International Journal of Research in Medical Sciences
Rahul et al. Int J Res Med Sci. 2024 Dec;12(12):4859-4864
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20243754

Review Article

The effect of body position on oscillometric blood pressure readings in young adults: narrative review

Rahul Nimar*, Gitanjali Sikka, Vikram Singh Yadav

College of Physiotherapy, Pt. B.D Sharma University of Health Sciences, Rohtak, Haryana, India

Received: 14 October 2024
Accepted: 11 November 2024

***Correspondence:**
Dr. Rahul Nimar,
E-mail: rahulnimar999@gmail.com

ABSTRACT

Accurate measurement of blood pressure (BP) is crucial for diagnosing hypertension and evaluating cardiovascular risk. Although office BP readings are generally consistent with 24-hour ambulatory measurements, their accuracy can be influenced by various factors. Elements such as environmental conditions, participant behaviour, device calibration, and measurement methods can lead to variations in readings, ranging from 1-2 mmHg to as much as 20-50 mmHg. Studies show that room temperature, noise, recent physical activity, and dietary choices affect BP measurements. Additionally, differences between BP readings from the right and left arms and variations due to body position (sitting versus supine) add complexity. Demographic factors, including age and sex, also contribute to variability, highlighting the need for standardized measurement procedures. This study seeks to analyse how arm side, body position, and measurement sequence influence BP variability and its effect on hypertension prevalence, aiming to improve the precision of clinical and epidemiological assessments. Thereby findings of these studies limit the generalizability of the results to hypertensive and normotensive patient population. Previous studies have also shown that there is difference in reading of blood pressure between right arm and left arm with readings of left arm are higher than right arm with oscillometric and sphygmomanometer blood pressure measuring device. Therefore, need to develop a definitive protocol for accurately measuring oscillometric blood pressure in young adults across eight different positions of the right and left arms.

Keywords: Blood pressure, Body positioning, Difference between right and left, Sitting, Supine

INTRODUCTION

Accurate blood pressure (BP) measurement is crucial in clinical and epidemiological practices, serving as a fundamental determinant in diagnosing hypertension and assessing cardiovascular risk.[1] The indirect measurement of BP by trained observers, typically performed in a clinical setting, has demonstrated strong validity when compared to 24 hours ambulatory BP readings.[2] Correlations of 0.9 and 0.8 for systolic and diastolic BP, respectively, indicate that office BP readings are reliable proxies for blood pressure status in patients. However, achieving precise BP readings is complex due to various influencing factors, including environmental conditions, participant behaviour prior to measurement, device accuracy, and specific measurement procedures.[3] Research has identified numerous variables that can affect BP readings, such as room temperature, noise, the subject's recent physical activity, and even dietary choices like heavy meals and smoking.[4] These factors can result in significant measurement discrepancies, with variations reported from as low as 1-2 mmHg to as high as 20-50 mmHg in individual readings, highlighting the importance of standardized measurement procedures.[5] An intriguing area of investigation lies in the differences observed between arm measurements, where studies suggest disparities between the right and left arms may vary based on demographic factors. Controversy remains regarding

the effects of body positioning (e.g. supine versus sitting) on BP readings, with some research indicating that supine systolic BP may be higher by 2-3 mmHg compared to sitting BP, while others find no significant impact.[6]

Furthermore, the interaction of these variabilities with demographic variables, such as age and sex, adds another layer of complexity. For instance, the historically documented differences in hypertension prevalence and response to treatment across sexes may confound results if not appropriately accounted for in studies. This indicates a pressing need for comprehensive epidemiological studies that utilize rigorous and standardized measurement protocols to systematically investigate these factors.[7]

Given the critical implications of accurate BP measurements for clinical decisions and public health, the objectives of this study were to quantify variability in BP associated with arm side (right versus left), body position (sitting versus supine) and the order of successive measurements within a population-based observational framework.[8]

