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Original article

# Clinician accountability in a primary care clinic time-interval blood pressure measurements study: Practice implications☆

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ABSTRACT

*Background:* Accurate blood pressure measurements (BPM) are important, as clinicians are tasked daily with using such measurements to make clinical diagnoses and patient care judgments. Research studies and controlled trials hold such measurements to a higher standard than everyday clinical practice.
*Objective:* The aim of this study was to evaluate difference in BPM outcomes of individuals in a clinic setting when clinicians collect BPM as usual vs BPM after 5- (USPSTF recommendation) and 10- minute (study unique intervention) timed rest interval.
*Methods:* A repeated-measures design was used to examine individual BPMs at the intervals of baseline, after a 5-minute rest interval post-baseline, and after a 10-minute rest interval post-baseline. Results Pairwise comparisons indicated that baseline SBP was the highest when compared to SBP measured at both 5- and 10-minutes post-baseline. SBP measured at 5-minutes was also significantly higher compared to SBP collected at 10-minutes post-baseline ($ps < .05$). For DBP, the repeated-measures ANOVA indicated that there was no significant difference across BPMs, $F(2,198) = 1.25$, $p = .29$.
*Conclusions:* Results from this study revealed that implementing a 5-minute rest interval before BPMs are taken in a clinic setting produces a “clinically observable” reduction in the overall mean systolic BPs as seen at both 5- and 10-minute BPM intervals. It is important for all healthcare clinicians to recognize the importance of accurate BPM and the need to encourage better regulated BPM standard in everyday practice.

## 1. Introduction

Assessment of patients by healthcare clinicians typically begins with collection and evaluation of vital signs, including blood pressure measurement(s) (BPM). The United States Preventive Services Task Force (USPSTF) recommends that all adults 18 years of age and older are screened for elevated blood pressure (BP) or hypertension (United States Preventive Services Task Force, 2015). Furthermore, the USPSTF recommends a protocol allowing a 5-minute rest interval before any BPM is collected; however, it is known that these protocol recommendations are not carried out in everyday practice in contrast to research studies and controlled trials (Campbell, Berbari, Zhang, et al., 2014; Stergiou & Parati, 2012; United States Preventive Services Task Force, 2015). Nearly 75 million Americans 18 years and older, carry the diagnosis of hypertension, which translates into about 1 in every 3 people (Centers for Disease Control and Prevention, 2016). Recently, the American College of Cardiology and the American Heart Association (ACC/AHA) released an updated guideline for the prevention, detection, evaluation, and management of high blood pressure which highlights the need for accurate BPM (Whelton, Carey, Aronow, et al.,

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2017). Early detection of hypertension through BPM can delay and prevent end-organ damage providing microvascular and macrovascular protection in vital organs such as the heart, brain, kidneys and eyes (Persu & De Plaen, 2004). This is especially important for high risk individuals such as those with previous cerebral vascular accident (CVA) and previous myocardial infarction (MI) and those who are living with chronic conditions such as diabetes or chronic kidney disease (CKD). Clinicians (medical assistants, nurses, physicians and other non-licensed professionals) are trusted with properly obtaining BPMs; however, their clinical approach may vary. Poor BPM in clinical practice can lead to misdiagnosis, under diagnosis, misrepresentation and inappropriate treatment (Campos-Outcalt, 2016; Headley, Wall, & Cushman, 2017; Pickering, Hall, Appel, et al., 2005). Deviations in BPM include but are not limited to cuffs applied over clothing, measurement without allowing patients a 5-minute rest interval and measurement with patient legs crossed and feet unsupported (Appel, Miller, & Charleston, 2011; Headley et al., 2017). Additionally, there are well documented factors and phenomena that adversely affect BPMs such as pain, physical activity and "white coat" effect, which the clinician has limited to no control over (Headley et al., 2017; Koroboki, Manios, Psaltopoulou, et al., 2013). The aim of this study was to evaluate difference in BPM outcomes of individuals in a clinic setting when clinicians collect BPM as usual vs BPM after a 5-(USPSTF recommendation) and 10-minute (study unique intervention) timed rest interval.

