Comparison of Acceptability of Traditional and Novel Blood Pressure Measurement Methods

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BACKGROUND
Blood pressure (BP) monitor technology has developed significantly over the past years with the introduction of smaller and quieter home and ambulatory monitors that can both measure BP at night. The acceptability of different BP measurement methods using modern monitors is currently unknown. The purpose of this study was to compare patients' acceptability of traditional and novel BP measurement methods using up-to-date monitors.

METHODS
A population sample of 223 participants underwent 4 office measurements on 2 occasions, a 24-hour ambulatory monitoring and 4 home measurements on 7 consecutive days with home nighttime (home-night) measurements on 2 nights. The acceptability of each method was evaluated with a questionnaire. Analysis of variance with *post hoc* Bonferroni correction was used to compare mean acceptability scores.

RESULTS
Mean acceptability score, with a lower score indicating better acceptability, decreased from ambulatory (3.11 ± 0.93) to home-night (2.74 ± 0.81) to home (2.20 ± 0.70) to office (1.95 ± 0.63) measurements (P < 0.001 for all between-method comparisons). The largest between-method differences were observed in comfort of use and disturbance of everyday activities (P < 0.001). 73.1%, 31.8%, 1.3%, and 2.2% rated office, home, home-night, and ambulatory measurements as the most acceptable method, respectively.

CONCLUSIONS
In the general population and under a research setting, office BP measurement was the method most preferred by the participants while home measurement was the second most preferred. Home-night measurement was slightly more preferred than ambulatory monitoring. However, before home-night BP measurement can be widely promoted as an alternative method for measuring nighttime BP, more evidence of its prognostic significance is needed.

Keywords: acceptability; ambulatory blood pressure; blood pressure measurement; home blood pressure; hypertension; office blood pressure.

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Blood pressure (BP) measurement outside of the office has increased steadily over the past 2 decades.[1] Several recent guidelines recommend out-of-office BP measurements, with either home BP measurements or 24-hour ambulatory monitoring, to confirm the diagnosis of hypertension in all patients[2–4] or only in unclear cases such as when suspecting white-coat or masked hypertension.[5] Home BP monitoring is also recommended for the follow-up of stable patients.[2,5]

Acceptability of ambulatory BP monitoring among patients has been reported to be lower than that of office[6] and home[7] measurements. However, only one previous study by Little *et al.* in 2002 has compared the preference and acceptability of all major BP measurement methods available at the time.[8] The authors concluded that the acceptability of office measurement, performed by a nurse or a doctor, was higher than that of ambulatory BP measurement, while home BP measurement was the method most preferred by patients.[8] Furthermore, a 2004 meta-analysis by Cappuccio *et al.* concluded that the use of home BP monitoring instead of traditional office measurements led to better BP control.[9] These results suggest that patients' preference and acceptability of different BP measurement methods could even have a positive or negative effect on adherence to hypertension treatment.

BP monitor technology has developed significantly over the past 13 years after the study by Little *et al.*[8] During this period, home and ambulatory monitors have become markedly smaller, quieter, and fully automatic. In addition, timer-equipped home monitors have been introduced, offering a new option for measuring nighttime BP outside of the office.[10] To our knowledge, no previous study has extensively compared the acceptability of home nighttime (home-night) and ambulatory BP measurement. Furthermore, the acceptability of home and ambulatory BP measurement using modern monitors is currently unknown. The purpose of this study was, therefore, to compare patients' acceptability of

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traditional and novel BP measurement methods using up-to-date monitors.

METHODS

The DILGOM (Dietary, Lifestyle, and Genetic determinants of Obesity and Metabolic syndrome) study was a population survey with 5,024 participants aged 25–74 years that aimed to assess how nutrition, diet, lifestyle, psychosocial factors, environment, and genetics are linked to obesity and the metabolic syndrome. DILGOM was carried out in 2007 in 5 geographical areas of Finland and 1,037 persons were examined in the southwestern Finland area. Of these participants, 500 (50 men and 50 women from each 10-year cohort) were randomly invited to participate in a cardiovascular substudy and 493 agreed to participate. In 2014, 453 still living participants of the cardiovascular substudy were invited to a reexamination and a total of 283 (62%) persons participated. Sixty persons were excluded from this study because of missing data ($n = 50$) or because the participants had given identical scores to ≥3 BP measurement methods indicating careless responding ($n = 10$). Thus, the final study population consisted of 223 participants. All participants gave written informed consent, and the study was approved by The Ethics Committee of the Varsinais-Suomi Hospital District, Finland.

