

## Original Article

## The Differences in the Measurements of Blood Pressure over Bare Versus Sleeved Arm with Routine Clothing in Outdoor Patients

Abdul Khalid, Rubina Rafique, Muhammad Arshad, Mazhar Hamdani,

M. Naseem Sheikh, Sabahat Zahra

*AJK Medical College Muzaffarabad*

### Abstract

**Objective:** To observe the differences in the measurements of the Blood pressure over the sleeved arm with routine clothing versus bare arm. To determine whether these differences were statistically significant in making clinical decisions for treatment of hypertension.

**Methods:** This prospective, Observational study was done in the Abbas Institute of Medical Sciences (AIMS) Muzaffarabad. 100 adult patients attending the medical OPD were included. The first measurement of the blood pressure was taken over the sleeved arm with cloths. For the second measurement, all extra cloths over the shirt (Shawls, Coats, sweaters) were removed and sleeve of the shirt was folded upward to expose the arm and then the Blood pressure was measured over the bare arm. The values were compared by the independent sample t-test and reliability was determined by Cronbach alpha with SPSS-23.

**Results:** The Mean systolic Blood pressure with Sleeve was 122.62 mmHg (SD  $\pm$ 25.56) and without Sleeve it was 120.25 mmHg (SD  $\pm$ 25.48). The mean difference of Blood pressure was 2.37 mmHg. The Mean Diastolic Blood pressure with Sleeve was 75.25 mmHg (SD  $\pm$ 14.20) and without Sleeve it was 75.96 mmHg (SD  $\pm$ 14.26). The mean difference of Blood pressure was 0.7 mmHg. When compared with the paired samples t-test the paired differences were not statistically significant.

**Conclusion:** The measurement of Blood pressures is only slightly different over the sleeved arm as compared with the bare arm and these trivial differences have no impact in the management decisions of patients.

**Keywords:** Hypertension, Blood pressure measurement, sleeved arm Blood pressure

### How to cite this:

Khalid A, Rafique R, Arshad M, Hamdani M, Sheikh MN, Zahra S. The Differences in the Measurements of Blood Pressure over Bare Versus Sleeved Arm with Routine Clothing in Outdoor Patients. *J Pak Soc Intern Med.* 2023;4(2): 120-124

**Corresponding Author:** Dr. Abdul Khalid

**Email:** [abdulkhalid301@gmail.com](mailto:abdulkhalid301@gmail.com)

### Introduction

Hypertension is a major risk factor for death from stroke and cardiovascular disease.<sup>1</sup> The measurement of Blood Pressure (BP) is among one of the essential components of the clinical examinations in medical Out Patient Departments (OPDs). It is a part of vital signs and without measurement of the Blood Pressure, patients are not satisfied of their clinical evaluation. The use of oscillometric devices have rapidly replaced the traditional auscultatory method of measuring the blood pressure with mercury sphygmomanometers. However, sphygmomanometers are still widely used and undergraduates are trained to measure blood pressure with these devices. There is a check list to properly prepare the patient and certain recommended guidelines for accurate recoding of the blood pressure.<sup>2,3</sup> One recommendation is to

remove all clothing covering the location of the cuff placement<sup>4</sup>. This is challenging in geographical regions with severe winter seasons where temperatures fall below zero Celsius. In low-income countries, where OPDs are not fully air-conditioned it becomes difficult to strictly adhere to these guidelines. The northern areas of Pakistan have long and cold winter season. The average number of clothing in adult patients in winter season is 2-4, which is variable according to the weather in Azad Kashmir and the Northern region of Pakistan. The winter dress in Azad Kashmir includes shirt and under shirt warmer suits, woolen or cotton sweaters, coats and woolen or cotton Shawls. It is practically not feasible to remove all the cloths to take the Blood Pressure over a bare arm. The most optimum alternative is to measure the BP by rolling up the sleeve. In winter season,

