

Original Article**Comparison of Blood Pressure Readings on a Bare Arm, over a Sleeve Arm and over a Rolled-Up Sleeve Arm in Outpatient Department of Medicine in Dhulikhel Hospital, Kathmandu University Hospital****Nirish Vaidya*, Nishan Bhattarai, Prabhat Gami, Bijay Tamang, Sahil Bade, Sohail Bade**

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Article Received: 12th March, 2022; Accepted: 16th June, 2022; Published: 30th June, 2022**DOI: <https://doi.org/10.3126/jonmc.v11i1.46082>****Abstract****Background**

It is universally recommended that blood pressure should be measured on bare arm for accurate reading. However, this is seldom done in busy clinical schedules. This study aims to see if clothing adjustments should be a concern while measuring blood pressure under suboptimal conditions.

Materials and Methods

This was a cross sectional study conducted at medicine department of Kathmandu University Hospital, Dhulikhel Hospital among conveniently selected 100 patients. After getting informed consent, consecutive blood pressure measurements were done over rolled-up sleeve arm, sleeve arm and bare arm in seated position. Socio-demographic information were obtained through an interview using a semi-structured questionnaire. Data were entered in Microsoft Excel and analyzed using descriptive and inferential statistics in Statistical Software for Social Sciences version 20.


Results

The median of differences between sleeved arm and bare arm was 0 for both systolic and diastolic blood pressure and the median value for differences between rolled up arm and bare arm was 2 units for both systolic and diastolic blood pressure. Although the differences looked statistically significant, the size of the differences was not clinically significant.

Conclusion

Meticulous clothing adjustment has clinically insignificant differences in measurement of blood pressure if patient is wearing thin sleeves. Therefore, in suboptimal conditions, blood pressure can be measured on rolled-up sleeve arm and sleeve arm if patient is wearing thin sleeve clothes.

Keywords: *Arm, Blood pressure, Clothing*

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Citation

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Introduction

Although it is recommended that blood pressure (BP) be measured on a bare arm, in clinical settings, it is occasionally measured over clothes. One of the most important physical examination techniques is the measurement of blood pressure. Thus, accurate measurement is necessary. The 2017 ACC/AHA Hypertension guideline recommends measuring blood pressure by removing the covering in the location of cuff placement along with other standard check list of accurate blood pressure measurement [1]. American Academy of Family Physicians (AAFP), European Society of Hypertension practice guideline 2021 and Canadian Hypertension Guideline 2020 also recommend office BP measurement over bare arm [2–4]. However, following these criteria is not always possible because the patient's condition makes it difficult to undress, there is inadequate time for resting in busy clinical schedules, environmental variables such as home visit, or the cuff size is insufficient. Hence, it is usual to measure BP in sleeve arm or rolled over sleeve arm. Anecdotal observations suggested that there were many barriers to consistent and accurate BP measurement at our outpatient clinics [5].

This study aims to see if the clothing conditions should be a concern while measuring blood pressure by a busy clinician and see if advantages of meticulous clothing adjustments outweigh the risk of under or over diagnosing hypertension while measuring blood pressure in time saving fashion without making clothing adjustments.

The main objective of this study is to assess the accuracy of BP measurements on unrolled sleeve and rolled sleeve over bare arm in clinical settings. Secondly, it also aims to see if BP variation in these clothing conditions varies in hypertensive versus non hypertensive patients and patients with different Body Mass Index (BMI) categories.

Materials and Methods

This was a cross sectional study conducted at Medicine outpatient department at Kathmandu University Hospital, Dhulikhel Hospital in January/February 2022. Ethical approval for the study was obtained from the Institutional Review Committee of Kathmandu University School of Medical Sciences. Those patients whose blood pressure could not be measured on the arm due to wound or bandages on arm, patients with arrhythmia, patients who had ingested caffeinated beverages and cigarettes within 30

minutes before the blood pressure measurements and those who did not provide informed consent were excluded from the study. Convenient sampling method was used for enrolling 100 patients for BP measurement on days feasible to the researcher. As this was non-probability sampling method, scientific sample size calculation was not done. Patient were explained about the study objectives and informed consent was obtained from the participants before data collection. Patients were told that participation in the study was voluntary and they could withdraw from the study at any time.