All participants underwent 3 study visits between April and December 2014. On the first visit, office BP was measured twice by a nurse after a 3-minute rest at 1-minute intervals with an oscillometric BP monitor (Microlife WatchBP Office Central).[11] Twenty-four-hour ambulatory BP was then measured with a Microlife WatchBP O3 monitor every 20 minutes during the day (from 7 AM to 10 PM) and every 30 minutes during the night (from 10 PM to 7 AM).[12] On the following day, the participant returned the ambulatory monitor, underwent similar office BP measurements as on the previous day, and received a Microlife WatchBP Home N automatic oscillometric monitor[13] with oral and written instructions on how to measure home BP. Home BP was measured twice every morning between 6 AM and 9 AM and every evening between 6 PM and 9 PM on 7 consecutive days. In addition, home-night BP was measured during the last 2 nights at fixed times 2, 3, and 4 hours after going to bed.

After the 1-week home measurement period, the participants rated the 4 different methods of BP measurement—office, home, home-night, and ambulatory—for acceptance and preferability with a questionnaire. We used a slightly modified version of the questionnaire used by Little *et al.* to have easily comparable results.[8] The questionnaire consisted of 9 questions (questions 1–5, 7–10) concerning potential inconveniences related to BP measurement: anxiety caused by measurement, discomfort, uncertainty and the disturbance of home life, everyday activities, sleep, and work. In addition, 4 questions (questions 6, 11–13) assessed participants' BP awareness and their perceptions of the accuracy, efficiency, and controllability of each measurement method. All questions are presented in Table 1.

We reversed the scores for positive items (questions 6, 11–13) and calculated mean item scores for all measurement methods, with a lower score indicating better acceptability. Cronbach's α calculated for each method was between 0.74 and 0.80 indicating a good internal consistency. Mean item scores were approximately normally distributed. Repeated measures analysis of variance with *post hoc* Bonferroni correction was used to compare scores. McNemar's test was used to compare the pairwise differences in the ranking for the most preferred measurement method. *P*-value under 0.05 was considered statistically significant. Statistical analyses were performed with SAS 9.4 software (SAS Institute, Cary, NC). Values are presented mean ± SD, unless indicated otherwise.

RESULTS

The mean age of the participants was 57 ± 12.9 years and 54.7% ($n = 122$) were female. The mean BP values for home-night, home, office, and 24-hour ambulatory measurement were 113.3 ± 12.2/65.2 ± 7.6, 126.3 ± 13.3/76.7 ± 8.0, 130.7 ± 16.0/78.0 ± 9.1 and 122.7 ± 11.5/73.4 ± 7.7, respectively. 26.9% of the participants were using antihypertensive medication, 7.1% had diabetes, 1.7% had a history of myocardial infarction, 3.6% had a history of stroke, and 3.1% were current smokers.

Mean scores for individual questions and mean item scores are presented in Table 1. Mean item scores calculated for different methods differed significantly overall ($P < 0.001$) and in all between-method comparisons ($P < 0.001$ for all). The mean score increased from office (1.95 ± 0.63) to home (2.20 ± 0.70) to home-night (2.74 ± 0.81) with ambulatory BP measurement receiving the highest score (3.11 ± 0.93) indicating that patients preferred it the least. The largest between-method differences in individual questions were observed in comfort of use and disturbance of home life and everyday activities ($P < 0.001$ for all between-method comparisons). Furthermore, ambulatory measurement was found to be more disturbing for work than home-night measurement ($P < 0.001$); 73.1% gave the lowest score, indicating the most preferred method of measurement, for office BP measurement, 31.8% to home BP measurement and only 1.3% and 2.2% to home-night and ambulatory BP measurement, respectively. All between-method differences in the ranking for the most preferred measurement method were significant ($P < 0.0001$), except for between home-night and ambulatory measurement ($P = 0.48$, Table 1).

DISCUSSION

In this study, we found that acceptability of different BP measurement methods increased from ambulatory to home-night to home to office measurement. The differences in acceptability between methods were mainly due to greater disturbance and discomfort caused by home-night measurement and especially ambulatory BP measurement.

