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ORIGINAL ARTICLE

A Cross-Sectional Study on Inter-Arm Blood Pressure Difference among Healthy Young Adults

MUNAZZA KHAN[1], ZAFARUDDIN[2], SABA FAROOQ[3], AHSAN MOBIN[4], FAREEHA HASAN[5], SYED HASSAN IDREES[6]
[1]*Associate Professor, Department of Physiology, Saidu Medical College, Swat Pakistan*
[2]*Assistant Professor, Department of Family Medicine, MTI LRH, Peshawar Pakistan*
[3]*Demonstrator Physiology Department, Superior University, Lahore Pakistan*
[4]*Assistant Professor General Medicine, Dow University of Health Sciences/ Civil Hospital Karachi*
[5]*Associate Lecturer, Pharmaceutical Chemistry (Pharmacist), Capital University of Science and Technology, Rawalpindi*
[6]*District Medical Office, Sehat Sahulat Program/ State Life Insurance Corporation, Jhang*
Corresponding author: Zafaruddin, Email: Zafaruddinkh@yahoo.com

ABSTRACT

Introduction: The inter arm difference of blood pressure is the alteration in DBP and SBP between individuals' both arms. IAD researches have been conducted in the pregnant women, elderly and subjects with DM and cardiovascular disease, but the number of studies in healthy young adults is very limited.

Aim: Therefore, this analysis intended to assess the inter-arm difference in blood pressure in healthy young adults and its relation with gender, age, family history of hypertension and BMI.

Study Design: A cross-sectional study.

Place and Duration: In the Physiology Department of Saidu Group of Teaching Hospital Swat and Medicine department of MTI LRH, Peshawar for duration from October 2021 to March 2022.

Methods: This study was held among 150 individuals. A mercury sphygmomanometer was used for measuring blood pressure. Statistical analysis was performed by means of the chi-square, paired t and SPSS 21.0 test and the Pearson correlation test.

Results: The IAD absolute mean for systolic blood pressure was 6.02 ± 4.10 mm Hg, and 3.90 ± 2.79 mm Hg for DBP. There is a substantial IAD for SBP ($t = 4.701$, $p < 0.001$), but no variance DBP. The IAD in SBP was suggestively related to patient's arterial hypertension and with their family history ($\chi 2 = 6.50$, $p = 0.01$) but insignificantly related to age ($r = +0.140$, $p = 0.05$). The inter-arm systolic blood pressure has no substantial variance with respect to BMI and gender. Meanwhile, no statistically substantial association between gender, age, family history of hypertension, BMI, and interarm DBP.

Conclusions: There is a substantial inter-arm difference in SBP amongst healthy young adult and related with age and positive hypertension family history.

Keywords: Young adults, Inter-arm difference and Blood pressure.

INTRODUCTION

Hypertension (HTN) is a comprehensive healthiness delinquent and is the foremost reasons of cardiovascular disease and early bereavement globally[1-2]. About 114 million individuals globally have hypertension, and about 2/3rd of them live in middle and low-income states[3-4]. The measurement of blood pressure is an assenting valuation in the diagnosis of arterial hypertension[5]. In clinical practice, measuring blood pressure is usually routine, and regular blood pressure monitoring can help prevent high blood pressure[6]. Though, researches have shown that values of blood pressure vary from arm to arm and can cause mistakes in the treatment and interpretation of blood pressure[7-8]. For this reason, most guidelines recommend measuring blood pressure of both arms in the preliminary valuation and in the arm with the highest value for following evaluations[9]. However, most clinicians do not follow this practice. The IAD variations, the differences in BP in the left and right arm are supposed to be related with DM, HTN, peripheral vascular disease or CKD. One analysis found that an ≥10 mmHg of IAD, diabetes mellitus and positive hypertension family history were predictive in expecting cardiovascular issues[10]. It has also been instituting that IAD valuation can be a non-invasive and simple test to identify individuals predisposed to cardiovascular and peripheral incidents. So far, most of the IAD research has focused on the elderly, diabetics, people with high blood pressure, and pregnant women[11]. However, few researches are held amongst young adults who are healthy. We are also not aware of the existence of additional factors related with IAD amongst young adults[12]. Therefore, this analysis intended to assess the inter-arm difference in blood pressure in healthy young adults and its relation with gender, age, BMI and hypertension family history.