## 2. Methods

### 2.1. Design and sampling

A repeated-measures design was used to examine individual BPMs at the intervals of baseline, after a 5-minute rest interval (USPSTF recommendation) post-baseline, and after a 10-minute rest interval (study unique intervention) post-baseline. BPMs were collected during a single patient encounter. Approval was granted by the Institutional Review Board of the institution.

### 2.2. Participants

The sample included 100 participants (48% European American; 51% African American; 1% Asian; 68% Female) between the ages of 18 and 88 years old ($M_{age}$ = 53.23, SD = 14.95) who visited a university based primary care clinic in the Southeast United States. In order to participate in this study, participants had to be at least 18 years of age with English language fluency. Exclusion criteria included minors under the age of 18, pregnant women and decisionally challenged (as deemed by guardianship). Data regarding existing comorbidities and treatments, including a history of hypertension, were not collected from study participants. Two participants were excluded from the analysis due to insufficient participants in those categories, the single Asian participant and the single underweight participant. Thus, the final sample included 98 participants.

### 2.3. Study purpose

The purpose of this study includes: (United States Preventive Services Task Force, 2015) determining the effect USPSTF recommendations have on BPM (Campbell et al., 2014; United States Preventive Services Task Force, 2015), determining whether an additional 5 min wait period effects BPM outcomes, and (Stergiou & Parati, 2012) assessing the impact demographic variables have on BPM.

## 3. Implementation and data collection

### 3.1. Demographics

Race, age, and sex were collected using a brief self-report questionnaire.

### 3.2. BMI

Body Mass Index (BMI) was calculated using a standard formula by dividing participants' weight in kilograms by their height in meters squared (**BMI = Weight (kg) / (Height (m)$^2$**). Height and weight were measured during the initial triage period. Participants were assigned to one of four BMI categories as defined by the World Health Organization (WHO): underweight (≤18.5), normal weight (18.6–24.9), overweight (25–29.9), or obese (≥30) (World Health Organization, 2016).

### 3.3. Blood pressure measurement

To maintain consistency and validity, a single individual collected each BPM according to clinical practice guidelines: with the same automatic BP monitoring device, using the same cuff and arm for all three measurements with the cuff remaining in place from start to finish. The left arm was preferred unless medically contraindicated (including but not limited to: dialysis graft presence, mastectomy, or limb amputation) or the participant preferred to use their right arm. Participants were seated with their arm rested at the level of the heart and their feet flat on the ground with legs uncrossed. A baseline set of vital signs were taken with no regard to a wait time interval upon being properly seated, usually within 1–2 min of the participant being taken back to the clinic area from the check-in area. After the initial BPM, participants were reinformed that two additional BP measurements would be collected as explained on invitation: one 5-minute post-baseline and another 10-minute post-baseline using two portable tabletop digital timers as indicators.

## 4. Results

### 4.1. Descriptive statistics

Means and standard deviations for systolic blood pressure (SBP) and diastolic blood pressure (DBP) at baseline, 5-minute post-baseline, and 10-minute post-baseline are presented by sex, race, age, and BMI in Table 1.

### 4.2. Between-Group Differences on average mean SBP and DBP

One-way ANOVAs were used to compare participants on average mean SBP and DBP across the three collections by race, sex, BMI, and age. For SBP, results indicated that there were no significant differences across sex, $F(1, 96) = 0.50$, $p = .48$, race, $F(1, 96) = 3.42$, $p = .07$, or BMI categories, $F(2, 95) = 1.30$, $p = .28$. However, there were significant differences between age groups, $F(2, 95) = 4.21$, $p = .02$. Tukey *post-hoc* tests indicated that 18–45 year olds had significantly lower SBP than both 46–64 year olds and 65+ year olds (both $ps < 0.05$).