Two previous studies have shown ambulatory BP monitoring to be less acceptable to patients than office[6] or home[7] BP measurement. In a study of 87 patients by McGowan and Padfield, 81% of the participants preferred home measurement to ambulatory measurement because it caused less

Table 1. Rating of different methods of blood pressure measurement

	Home BP with nighttime measurement	Home BP without nighttime measurement	Office BP measurement	Ambulatory BP measurement
Disturbance and discomfort				
1. It made me anxious	2 (1 to 5); 2.83	2 (1 to 2); 1.95	1 (1 to 2); 1.48	2 (1 to 5); 2.96
2. It disturbs home life or everyday activities	3 (2 to 5); 3.17	2 (2 to 4); 2.75	1 (1 to 2); 1.77	5 (3 to 6); 4.47
3. It disturbs sleep	5 (2 to 6); 4.46	1 (1 to 2); 1.62	1 (1 to 1); 1.26	5 (3 to 6); 4.60
4. It disturbs work	2 (1 to 4); 2.36	1 (1 to 3); 2.04	1 (1 to 2); 1.84	5 (2 to 6); 4.26
5. I was uncomfortable	3 (2 to 5); 3.58	1 (1 to 3); 2.15	1 (1 to 2); 1.64	5 (3 to 6); 4.24
Awareness				
6. I was more aware of my blood pressure level	5 (4 to 6); 4.99	6 (5 to 6); 5.42	5 (4 to 6); 5.07	4 (2 to 6); 4.23
Uncertainty				
7. I felt unsure what to do	2 (1 to 2); 2.11	2 (1 to 2); 1.86	1 (1 to 2); 1.42	2 (1 to 3); 2.10
8. There was a lot of waiting around	2 (1 to 4); 2.71	2 (1 to 4); 2.77	2 (1 to 3); 2.34	2 (1 to 5); 2.93
9. It worried me knowing the blood pressure	1 (1 to 2); 1.98	1 (1 to 2); 1.99	1 (1 to 2); 1.85	1 (1 to 2); 1.95
10. It was difficult to remember to do it	2 (1 to 3); 2.26	2 (1 to 3); 2.40	1 (1 to 1); 1.48	1 (1 to 2); 1.46
Accuracy				
11. It was worth the trouble to get accurate readings	6 (5 to 7); 5.59	6 (5 to 7); 5.79	6 (5 to 7); 5.78	6 (4 to 7); 5.43
Control and efficiency				
12. I felt in control	6 (5 to 6); 5.50	6 (5 to 7); 5.85	6 (5 to 7); 5.86	6 (4 to 6); 5.25
13. It is a good way to save doctor or nurse time	6 (5 to 7); 5.75	6 (5 to 7); 5.86	6 (4 to 6); 5.05	6 (5 to 7); 5.65
Analysis				
Mean (SD) item score[a]	2.74 (0.81)	2.20 (0.70)	1.95 (0.63)	3.11 (0.93)
Difference in mean item score (95% CI) compared with ambulatory monitoring[b]	−0.37 (−0.28 to −0.46), $P < 0.001$	−0.91 (−0.80 to −1.02), $P < 0.001$	−1.16 (−1.05 to −1.27), $P < 0.001$	Not applicable
The most preferred measurement[c]	3/223 (1.3%)	71/223 (31.8%)	163/223 (73.1%)	5/223 (2.2%)

Values are median (interquartile range) and mean unless indicated otherwise. Ratings: 1 = disagree strongly; 2 = disagree; 3 = disagree slightly; 4 = unsure or not applicable; 5 = agree slightly; 6 = agree; 7 = agree strongly.

[a]Scoring reversed for positive items (awareness, accuracy and control and efficiency). [b]Analyzed by using repeated measures analysis of variance (ANOVA) and Bonferroni correction for *post hoc* comparisons. [c]Calculated from individual measurement scores interpreting the lowest score as the most preferred measuring method. All between-method differences in the ranking for the most preferred measurement method were significant ($P < 0.0001$), except for between home-night and ambulatory measurement ($P = 0.48$). Sum of percentages over 100% because of 19 equal scores for home BP and office BP measurement.