Additionally, we sought to evaluate how these variabilities influence the prevalence of hypertension, defined as a systolic BP of 140 mmHg or above and/or diastolic BP of 90 mmHg or above. Through this, it is hoped that the study will contribute valuable insights that enhance the accuracy and reliability of BP measurements, thereby improving clinical outcomes and epidemiological assessments related to hypertension.[9] Several studies have shown the effect of body and arm positions on the blood pressure readings (Table 1).[2,3,6,8-12]

Influences of the body positions and arm on blood pressure readings

Several studies have shown that the significant changes in blood pressure readings during changing position. This finding is in line with physiological expectations, as sitting can elevate the workload on the cardiovascular system due to increased gravitational effects and muscle tone. However, systolic blood pressure (SBP) responses exhibit variability among studies. Some research indicates an increase in SBP when sitting, while others report a decrease.

A common finding across studies is the decrease in both SBP and DBP upon standing from a supine or sitting position. This decrease is consistent with the physiological response of orthostatic hypotension, where blood pools in the lower extremities, leading to reduced venous return, decreased stroke volume, and subsequently lower blood pressure. The reduction in BP upon standing can be particularly pronounced in individuals with impaired autonomic regulation, which can influence the generalizability of these findings. The impact of the arm used for measurement on BP readings generally appears minimal but BP readings at desk level were significantly higher than those at heart level and BP readings at chair support level were also significantly higher compared to those at heart level which suggests that the position of the arm in relation to the heart level influences BP readings, with higher measurements associated with arm positions above heart level.

This increase is likely due to the effect of gravity and muscle tone impacting the BP measurement when the arm is elevated compared to the heart. In the comparison of supported back and unsupported back position higher systolic blood pressure (SBP) and diastolic blood pressure (DBP) when measured in the unsupported back position.

The regression analysis provided insights into the factors influencing BP differences between the two body positions that supported BP levels were negatively associated with the variation in SBP, suggesting that a supported back position might stabilize SBP. Age positively correlated with SBP differences, indicating that older individuals might experience greater variations in SBP due to body position. However, the regression coefficient was small, indicating a modest effect. Supported DBP levels were positively associated with the variation in DBP differences, while age was also a positive factor, meaning that older adults may see more pronounced changes in DBP with body position.

Conversely, a history of hypertension was negatively associated with DBP differences, though this effect was also small. The protocols for blood pressure measurement such as whether the back is supported or unsupported and the type of device used (oscillometric vs. mercury sphygmomanometer) can lead to significant variability in BP readings. Unsupported back positions and dangling feet frequently result in slight increases in blood pressure, especially affecting diastolic pressure.

To date, there has been no evaluation of how different body positions impact oscillometric blood pressure readings from both arms, nor how alternating arms due to changes in body position affects these readings. Therefore, further research is necessary to establish a definitive protocol for measuring blood pressure in various positions and with different arms in young adults using oscillometric devices and this contrasts with findings from studies using different methodologies, highlighting the need for standardized measurement techniques to ensure accurate and consistent blood pressure readings.

CONCLUSION

This study reveals significant variability in blood pressure (BP) measurements due to body position, timing of measurements, and the method of averaging successive readings. Notably, BP measurements are higher when the back is unsupported compared to when it is supported, highlighting the need for consistent measurement conditions.

Table 1: Summary of studies conducted on the effect of body and arm positions on the blood pressure readings.