For DBP, results indicated that there were no significant differences across sex, $F(1, 96) = 0.14$, $p = .71$, race, $F(1, 96) = 2.54$, $p = .11$, or age groups, $F(2, 95) = 2.72$, $p = .07$. However, there were significant differences between BMI categories $F(2, 95) = 3.31$, $p = .04$. Tukey *post-hoc* tests revealed that participants with a normal BMI had significantly lower DBP than obese participants, $p = .04$.

Interactions amongst the demographic variables were explored with significance as follows. For SBP, the two-way sex by age group interaction, $F(2, 78) = 3.41$, $p = .04$, and the sex by race interaction, $F(1, 78) = 5.93$, $p = .02$, were significant. Examining the sex by age group interaction revealed that females between the ages of 46 and 64 (M = 140.21, SD = 32.72) had significantly higher SBP than females between the ages of 18 and 45 (M = 122.37, SD = 17.10; $p = .03$). Examining the sex by race interaction revealed that female African Americans (M = 140.21, SD = 32.72) had significantly greater SBP

**Table 1**
Descriptive statistics by demographic characteristics.

| | | Baseline SBP | | 5-minute SBP | | 10-minute SBP | | Baseline DBP | | 5-minute DBP | | 10-minute DBP | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *N* | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* |
| Sex | | | | | | | | | | | | | |
| Male | 31 | 137.39 | 20.78 | 137.00 | 18.51 | 134.74 | 13.55 | 81.00 | 12.53 | 82.97 | 12.00 | 81.97 | 13.05 |
| Female | 67 | 136.15 | 29.74 | 131.55 | 30.05 | 129.76 | 26.72 | 80.99 | 12.06 | 81.27 | 13.03 | 80.75 | 11.94 |
| Race | | | | | | | | | | | | | |
| European American | 48 | 131.21 | 20.16 | 128.75 | 19.53 | 126.94 | 16.67 | 78.21 | 11.62 | 80.25 | 10.78 | 79.65 | 11.26 |
| African American | 50 | 141.66 | 31.81 | 137.62 | 32.16 | 135.56 | 27.95 | 83.66 | 12.16 | 83.30 | 14.22 | 82.56 | 13.08 |
| Age | | | | | | | | | | | | | |
| 18–45 | 26 | 123.96 | 17.93 | 121.50 | 18.13 | 120.85 | 17.21 | 79.96 | 10.74 | 80.58 | 11.67 | 80.65 | 11.30 |
| 46–64 | 49 | 139.39 | 25.68 | 136.39 | 27.06 | 134.12 | 23.71 | 83.67 | 12.55 | 84.39 | 13.96 | 83.33 | 13.11 |
| 65 + | 23 | 144.70 | 34.11 | 139.96 | 31.66 | 137.26 | 25.87 | 76.43 | 11.70 | 77.70 | 9.74 | 77.00 | 10.59 |
| BMI | | | | | | | | | | | | | |
| Normal (18.6–24.9) | 15 | 127.87 | 31.74 | 125.87 | 28.20 | 125.87 | 21.76 | 73.93 | 7.85 | 75.93 | 6.91 | 75.20 | 8.15 |
| Overweight (25–29.9) | 21 | 132.33 | 21.23 | 131.19 | 19.95 | 126.19 | 17.14 | 79.52 | 9.61 | 81.14 | 8.53 | 78.76 | 8.50 |
| Obese (> 30) | 62 | 140.06 | 27.45 | 135.77 | 28.67 | 134.40 | 25.31 | 83.19 | 13.13 | 83.45 | 14.47 | 83.37 | 13.56 |
| Total | 98 | 136.54 | 27.12 | 133.28 | 26.96 | 131.34 | 23.41 | 80.99 | 12.15 | 81.81 | 12.68 | 81.13 | 12.25 |

Note: SBP = Systolic blood pressure; DBP = Diastolic blood pressure.

than female European Americans (M = 122.37, SD = 17.10; $p = .02$).