sleep interference and embarrassment in public, gave the possibility to see the results immediately and provided a feeling of being more "in control." The rest of the patients preferred ambulatory measurement because of the shorter duration of the procedure.[7] In 2002, Little *et al*. compared the acceptability and preferences of all BP measurement methods available at the time in 63–156 patients: home BP measurement, ambulatory BP measurement, office measurement by a nurse or a doctor, and self-measurement at the office.[8] In this study, home measurement and office measurement by nurse were 2 of the most popular methods while the acceptability of ambulatory BP monitoring was the lowest. However, in contrast to our study, home BP measurement was the most preferred method. This disparity may be due to the differences in study populations. In the study by Little *et al*., the participants were patients with newly diagnosed hypertension, whereas our study included a random population sample. Thus, the measurement methods were not ranked in a clinical setting where repeated office BP measurements over several years would most likely reduce their acceptability. In addition, our relatively arduous home measurement schedule, although in full accordance with the current guidelines, may have reduced the acceptability of home BP measurement.[2,5] Although a longer period of home measurements increases diagnostic accuracy, the probability of lower compliance and acceptability increases at the same time.[14] Instead of 7 home measurement days, 3 days might be sufficient for cardiovascular risk assessment and could lead to better acceptability.[14]

Ambulatory measurement has quite obvious drawbacks. It is a costly and laborious procedure with limited availability, especially in primary care. Because ambulatory monitoring is usually performed on a weekday with measurements every 15–30 minutes, it often causes a major disturbance to work, everyday life and sleep. According to Beltman *et al.*, sleep disturbance was a serious problem for 16% of the patients, and only 23% of the patients reported having slept normally during ambulatory monitoring.[6] Less frequent side effects of ambulatory monitoring included pain, skin irritation, disturbing noise, inconvenience with work, and hematoma.[6] Despite its drawbacks, ambulatory measurement has also major benefits. It offers the possibility to take numerous BP readings over a 24-hour period for assessment of diurnal BP variation. In addition, ambulatory BP, and especially nighttime BP, has a stronger association with cardiovascular risk than office BP.[15,16]

Until now, the measurement of nighttime BP has been possible with only ambulatory monitoring. However, nighttime BP can now also be measured with timer-equipped home monitors. To our knowledge, this was the first extensive study concerning users' perspectives on home-night measurement. We showed that home-night measurement was slightly more acceptable than ambulatory monitoring. Consistent with our study, a brief report by Ushio with 40 participants reported home-night BP measurement to be more comfortable to the patients than ambulatory monitoring.[17] Preliminary results from a study with 854 patients have demonstrated that home-night BP could have at least an equally strong relationship with hypertensive end-organ damage than nighttime ambulatory BP.[18] These findings suggest that home-night BP measurement could provide some of the beneficial features of ambulatory measurement without the same amount of discomfort and disturbance.

Although office BP measurement was more preferred than home BP in our study, it has been shown to have a poorer prognostic value than home[19] and ambulatory BP.[15] We therefore still believe that home BP measurement can be promoted as one of the best, if not the best, method for measuring BP in primary care. Several strategies should be considered for improving the acceptability of home, and especially ambulatory monitoring. Patients' uncertainty and anxiety could be reduced with adequate measurement training. Patients should also be informed that out-of-office measurements provide better diagnostic accuracy as they are free from the white-coat effect that often results in unneeded prescriptions. In addition, most patients and healthcare providers benefit from the reduced number of visits to the clinic when home measurements are used instead of office measurements. However, if neither home nor ambulatory BP measurement is feasible, the use of automated office BP measurement with the BpTRU measurement device should be considered as an option.[20] This device takes multiple readings with the patient resting alone at the clinic thus eliminating the white-coat effect.

In conclusion, the acceptability of BP measurement methods increases from ambulatory to home-night to home to office measurement. Our study demonstrates that home-night BP, which has been preliminarily shown to be at least equally strongly associated with end-organ damage as nighttime ambulatory BP,[18] seems to be slightly more acceptable to patients than ambulatory BP monitoring. In the future, home-night measurement could offer a more acceptable, accessible, and less expensive alternative to ambulatory monitoring. However, before home-night BP measurement can be widely promoted as an alternative method for measuring nighttime BP, more evidence of its prognostic significance is needed.

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DISCLOSURE

The authors declared no conflict of interest.