Author Journal year	Objective	Design	Characteristics of participants sample size	Method	Outcome measures	Results	Limitations
RTN et al Journal of Human Hypertension 2003[11]	To test the influence of the position of the patient on BP readings	Cross-sectional study	57 hypertensive patients	Two sessions of BP measurements, separated by a 10 min pause, were performed in two positions: (1) lying on a bed (2) sitting on a chair	Systolic blood pressure (SBP), diastolic blood pressures (DBP), and heart rate (HR)	The systolic (SBP) and the diastolic (DBP) blood pressures were significantly higher in the supine position. The HR was slightly, but significantly,higher in the sitting than supine position.	The study concludes that BP readings in sitting and supine positions should notbe considered equivalent, even with careful attention to arm position. The variability introduced by arm position and measurement techniques highlights the need for standardized practices and careful consideration of positional effects inBP measurement.
A. Adiyaman Blood Pressure Monitoring 2006[12]	To determine the influence the position the arm blood pressure measurement the sitting position.	Cross-sectional study	128 individuals	both arms were placed at the chair support level and blood pressure was measured three timeson both arms after 10 min of rest. Subsequently, while still remaining in thesame sitting position, five blood pressure measurements were made simultaneously at both arms with one arm placed on the desk and one arm placed and supported at heart level	Systolic and diastolic blood pressures	Both at desk level and at chair support level, mean systolic and diastolic blood pressures were higher than blood pressure atheart level.	A limitation of our study is that the determination of heart level was subjective, relyingon the investigator's assessment, albeit consistently usingthe mid-sternal criterion.

Continued.

Author Journal year	Objective	Design	Characteristics of participants sample size	Method	Outcome measures	Results	Limitations
Pujitha etal Int J Physiother Res 2014 10	To know the prevalence of orthostatic hypotension in healthy geriatric subjects.	Experimental study	Subjects 120	Age group 35 to >65years of both sex andthey are categorized into 4 groups based on their age Group-I: 35-45 years; Group-II: 45-55 years; Group-III: 55-65 Years; GroupIV: >65 years. Blood Pressure is recorded by using manual sphygmomano-meter and orthostatic test was conductedin all the subjects. Heart Rate was calculated by usingR-R interval by ECGmachine	body mass index,Heart Rate, systolic and diastolic Blood Pressure during resting	The findings suggested that the mean SBP and DBP are higher in Group IV compared to Group I which is statistically highly significant. After immediate standing in all the subjects the SBP is decreased and DBP is increased and this variation is variable in different groups. The Heart Rate in all four Groups increases. And this variation is also variable in different groups	In healthy elderly individuals, the prevalence of orthostatic hypotension is lower. Further research is needed to validate these findings, particularly with alarge sample of healthy geriatric subjects to accurately represent the Indian population
Lacruz M E. et at BMC Cardiovascular Disorders 2017[2]	To quantify the variability in BP associated with arm side, body position, and successive measurements in the setting of apopulation	Cross-sectional study	sample included 967 men and 812 women	BP was measured including three sitting measurements at left arm, one supine measurement at both arms, 4 supine measurements at the arm with the higher BP	Variability in SBP and DBP	Substantial higher DBP andfor men also higher SBP wasobserved in sitting than in supine position	There were some restrictions to BP measurements: 1) there was only one simultaneous supine measurement; 2) supine measurements werenot consistently throughout on one arm and did not compared differences of both arms.
Islam et at Bang MedJ Khulna 2017[8]	The blood pressure (BP) changes in accordance with posture changes in healthy adult male and females.	Cross-sectional study	100 patients	All the parameters were calculated and comparison in supine, sitting and standing position was done by repeated measures	Mean of the systolic blood pressure and diastolic blood pressure	Blood pressure changes during change of posture from supine to sitting or from sitting tostanding was notsignificant	All the patients wereof different diseases. Small sample size. Paediatric patientswere not included.

Continued.