even rolling up the sleeve is difficult, owing to the thickness of the clothes and more than one sweater worn by the patients. These patients who are sick, with other comorbidities often start shivering when clothes are removed and accuracy of BP measurement becomes questionable.<sup>5</sup> The practical options left in OPDs is a tradeoff to measure the Blood Pressure over the sleeved arm or don't take the blood pressure. The second option is in fact, not an option in medical OPDs. It is not possible to send patients home without knowing the status of their Blood Pressures. This study was planned to observe the differences in the measurements of the Blood pressure when measured over the sleeved arm versus bare arm. There is no available study from the public sector hospitals of the northern regions of Pakistan, where winter temperatures often fall from 0°C. Patients attending the medical OPDs wear more than one clothes and females always cover their body with at least one shawl over other cloths. In the prevailing social setup, in that climate, with the type and number of clothes, it becomes almost impossible to get a bare arm for measuring the Blood Pressure. It is even more difficult in female patients who are 48.54% of the population in Pakistan.

## Methods

This prospective, Observational, Quasi experimental study was done in the Abbas Institute of Medical Sciences (AIMS) Muzaffarabad, a public sector tertiary care teaching hospital of Azad Jammu and Kashmir Medical College. 100, Adult patients attending the medical OPD above the age of 18 years were included in the study. All patients were advised to take rest for 15 minutes. The first measurement of the blood pressure was taken over the sleeved arm with cloths (Shirt and sweater) worn by the patient, in the sitting position. For the second measurement, all extra cloths over the shirt (Shawls, Coats and sweaters) were removed and sleeve of the shirt was folded upward to expose the arm and then the Blood pressure was measured over the bare arm. The Yamasu Mercurial Sphygmomanometer and Mortara Surveyor S12 (Milwaukee, WI-USA) electronic monitor were used for measuring the Blood Pressure. The thickness of the sleeve of each cloth, separately measured by using the Screw Gauge (Yipin Mingma: pulling dry ruler GB/T1216-1985).

**Inclusion Criteria and Exclusion Criteria:** Adult patients above the age of 18 years attending the medical OPDS will be included except patients with acute painful medical conditions, patients with acute febrile illnesses, heavy clothed Patients where removing the cloths was not possible to expose the arm, obese patients where, circumference of the arm with worn clothes rendered the cuff of the sphygmomanometer undersized for that patient.

**Statistical Analysis:** All statistical analyses were performed using SPSS version 23.0 (SPSS Inc., Chicago, IL, USA). For all tests, p values of <0.05 were considered statistically significant. Continuous parametric variables were reported as mean  $\pm$  standard deviation; nonparametric continuous variables were reported as median and categorical variables were expressed as percentages, means were compared by using paired sample t-tests and Cronbach's alpha was used for reliability.

## Results

100 patients were included in the study. The mean age of the participants was 43.0 years, 77 % were females and 33% were male patients. The median number of clothes worn by 87% of patients during the study period were 3-4 and ranged from 2-6. The mean thickness of the clothes over the arm for sweaters and shirts was 1.19 mm (SD  $\pm$ 0.22) and 0.12 mm (SD  $\pm$ 0.01) respec-

**Table 1:** Descriptive statistics

Age of patients			
Minimum	Maximum	Mean	Std. deviation
22.00	90.00	43.07	17.71
Number of Clothes worn by the patients			
Percent		Number of Clothes	
3.0		2.0	
47.0		3.0	
41.0		4.0	
5.0		5.0	
4.0		6.0	
Average thickness clothes (mm)			
		shirt	Sweater
Mean		0.12	1.19
Std. Deviation		0.01	0.22
Minimum		0.11	1.00
Maximum		0.14	2.00

tively (table-1).

The Mean systolic Blood pressure with Sleeve was 122.62 mmHg (SD  $\pm$ 25.56) and without Sleeve it was 120.25 mmHg (SD  $\pm$ 25.48). The mean difference of Blood pressure was 2.37 mmHg (Table-2).