REFERENCES

1. McManus RJ, Ryan A, Greenfield S, Pattison HM, Clifford S, Marriott J, Wilson S. Self measurement of blood pressure: a community survey. *J Hum Hypertens* 2007; 21:741–743.
2. Krause T, Lovibond K, Caulfield M, McCormack T, Williams B; Guideline Development Group. Management of hypertension: summary of NICE guidance. *BMJ* 2011; 343:d4891.
3. Shimamoto K, Ando K, Fujita T, Hasebe N, Higaki J, Horiuchi M, Imai Y, Imaizumi T, Ishimitsu T, Ito M, Ito S, Itoh H, Iwao H, Kai H, Kario K, Kashihara N, Kawano Y, Kim-Mitsuyama S, Kimura G, Kohara K, Komuro I, Kumagai H, Matsuura H, Miura K, Morishita R, Naruse M, Node K, Ohya Y, Rakugi H, Saito I, Saitoh S, Shimada K, Shimosawa T, Suzuki H, Tamura K, Tanahashi N, Tsuchihashi T, Uchiyama M, Ueda S, Umemura S; Japanese Society of Hypertension Committee for Guidelines for the Management of Hypertension. The Japanese Society of Hypertension Guidelines for the Management of Hypertension (JSH 2014). *Hypertens Res* 2014; 37:253–390.
4. Daskalopoulou SS, Rabi DM, Zarnke KB, Dasgupta K, Nerenberg K, Cloutier L, Gelfer M, Lamarre-Cliche M, Milot A, Bolli P, McKay DW, Tremblay G, McLean D, Tobe SW, Ruzicka M, Burns KD, Vallee M, Ramesh Prasad GV, Lebel M, Feldman RD, Selby P, Pipe A, Schiffrin EL, McFarlane PA, Oh P, Hegele RA, Khara M, Wilson TW, Brian Penner S, Burgess E, Herman RJ, Bacon SL, Rabkin SW, Gilbert RE, Campbell TS, Grover S, Honos G, Lindsay P, Hill MD, Coutts SB, Gubitz G, Campbell NR, Moe GW, Howlett JG, Boulanger JM, Prebtani A, Larochelle P, Leiter LA, Jones C, Ogilvie RI, Woo V, Kaczorowski J, Trudeau L, Petrella RJ, Hiremath S, Stone JA, Drouin D, Lavoie KL, Hamet P, Fodor G, Gregoire JC, Fournier A, Lewanczuk R, Dresser GK, Sharma M, Reid D, Benoit G, Feber J, Harris KC, Poirier L, Padwal RS; Canadian Hypertension Education Program. The 2015 Canadian Hypertension Education Program Recommendations for Blood Pressure Measurement, Diagnosis, Assessment of Risk, Prevention, and Treatment of Hypertension. *Can J Cardiol* 2015; 31:549–568.
5. Mancia G, Fagard R, Narkiewicz K, Redon J, Zanchetti A, Bohm M, Christiaens T, Cifkova R, De Backer G, Dominiczak A, Galderisi M, Grobbee DE, Jaarsma T, Kirchhof P, Kjeldsen SE, Laurent S, Manolis AJ, Nilsson PM, Ruilope LM, Schmieder RE, Sirnes PA, Sleight P, Viigimaa M, Waeber B, Zannad F, Redon J, Dominiczak A, Narkiewicz K, Nilsson PM, Burnier M, Viigimaa M, Ambrosioni E, Caufield M, Coca A, Olsen MH, Schmieder RE, Tsioufis C, van de Borne P, Zamorano JL, Achenbach S, Baumgartner H, Bax JJ, Bueno H, Dean V, Deaton C, Erol C, Fagard R, Ferrari R, Hasdai D, Hoes AW, Kirchhof P, Knuuti J, Kolh P, Lancellotti P, Linhart A, Nihoyannopoulos P, Piepoli MF, Ponikowski P, Sirnes PA, Tamargo JL, Tendera M, Torbicki A, Wijns W, Windecker S, Clement DL, Coca A, Gillebert TC, Tendera M, Rosei EA, Ambrosioni E, Anker SD, Bauersachs J, Hitij JB, Caulfield M, De Buyzere M, De Geest S, Derumeaux GA, Erdine S, Farsang C, Funck-Brentano C, Gerc V, Germano G, Gielen S, Haller H, Hoes AW, Jordan J, Kahan T, Komajda M, Lovic D, Mahrholdt H, Olsen MH, Ostergren J, Parati G, Perk J, Polonia J, Popescu BA, Reiner Z, Rydén L, Sirenko Y, Stanton A,