### 4.3. Changes in blood pressure over time

Two within-subjects ANOVAs were run comparing SBP measurements collected at baseline, 5-minute post-baseline, and 10-minute post-baseline and DBP measurements collected at baseline, 5-minute post-baseline, and 10-minute post-baseline. For SBP, results indicated a significant within-subjects effect, $F(1.8,\ 198) = 13.89$, $p < .001$. Pairwise comparisons indicated that baseline SBP was the highest when compared to SBP measured at both 5- and 10-minute post-baseline. SBP measured at 5-minute was also significantly higher compared to SBP collected at 10-minute post-baseline ($ps < 0.05$). For DBP, the repeated-measures ANOVA indicated that there was no significant difference across BPMs, $F(2,198) = 1.25$, $p = .29$.

Interactions involving changes in BP over time by demographic variables was also explored. No significant interactions were found, suggesting that the changes in BPM readings at each interval were not driven by a particular demographic characteristic alone.

## 5. Discussion

Results from this study revealed that implementing the USPSTF recommendation of a 5-minute rest interval before BPMs are taken in a clinic setting produces a "clinically observable" reduction in the overall mean SBPs as seen at both 5- and 10-minute BPM intervals, across all demographic groups and variables (United States Preventive Services Task Force, 2015). Additionally, the study unique intervention of collecting a third BPM at 10-minute post-baseline revealed a "clinically observable" lower BP versus the 5-minute post-baseline systolic BP measurement (USPSTF recommendation) (United States Preventive Services Task Force, 2015). This finding suggest that an additional 5-minute rest interval may be clinically appropriate for certain patient populations, such as those being ruled-out for "white coat" effect (BP elevation in the presence of a healthcare professional vs normal home BP measurements) (Pioli, Ritter, de Faria, & Modolo, 2018). It has been noted that "white coat" effect leads to "white coat" hypertension (BP elevation in the presence of a healthcare professional on subsequent visits vs normal home BP), which predominantly effects the systolic BP of between 10 and 20% of the general population with a direct correlation with aging in each decade of life from 30–80 years of age (Abolbashari, 2018; Bloomfield & Park, 2017; Headley et al., 2017; Pioli et al., 2018). Accurate BPMs are important, as clinicians are tasked daily with using such measurements to make clinical diagnoses and patient care judgements. Hypertension is a prominent risk factor for cardiovascular disease (CVD), the leading cause of death amongst men and women in the United States (Centers for Disease Control and Prevention, 2015). With the release of the new hypertension classification of 130/80 vs the previous 140/90; two-thirds of participants in this study would carry a diagnosis of hypertension (Whelton et al., 2017). Similarly, nearly half of all American adults (46%) will now carry a diagnosis of hypertension up from the (32%) who met the previous classification (Whelton et al., 2017). Findings from this study align with previous studies supporting the need for better-quality BPM standards improving patient care and clinical decision making (Campos-Outcalt, 2016; Headley et al., 2017; Pickering et al., 2005). Demographic variables are those that individuals have little to no control over and in this study they proved to played an insignificant role in the difference in BPM outcomes.

### 5.1. Limitations

Limitations of this study include the lack of racial diversity secondary to geographical demographic confines and program exclusion criteria. This could be rectified with a repeat study with a more diverse population or in a more diverse geographical location. An additional limitation was the fact that all blood pressure measurements were collected in one visit versus multiple visits skewing all results to the physiological or psychological stressors of that single encounter.

### 5.2. Conclusion and practice implications

It is imperative for all healthcare clinicians to recognize the importance of accurate BPM (Campos-Outcalt, 2016; Headley et al., 2017; Pickering et al., 2005; Whelton et al., 2017). Furthermore, in order to fully implement the recommendations from the ACC/AHA clinicians must assure BPMs are collected as accurate as possible (Whelton et al., 2017). Due to busy schedules, time constraints, productivity goals, and longstanding routines or practices, clinicians may not stop to evaluate the effectiveness and appropriateness of processes such as BPM for accuracy or latest supported evidence. It is important that clinicians are aware of these findings in order to properly screen and prevent misdiagnosis of hypertension (over or under), which can lead to a myriad of problems for the individual who is receiving care.