The Mean Diastolic Blood pressure with Sleeve was 75.25 mmHg (SD  $\pm$ 14.20) and without Sleeve it was 75.96 mmHg (SD  $\pm$ 14.26). The mean difference of Blood pressure was 0.7 mmHg (Table-2).

When compared with the paired samples t-test the paired (table-3) differences were not significant for systolic Blood Pressure over the sleeved and bare arm ( $p > 0.081$ ). The paired difference was also not significant as for diastolic Blood pressure over the sleeved and bare

**Table 2:** Comparison of Blood Pressure over the Sleeve vs bare arm

Blood Pressure Measurement (mmHg)	N	Mean	Std. Deviation	Std. Error Mean
Systolic Blood Pressure with Sleeve	100	122.62	25.56	2.55
Systolic Blood pressure without Sleeve	100	120.25	25.48	2.54
Mean difference Systolic Blood Pressure with Sleeve compared to without Sleeve			2.37 mmHg	
Diastolic blood pressure without Sleeve	100	75.25	14.20	1.42
Diastolic Blood Pressure with Sleeve	100	75.96	14.26	1.42
Mean difference Diastolic blood pressure with Sleeve compared to without Sleeve			0.71 mmHg	

**Table 3:** Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
<b>Pair 1</b>	Systolic Blood Pressure with Sleeve - Systolic Blood pressure without Sleeve	2.37	6.61	.66	1.05	3.68	3.58	99	0.081
<b>Pair 2</b>	Diastolic Blood Pressure with Sleeve - Diastolic blood pressure without Sleeve	0.71	4.51	.45	-.18	1.60	1.57	99	0.119

**Table 4:** Reliability Statistics

	Cronbach's Alpha	
Systolic Blood Pressure with Sleeve	-	0.98
Systolic Blood pressure without Sleeve		
Diastolic Blood Pressure with Sleeve	-	0.79
Diastolic Blood pressure without Sleeve		

arm (p>0.119)

The Cronbach’s reliability statistics showed high reliability for the measurements of systolic Blood Pressure (0.98) over the sleeved and bare arm. The reliability of the measurement of the diastolic Blood Pressure was 0.79 (table-4).

**Discussion:**

Hypertension affects more than 40% of adult population and is a major risk factor for cardiovascular and cerebrovascular mortality and morbidity.<sup>6</sup> There are several standardized recommendations for accurate assessment of the Blood Pressure (PB). These include pre-measurement preparation of the patients, proper positioning of the patient while taking BP, appropriate cuff size and its placement, the accurate technique and a standardized equipment.<sup>7,8</sup> The measurement of the Blood Pressure is one of the most common and routinely performed examination in medical outpatient departments. Historically, it is by the manual measurement using the auscultatory technique and the manual mercurial sphygmomanometer being the most commonly used instrument for measuring the Blood pressure.<sup>9</sup> However, during the past few decades, with technological advances

and improved accuracy of measurement, there is wide spread use of semi-automated and fully automated devices for measuring the BP.<sup>10,11,12,13</sup> In ideal settings the recommendation is to place the cuff over the bare arm.<sup>14</sup> In winter season, in areas with cold climates it is often difficult to remove the clothes and expose the arm for taking the Blood Pressure. This study was conducted during the winter season in the sub-Himalayan region, where patients on average, were wearing 2-4 cloths due to cold climate. In the absence of adequate heating facilities in OPDs (common in low-income countries), removing the cloths to expose the upper arm causes a significant discomfort to already sick and elderly patients. On the other hand, as a part of residency training, doctors are in the habit of taking BP on the bare arm. The results of this study have shown that taking the BP over the clothed arm is only slightly different from measurements over the bare arm. This difference of 2.37 mmHg in systolic and 0.71 mmHg in Diastolic Blood Pressures will not impact the management decisions in medical OPDs. The reliability of taking the blood pressure with auscultatory method was very high for systolic blood pressure (0.98), while still reliable but slightly lower for diastolic blood pressure (0.79). This low reliability explains individual variability in the interpretation of Korotkoff sounds at phase-4 (a blowing sound) and phase-5 (silence) while recording the diastolic blood pressure. In circumstances, where frail, elderly, sick patients, who are wearing more than two clothes in severe, cold winter conditions, in OPDs without adequate heating, it would be better to take BP over the sleeved arm. This study provides evidence that such