Struijker-Boudier H, Tsioufis C, van de Borne P, Vlachopoulos C, Volpe M, Wood DA. 2013 ESH/ESC guidelines for the management of arterial hypertension: the Task Force for the Management of Arterial Hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC). *Eur Heart J* 2013; 34:2159–2219.
6. Beltman FW, Heesen WF, Smit AJ, May JF, Lie KI, Meyboom-de Jong B. Acceptance and side effects of ambulatory blood pressure monitoring: evaluation of a new technology. *J Hum Hypertens* 1996; 10(Suppl 3):S39–S42.
7. McGowan N, Padfield PL. Self blood pressure monitoring: a worthy substitute for ambulatory blood pressure? *J Hum Hypertens* 2010; 24:801–806.
8. Little P, Barnett J, Barnsley L, Marjoram J, Fitzgerald-Barron A, Mant D. Comparison of acceptability of and preferences for different methods of measuring blood pressure in primary care. *BMJ* 2002; 325:258–259.
9. Cappuccio FP, Kerry SM, Forbes L, Donald A. Blood pressure control by home monitoring: meta-analysis of randomised trials. *BMJ* 2004; 329:145.
10. Anwar YA, Giacco S, McCabe EJ, Tendler BE, White WB. Evaluation of the efficacy of the Omron HEM-737 IntelliSense device for use on adults according to the recommendations of the Association for the Advancement of Medical Instrumentation. *Blood Press Monit* 1998; 3:261–265.
11. Cheng HM, Sung SH, Shih YT, Chuang SY, Yu WC, Chen CH. Measurement accuracy of a stand-alone oscillometric central blood pressure monitor: a validation report for Microlife WatchBP Office Central. *Am J Hypertens* 2013; 26:42–50.
12. Ragazzo F, Saladini F, Palatini P. Validation of the Microlife WatchBP O3 device for clinic, home, and ambulatory blood pressure measurement, according to the International Protocol. *Blood Press Monit* 2010; 15:59–62.
13. Stergiou GS, Giovas PP, Gkinos CP, Patouras JD. Validation of the Microlife WatchBP Home device for self home blood pressure measurement according to the International Protocol. *Blood Press Monit* 2007; 12:185–188.
14. Niiranen TJ, Johansson JK, Reunanen A, Jula AM. Optimal schedule for home blood pressure measurement based on prognostic data: the Finn-Home Study. *Hypertension* 2011; 57:1081–1086.
15. Dolan E, Stanton A, Thijs L, Hinedi K, Atkins N, McClory S, Den Hond E, McCormack P, Staessen JA, O'Brien E. Superiority of ambulatory over clinic blood pressure measurement in predicting mortality: the Dublin outcome study. *Hypertension* 2005; 46:156–161.
16. Fagard RH, Celis H, Thijs L, Staessen JA, Clement DL, De Buyzere ML, De Bacquer DA. Daytime and nighttime blood pressure as predictors of death and cause-specific cardiovascular events in hypertension. *Hypertension* 2008; 51:55–61.
17. Ushio H, Ishigami T, Araki N, Minegishi S, Tamura K, Okano Y, Uchino K, Tochikubo O, Umemura S. Utility and feasibility of a new programmable home blood pressure monitoring device for the assessment of nighttime blood pressure. *Clin Exp Nephrol* 2009; 13:480–485.
18. Ishikawa J, Hoshide S, Eguchi K, Ishikawa S, Shimada K, Kario K; Japan Morning Surge-Home Blood Pressure Study Investigators Group. Nighttime home blood pressure and the risk of hypertensive target organ damage. *Hypertension* 2012; 60:921–928.
19. Niiranen TJ, Hänninen MR, Johansson J, Reunanen A, Jula AM. Home-measured blood pressure is a stronger predictor of cardiovascular risk than office blood pressure: the Finn-Home study. *Hypertension* 2010; 55:1346–1351.
20. Myers MG, Godwin M, Dawes M, Kiss A, Tobe SW, Kaczorowski J. Measurement of blood pressure in the office: recognizing the problem and proposing the solution. *Hypertension* 2010; 55:195–200.