METHODS

This observational and cross-sectional study was held in the Physiology department Saidu Group of Teaching Hospital Swat and Medicine department of MTI LRH, Peshawar for duration from October 2021 to March 2022. The technique of sampling used was purposive nonprobability sampling. The subjects with a history of high BP, renal disease, cardiovascular disease and who were taking medicines and refused to partake in the study were excluded. Prior to the study, Institutional Review Committee (IRC) approve the study and volunteers gave written informed consent preceding to collection of data. The standard digital weighing scale was used for weight assessment and non elastic measuring tape was used for height measurement with bare feet on a hard, flat floor surface.

Blood pressure measurement: A mercury sphygmomanometer was used for BP evaluation. Participants were given rest for 5 minutes without crossed legs. During measurement of the BP, the blood pressure monitor was held at heart level and the hands were supported. Care was taken to ensure that the size of the cuffs corresponded to the circumference of the tested arm. When the Korotkoff sound was 1st perceived (stage I), pressure was noted and was taken as the systolic pressure, and when the sounds vanished (stage V) was labelled as the diastolic pressure. Blood pressure was evaluated two times in both arms (with minimum three minutes difference) and the readings mean was taken. IAD of BP was determined as the change between the mean DSP and SBP between the left and right arms.

All data collected was coded, compiled and arranged in the Microsoft Excel and SPSS 16.0 was used for analysis of data. Descriptive statistics were applied to calculate the standard deviation and mean. To determine the significant difference between the DSP and SBP between the arms, inferential statistics were accomplished like paired t-test. While the chi-square test was cast-off to test the relation amid diastolic and systolic blood pressure IAD with positive hypertension family history, the Pearson correlation test was applied to govern the association amid age and BMI with the diastolic and systolic IAD.

RESULTS

150 subjects aged 18 to 30 (mean 21.31 ± 3.2 years) took part in the anlaysis. The participants mean height was 160.58 ± 0.82 cm,

and the mean weight was 56.82 ± 8.69 kg. The participants mean BMI was 22.12 ± 3.20 kg / m^2. Most of the contributors were female, had a normal BMI, and had no positive hypertension family history (Table 1).

Table 1: Family history and General characteristics of hypertension of the participants

Variables		Number	Percentage
Sex	Male	45	30
	Female	105	70
Family history of HTN	Present	51	34
	Absent	99	66
BMI	<18.5	22	14.7
(Kg/m^2)	18.5-24.9	86	57.3
	25.0-29.9	34	22.7
	≥30.0	8	5.3

Mean DBP and SBP of the right arm were 72.28 ± 10.63 mm Hg and 110.08 ± 12.59 mm Hg, correspondingly. Likewise, the mean DBP and SBP of the left arm were 72.78 ± 8.95 mmHg and 108.50 ± 12.04 mmHg, correspondingly. IAD is substantial for systolic blood pressure (t = 4. 701, p <0.001) but not for DBP (t = 5.450, p = 0.21). The BP differences distribution between the arms is exhibited in Table 2.

Table 2: Assessment of inter-arm differences of blood pressures in relative to hypertension family history and gender

Variables and Categories		SBP difference		DBP difference	
		<10 mmHg	≥10 mmHg	<10 mmHg	≥10 mmHg
Total	Frequency	105	45	110	40
	Percentage	70	30	73.3	26.7
	Mean difference	6.02 ± 4.10	3.90 ± 2.79		
Sex	Male	38	7	40	5
	Female	80	25	90	15
	P value (χ^2)	0.10	0.66		
Family history of hypertension	Present	41	10	42	3
	Absent	50	49	95	10
	P value (χ^2)	0.01	0.07		

The IAD absolute mean for systolic blood pressure was 6.02 ± 4.10 mm Hg, and 3.90 ± 2.79 mm Hg for DBP. The percentage of IAD ≥10 mm Hg for DBP and SBP was 26.7% and 30%, correspondingly. The IAD in SBP was suggestively related to patient's arterial hypertension and with their family history ($\chi 2$ = 6.50, p = 0.01) but insignificantly related to age (r = +0.132, p = 0.05) (Tab. 3).