Healthcare organizations can emphasize the importance of accurate BPM by incorporating annual or biannual check points, integrated with other required skill set validations. This reflects current practice as many healthcare clinicians are required to maintain skills through revalidation and certification such as cardiopulmonary resuscitation (CPR). Providers are challenged with providing care that is at the highest quality and evidence-based in nature. In the primary care setting, BPM is a clinician-controlled process, and it is important to ensure that protocols and processes follow evidence-based recommendations of best practice, enhancing patient health care services.

## References

Abolbashari, M. (2018). White coat hypertension and cardiovascular diseases: Innocent or guilty. *Current Cardiology Reports, 20*(4), 25. https://doi.org/10.1007/s11886-018-0964-0.

Appel, L. J., Miller, E. R., & Charleston, J. (2011). Improving the measurement of blood pressure: Is it time for regulated standards? *Annals of Internal Medicine, 154*, 838–839. https://doi.org/10.7326/0003-4819-154-12-201106210-00014.

Bloomfield, D. A., & Park, A. (2017). Decoding white coat hypertension. *World Journal of Clinical Cases, 5*, 82–92.

Campbell, N., Berbari, A., Zhang, X., et al. (2014). Policy statement of the world hypertension league on noninvasive blood pressure measurement devices and blood pressure measurement in the clinical or community setting. *The Journal of Clinical Hypertension, 5*, 320.

Campos-Outcalt, D. (2016). USPSTF urges extra step before treating hypertension. *The Journal of Family Practice, 65*(1), 41–44.

Centers for Disease Control and Prevention (2015). Heart disease facts. http://www.cdc.gov/heartdisease/facts.htm.

Centers for Disease Control and Prevention (2016). High blood pressure fact sheet. http://www.cdc.gov/dhdsp/data_statistics/fact_sheets/fs_bloodpressure.htm.

Headley, C. M., Wall, B. M., & Cushman, W. C. (2017, January). A blood pressure you can believe in. *Nephrology Nursing Journal, 44*(1), 57–71.

Koroboki, E., Manios, E., Psaltopoulou, T., et al. (2013). Circadian variation of blood pressure and heart rate in normotensives, white-coat, masked, treated and untreated hypertensives. *Hellenic Journal of Cardiology, 53*(6), 432–438.

Persu, A., & De Plaen, J. F. (2004). Recent insights in the development of organ damaged caused by hypertension. *Acta Cardiologica, 59*(4), 369–381. https://doi.org/10.2143/AC.59.4.2005202.

Pickering, T. G., Hall, J. E., Appel, L. J., et al. (2005). Recommendations for blood pressure measurement in humans and experimental animals: part 1, blood pressure measurement in humans: a statement for professionals from the Subcommittee of Professional and Public Education of the American Heart Association Council on High Blood Pressure Research. *Circulation, 111*(5), 697–716.

Pioli, M. R., Ritter, A. M. V., de Faria, A. P., & Modolo, R. (2018). White coat syndrome and its variations: Differences and clinical impact. *Integrated Blood Pressure Control, 11*, 73–79.

Stergiou, G., & Parati, G. (2012). Should the measurement of blood pressure in the office be redefined? *The Journal of Hypertension, 30*(10), 1906–1908.

United States Preventive Services Task Force (2015). *Final recommendation statement: High blood pressure in adults: Screening*.

Whelton, P. K., Carey, R. M., Aronow, W. S., et al. (2017). 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults. *Journal of the American College of Cardiology*. https://doi.org/10.1016/j.jacc.2017.11.006.

World Health Organization (2016). BMI classification. http://apps.who.int/bmi/index.jsp?introPage=intro_3.html.