All the patients were preconditioned with the standard blood pressure measurement criteria mentioned by the American College of Cardiology (ACC) 2017 [1]. The participants wore no more than thin cardigan/shirt of thickness 2 mm measured from the vernier caliper. Blood pressure measurement was done by aneroid sphygmomanometer. Three measurements were taken consecutively without delays for each subject, once in each of the following three situations, in random order: (a) with the subject's sleeve rolled above the upper border of the blood pressure cuff ('rolled sleeve'), (b) with the cuff placed over the sleeve on the subject's upper arm ('sleeve') and (c) with the cuff placed on the subject's bare and unclothed arm ('bare arm'). Participants' information was collected through interview technique using a semi-structured questionnaire. Body Mass Index (BMI) was calculated after measuring participant's height using inch tape and weight using a digital weighing machine and BMI classification was done according to World Health Organization classification for Asia-Pacific population [6]. Data were entered in Microsoft Excel and analyzed using descriptive and inferential statistics (Wilcoxon sign rank test) in Statistical Software for Social Sciences version 20.

Results

The total number of participants was 100. The mean age of was 53.3 ± 13.9 years. Fifty four percent participants were females. There were almost equal numbers of participants with and without hypertension. Around one third of them were of normal weight. (Table 1) The comparison of systolic and diastolic blood pressure measurements in bare and sleeve arm is presented in Table 2 and the comparison between bare arm and rolled up arm is shown in Table 3. Non-parametric Wilcoxon sign rank test was conducted to compare the median difference between the groups as the distribution was not



normal upon test of normality. The median blood pressure in bare arm was 133/85 mm of Hg while the measurement in sleeved arm was 134/86 mm of Hg and that in rolled up arm was 134/88 mm of Hg. The median of differences between sleeve arm and bare arm was 0 for both systolic and diastolic blood pressure and the median value for differences between rolled up arm and bare arm was 2 units for both systolic and diastolic blood pressure. Both the differences were found to be statistically significant at 95% confidence level, however, the size of the differences are not clinically significant.

In Table 4, further analysis of the median blood pressure measurements bare, sleeve and rolled up arm are shown for hypertension status and BMI of participants. The differences in median systolic and diastolic blood pressure in sleeve arm and rolled up arm in comparison to bare arm was similar among hypertensive and normotensive participants. The differences in readings under the three different measurement conditions across different levels of BMI were also similar to each other.

Table 1: Socio-demographic characteristics of the respondents

n=100

Characteristics	Frequency/Percentage
Age (in completed years)	
<20	1
20-40	16
40-60	52
60-80	29
≥80	2
Sex	
Female	54
Male	46
Hypertension status	
Hypertensive	51
Normotensive	49
Body Mass Index	
Under weight	4
Normal weight	34
Overweight	43
Obese class I	19

Table 2: Comparison of blood pressure readings in bare arm and sleeved arm

n= 100

Blood pressure measurement	Bare arm Median (IQR)	Sleeved arm Median (IQR)	Sleeved arm -Bare arm Median (IQR)	p-value
Systolic blood pressure (mm of Hg)	133 (118,149)	134 (118,149)	0 (0,2)	<0.001
Diastolic blood pressure (mm of Hg)	85 (78,85)	86 (78,96)	0 (0,2)	<0.001

Table 3: Comparison of blood pressure readings in bare arm and rolled up arm

n= 100

Blood pressure measurement	Bare arm Median (IQR)	Rolled up arm Median (IQR)	Rolled up arm - Bare arm Median (IQR)	p-value
Systolic blood pressure (mm of Hg)	133 (118,149)	134 (118,149)	2 (0,2)	<0.001
Diastolic blood pressure (mm of Hg)	85 (78,85)	88 (78,96)	2 (0,2)	<0.001

Table 4: Comparison of blood pressure readings in bare arm, sleeved arm and rolled up arm according to hypertension and BMI status

n= 100

Characteristics	Bare arm systolic BP (Median mm of Hg)	Bare arm diastolic BP (Median mm of Hg)	Sleeved arm systolic BP (Median mm of Hg)	Sleeved arm diastolic BP (Median mm of Hg)	Rolled up arm systolic BP (Median mm of Hg)	Rolled up arm diastolic BP (Median mm of Hg)
Hypertension						
Hypertensive	144	90	144	92	146	92
Normotensive	120	82	120	84	120	84
Body Mass Index						
Underweight	113	74	115	76	116	76
Normal weight	136	85	136	86	138	87
Overweight	128	86	128	86	130	88
Obese class I	142	92	144	92	144	94