measurements of Blood Pressure were reliable (0.98 and 0.79 for systolic and diastolic BP respectively) and the difference was trivial and discomfort is more while exposing the arm. However, this practice should not be the routine and could not replace the recommendations for measuring the Blood Pressure in ideal conditions.

A study by Ertug N showed minimum and statistically insignificant differences in the measurement of Blood Pressure over the sleeve and rolled up sleeve<sup>15</sup>. The findings in that study were similar to the findings in our study.

The study in Korean population by Ji Hoon Ki, using Automatic Oscillometric Sphygmomanometer, the systolic blood pressure was 128.5 mmHg over the sleeve and 128.3 mmHg in the bare arm group. The diastolic BP was 80.7 mmHg and 80.6 mmHg in the sleeved and bare arm groups respectively. These differences were not statistically significant<sup>16</sup>. The findings were similar and results of that study also support the result of our study.

A systematic review and meta-analysis of thirteen studies by David Seguret and colleagues showed a non-significant 2.76 mmHg over-estimation of Systolic BP below the rolled up sleeve. The conclusion was that recoding Blood pressure over thin sleeves had no impact on Blood pressure values. The findings and conclusions of the systematic review and meta-analysis were similar to the findings in our study.<sup>17</sup> In another study Grace MA and colleagues also challenged the tradition of taking the BP over the bare arm.<sup>18</sup> They randomized the 376 patients in two groups and difference in the systolic blood pressure over the sleeved and bare arm was 3.4 mmHg and for the diastolic Blood pressure it was 0.4 mmHg. These differences were not statistically significant. The results of this study were also similar to the results of our study.

There are other studies where found differences in blood pressure over the sleeve compared with bare arm were statistically significant. A study by Sachiko Ozone in 186 subjects, the mean Blood Pressures over the bare arm, over a sleeve and over a rolled-up sleeve were 128.9/67.4 mmHg, 132.8/72.6 mmHg and 133.4/74.4 mmHg, ( $P < 0.001$ ) respectively.<sup>19</sup> Another study by Emel Tuğrul in 200 patients found constricting rolled-up sleeves produced higher systolic and diastolic blood pressure measurements.<sup>20</sup> In these studies differences were statistically significant but the magnitude was too small to affect the clinical decision making in the treatment of patients.

**Limitations of the study:** This was a small Out Patient based study. The Blood pressure was recorded in the same setting over the sleeve and then over the bare arm, it had the confounding factor of natural difference in

the measurement of the second from the first reading. We used the one, single sized cuff, available for adult patients in medical OPD. The study protocol was open and not blinded for the physician which might have affected by their own perception about the effect of clothing on the measurement of BP.

## Conclusion

The measurement of Blood pressures is only slightly different over the sleeved arm as compared with the bare arm in patients reporting to medical OPDs. This trivial difference in the measurement of the systolic and diastolic blood pressures, had no impact in the management decisions of these patients.