Author Journal year	Objective	Design	Characteristics of participants sample size	Method	Outcome measures	Results	Limitations
S. Jennifer **Blood Pressure Monitoring.2017**[9]	to determine to what extent back and feet support affects mean oscillometric BP measurements.	Cross-sectional study	85 participants	First, while the feet were supported, two sets of three BP readings were taken in random order: onewith the back supported and one with the back unsupported. Next, with the back supported, two sets of three BP readings were taken in random order: one with the feet dangling and one with feet supported.	Systolic blood pressure diastolic and blood pressure	Systolic BP differences were greater than or equal to 5 mmHg in 34% (back phase) and 23% (feet phase) of the participants.	The limitations of this study include the relatively low sample size and enrolment of menonly.
Abdelkarim et al International Journal of Novel Research in Healthcare and Nursing 2020[3]	The effect of body position change on blood pressure readings for botharm	Cross-sectional study	40 adult patients	In three differentpositions: Standing Sitting Supine	Systolicpressure diastolic pressure bloodand blood	A statistically significant difference was noted denoting that supine position was better than sitting and standing in the measuring the right and left arm systole among the studied patients	They did not addressthe type and years ofhypertension diagnosis
Wan et al Hypertension research 2021[6]	The differences in oscillometric blood pressure readings between unsupported and supported back conditions	Cross-sectional study	224 subject's adu	Two protocols formeasuring BP: 1. supported– unsupported–supported– unsupported 2. unsupported–supported–unsupported– supported	Systolicpressure diastolic pressure bloodand blood	The SBP/DBP levels measured with an unsupported back were slightly higher than those whenthe back wassupported.	This study has limitations owing to heterogenous sampleof hypertensive patients who are taking different types of antihypertensive medications.

The initial BP reading often overestimates mean BP, so averaging the second and third readings is more reliable. Aging increases BP due to vessel stiffness, and the drop in SBP from supine to standing is more pronounced in older adults, though underlying diseases and medications also play significant roles. BP measurements differ between arms and positions, with lower readings in the supine position compared to sitting and standing, especially in hypertensive individuals. To avoid misinterpretations, measurement protocols should standardize body position and arm use, aligning current guidelines with practical findings from studies like this.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

REFERENCES

1. Muntner P, Einhorn PT, Cushman WC, Whelton PK, Bello NA. Blood pressure assessment in adults in clinical practice and clinic-based research: JACC scientific expert panel. J Am Coll Cardiol. 2019;29;(3):317-35.
2. Lacruz ME, Kluttig A, Kuss O, Tiller D, Medenwald D, Nuding S et al. Short-term blood pressure variability–variation between arm side, body position and successive measurements: a population-based cohort study. BMC cardiovasc. disor. 2017;17(1):1-9.
3. Abdelkarim NE, Dawood TM. Effect of body position change on blood pressure readings from both arms. IJNRHN. 2020;7:675-86.
4. Weheida SM, Hafez EM. Blood Pressure Measurements: Factors Affecting Readings Accuracy.
5. Schutte AE, Kollias A, Stergiou GS. Blood pressure and its variability: classic and novel measurement techniques. Nature Reviews Cardiol. 2022;19(10):643-54.
6. Wan TX, Wu YH, Wu YQ, Hu W, Su H. Differences in oscillometric blood pressure readings between unsupported and supported back conditions. Hypertens. Res. 2021;44.5:528-32.
7. I_smet Eser, Leyla Khorshid , Ulku YapucuGunes. The effect of different body positions on blood pressure. J Nurs. 2007;16:137–14.
8. Islam MN, Kamal SK, Islam MS, Hossain SA. Variation of blood pressure during change of posture. Bangladesh Med J. 2018;51(1-2):16-20.
9. Ringrose JS, Wong J, Yousefi F, Padwal R. The effect of back and feet support on oscillometric blood pressure measurements. Blood Press Monit. 2017;00:213-6.
10. Pujitha K, Parvathi G, Sekhar KM. Postural changes in heart rate and blood pressure with ageing. Int J Physio Res. 2014;2(6):751-6.
11. Netea RT, Lenders JW, Smits P, Thien T. Both body and arm position significantly influence blood pressure measurement. J Human Hyp. 2003;17(7):459-62.
12. Adiyaman A, Verhoeff R, Lenders JW, Deinum J, Thien T. The position of the arm during blood pressure measurement in sitting position. Blood Pressure Monitoring. 2006;1;11(6):309-13.

Cite this article as: Rahul, Gitanjali S, Yadav VS. The effect of body position on oscillometric blood pressure readings in young adults: narrative review. Int J Res Med Sci 2024;12:4859-64.