Discussion

The purpose of the study is to see if the clothing conditions should be a concern while measuring blood pressure by a busy clinician. In this study, the median blood pressure in bare arm was 133/85 mm of Hg while the measurement in sleeved arm was 134/86 mm of Hg. There was an increase in median systolic blood pressure by 1 mm of Hg and increase in diastolic blood pressure by 1 mm. Although this increase was statistically significant at 95% confidence level, the increase in systolic and diastolic blood pressure by mere 1 unit is not clinically significant. Our finding is consistent with the findings from previous studies. A study done in 200 patients in Karachi, Pakistan showed clinically insignificant difference in means of systolic blood pressure and diastolic blood pressure between clothed and unclothed arm, that was 0.94 mmHg with a SD of 4.32 and 0.58 mmHg with a SD of 3.80 respectively [7]. A study by Tugrul et al in 2020 revealed that there is no positive correlation between blood pressure and thickness of clothing [8]. Kahan et al in his study that included 201 subjects found that the degree of clothing under the sphygmomanometer cuff does not have a clinically important effect on the blood pressure measurement [9]. Findings from a pretest posttest study design in Turkey did not find statistically significant different readings of



systolic blood pressure in bare arm and rolled up arm [10]. Similarly, Liebl et al in their study that included 201 subjects did not find clinically significant difference while measuring BP over sleeve less than 2mm [11]. However, a study conducted in Japan found that the differences in systolic and diastolic blood pressure measured with thin clothing was significantly different with variations within 5 mm of Hg [12].

In our study, the median systolic and diastolic blood pressure readings below a rolled up arm was 134/88 mm of Hg, an increase by 1/3 mm of Hg from the reading in bare arm. Similar to our findings, a previous study also found statistically significant difference in systolic blood pressure reading on bare arm and below a rolled-up sleeve arm [8,12] Although this difference was statistically significant at 95% confidence level, the magnitude of the difference did not seem to be clinically important in our study. Our interpretation was also supported by a previous study that did not find significant difference in systolic blood pressure reading in bare arm and below rolled-up sleeve [10].

A systematic review and meta-analysis of twelve comparative trials showed a non-significant 0.59 mmHg overestimation of systolic BP measured over a sleeve when the thinnest sleeve was considered, 1.10 mmHg overestimation of systolic BP when the thickest sleeve was considered and 2.76 mmHg overestimation of SBP measured below a rolled-up sleeve in studies that investigated various thicknesses [13]. Our study finding and interpretation is also in consistency with this systematic review.

Separate analysis according to hypertension status and BMI status was also done in this study. The readings of median systolic and diastolic blood pressure among hypertensive and normotensive patients also seemed similar with clinically insignificant differences in both groups. Hence, we could say that blood pressure measurement with minimal clothing did not make much difference among hypertensive and non-hypertensive patients. This supports to the findings in similar study done in hypertensive patient [14]. Likewise, the blood pressure measurements among different categories of BMI also showed no clinically significant different readings in bare arm, sleeved arm and rolled up arm. Our finding is similar to previous study findings that there was no significant difference in systolic and diastolic blood pressure readings in bare, sleeved and rolled-up arm based on the hypertension and BMI status of the participants [15]. Overall, our findings supported the results of

previous studies that there is no clinically significant different reading even when clothing adjustment is not made. It is however recommended to measure blood pressure in bare arm whenever feasible especially on patients wearing thick sleeves.

The limitation of our study was that single reading of blood pressure was taken on bare arm, sleeved arm and rolled-up arm each unlike other studies which took at least two readings. The size of the sphygmomanometer cuff should be different according to the arm circumference. However, we used same sized cuff in all the patients, which adds another limitation of our study.

Conclusion

This study in 100 patients showed that there is clinically insignificant difference in BP measurement even if clothing adjustment is not made when the patient is wearing thin sleeves like shirt or cardigan which were less than 2 mm thick in our study. The clinically significant differences were also not noted in both hypertensive and non-hypertensive patients and in different class of BMI. Hence, meticulous clothing adjustment might not be necessary for blood pressure measurement in busy clinic setting if patient is wearing thin sleeves. It is however recommended to measure blood pressure in bare arm whenever feasible especially in patients wearing thick sleeves like jacket or thick sweater.

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Conflict of interest: None

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