AG1	BHS

BHS: British Hypertension Society; International Protocol: European Hypertension Society

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■ **CLINICAL COMMENTARY**

Self-measured BP may help us better diagnose and manage hypertension

It has been shown that office blood pressure readings can give false-positive results in those who have "white coat hypertension" and give false-negative readings in those with "white coat normotension" or "masked hypertension"—patients who have normal blood pressure values in the office, but elevated blood pressure values outside the office. This is not a trivial issue. Ten to 20% of patients with normal blood pressure values in the office have elevated blood pressure values throughout the day, and evidence is beginning to mount that the cardiovascular consequences are the same for these patients as for those with sustained hypertension.[1]

The SHEAF trial (and other studies) have thrown another complexity into hypertension control by showing that OBP readings were inaccurate in 22% of treated hypertensive patients—13% had uncontrolled OBP with normal SMBP, and 9% had normal OBP but uncontrolled SMBP.[3]

Thus, SMBP is a potentially very powerful and cost-effective tool that may help us better diagnose and manage this complex disease. I have encouraged my hypertensive patients to do SMBP and, as one who has white-coat hypertension (and a strong family history of hypertension), I am diligent at taking my own SMBP on a regular basis to guard against the insidious onset of this disease.

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