**Conflict of Interest:** *None*

**Funding Source:** *None*

## References

1. Whelton PK, Carey RM, Aronow WS. Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Hypertension*. 2018;71(6): e13-e115.
2. Leung AA, Daskalopoulou SS, Dasgupta K. Hypertension Canada's 2017 guidelines for diagnosis, risk assessment, prevention, and treatment of hypertension in adults. *Can J Cardiol*. 2017;33(3):557-76
3. Liu C, Griffiths C, Murray A, Zheng D. Comparison of stethoscope bell and diaphragm, and of stethoscope tube length, for clinical blood pressure measurement. *Blood Press Monit*. 2016;21(3):178-83.
4. Weir MR. In the clinic: hypertension. *Ann Intern Med*. 2014;161(1):1-15
5. Sternbach TJ, Harper S, Li X, Zhang X, Carter E, Zhang Y, et al. Effects of indoor and outdoor temperatures on blood pressure and central hemodynamics in a winter-time longitudinal study of Chinese adults. *J Hyperten*. 2022;40(10):1950-9.
6. McFadden CB. Update in Hypertension. *Med Clin North Am*. 2022;106(2):259-267.
7. Hermida RC, Smolensky MH, Ayala DE, Portaluppi F. Ambulatory Blood Pressure Monitoring (ABPM) as the reference standard for diagnosis of hypertension and assessment of vascular risk in adults. *Chronobiol Int*. 2015;32(10):1329-42.
8. Pickering TG, Hall JE, Appel LJ, Falkner BE, Graves J, Hill MN et al. 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. *Hypertension*. 2005;45(1):142-61.

9. Soto-Perez-de-Celis, Enrique. "Karl Samuel Ritter Von Basch: the sphygmomanometer and the Empire." *J Hypertension*. 2007;25(6):1507-9.
10. Sharman JE, Tan I, Stergiou GS, Lombardi C, Saladini F, Butlin M, et al. Automated 'oscillometric' blood pressure measuring devices: how they work and what they measure. *J Hum Hypertens*. 2023;37(2):93-100.
11. Kuo CS, Hwu CM, Kwok CF, Hsiao LC, Weih MJ, Lee SH, Ho LT. Using semi-automated oscillometric blood pressure measurement in diabetic patients and their offspring. *J Diabetes Complications*. 2000; 14(5): 288-93.
12. Berkhof RT, Gazzola K, van den Born B-JH. Effect of self-initiated and fully-automated self-measurement on blood pressure. *J Hum Hypertens*. 2020; 34(2): 176-83.
13. Myers MG, Godwin M, Dawes M, Kiss A, Tobe SW, Kaczorowski J. The conventional versus automated measurement of blood pressure in the office (CAMBO) trial: masked hypertension sub-study. *J Hypertens*. 2012; 30(10): 1937-41.
14. Paul Muntner, Daichi Shimbo, Robert M. Carey, Jeanne B. Charleston, Trudy Gaillard, Sanjay Misra et al. Measurement of Blood Pressure in Humans: A Scientific Statement From the American Heart Association. *Hypertension*. 2019;doi.org/ 10.1161/ HYP.000000000000000087
15. Ertug N, Cakal T, Ozturk SB, Verim M. The effect of clothes on blood pressure measurement. *Pak J Med Sci*. 2017;33(1):205-9.
16. Ki JH, Oh MK, Lee SH. Differences in Blood Pressure Measurements Obtained Using an Automatic Oscillometric Sphygmomanometer Depending on Clothes-Wearing Status. *Korean J Fam Med*. 2013;34(2):145-51.
17. David Seguret, Danae Gamelon, Caoline Dourmap, Olivier Steichen. Blood pressure measurement on a bare arm or below a rolled up sleeve: a systematic review and metaanalysis. *J Hypertens*. 2020;38(9):1650-58.
18. Ma G, Sabin N, Dawes M. A comparison of blood pressure measurement over a sleeved arm versus a bare arm. *CMAJ*. 2008;178(5):585-9.
19. Ozone S, Shaku F, Sato M, Takayashiki A, Tsutsumi M, Maeno T. Comparison of blood pressure measurements on the bare arm, over a sleeve and over a rolled-up sleeve in the elderly. *Fam Pract*. 2016;33(5):517-22.
20. Tuğrul E, Karaçam Z. Comparison of blood pressure and pulse readings measured on a bare arm, a clothed arm and on an arm with a rolled-up sleeve. *Int J Nurs Stud*. 2020; doi: 10.1016/j.ijnurstu.2019.103506.