Table 3: Correlation (Pearson) of BMI and age and BP interarm differences

Variables	Systolic blood pressure		Diastolic blood pressure	
	Correlation coefficient	P value	Correlation coefficient	P value
Age	+0.132	0.05	-0.016	0.81
BMI	+0.29	0.66	-0.081	0.19

The inter-arm systolic blood pressure has no significant change with respect to BMI and gender. Meanwhile, no statistically substantial association between gender, age, hypertension family history, BMI, and interarm DBP.

DISCUSSION

This study examined the IAD of BP and identified factors associated with them. It confirms there is a significant IAD in SBP in healthy young people, but no variance in DBP[13]. This study outcomes also showed that the blood pressure in the right side of the arm was greater than that in the left side of the arm, which is in line with the outcomes of earlier researches[14]. This is due to the developed muscles of arm which is dominant than the muscles in the arm which was non-dominant and are therefore less compressed by the cuff of apparatus. In addition, several explanations for minor anatomical changes in aortic angles, branches and hemodynamic profiles have been proposed that may reconstruct the result[15]. Although differences of ≥10 mmHg between the arms in DBP and SBP were found in 26.6% and 30% of contributors, correspondingly, this is closer to few earlier researches, while other studies showed lower incidence rates compared to this study[16-17]. This is because of variances in the studied inhabitants and the approaches applied to evaluate blood pressure. The sequential method was used to measure BP in this study, which may result in a high incidence[18-19]. Analysis using simultaneous automated repetitive measures practices showed a lesser frequency of differences in blood pressure between the arm than with sequential measurements[20]. In this study, the SBP differences between the arms was associated significantly with a positive hypertension family history[21]. It is exhibited that persons with a positive hypertension family history are more disposed to differences in BP between arms. An earlier study showed that people with positive hypertension family history had a SBP greater than 10 mmHg, correlating with the outcomes by Igarashi et al who found that IAD in BP is frequently noted in subjects with suggested peripheral and coronary arterial disease[22-23]. Therefore, the pressure difference between the arms can be considered a simple marker of peripheral and coronary arterial diseases. A Lane et al study found no association between the IAD and the incidence of history of cardiovascular disease, diabetes and hypertension[24].

CONCLUSION

Among healthy young adult, there is a substantial interarm difference of SBP and it is positively related with family history of age and hypertension. The existence of noteworthy interarm differences of SBP suggests that blood pressure must be measured in right and left arms at the first visit, even in young healthy adults.

REFERENCES

1. Son JS, Choi S, Kim K, Kim SM, Choi D, Lee G, Jeong SM, Park SY, Kim YY, Yun JM, Park SM. Association of blood pressure classification in Korean young adults according to the 2017 American College of Cardiology/American Heart Association guidelines with subsequent cardiovascular disease events. Jama. 2018 Nov 6;320(17):1783-92.
2. Zhang Y, Vittinghoff E, Pletcher MJ, Allen NB, Zeki Al Hazzouri A, Yaffe K, Balte PP, Alonso A, Newman AB, Ives DG, Rana JS. Associations of blood pressure and cholesterol levels during young adulthood with later cardiovascular events. Journal of the American college of cardiology. 2019 Jul 23;74(3):330-41.
3. Neupane D, McLachlan CS, Mishra SR, Olsen MH, Perry HB, Karki A, Kallestrup P. Effectiveness of a lifestyle intervention led by female community health volunteers versus usual care in blood pressure reduction (COBIN): an open-label, cluster-randomised trial. The Lancet Global Health. 2018 Jan 1;6(1):e66-73.
4. Noubiap JJ, Essouma M, Bigna JJ, Jingi AM, Aminde LN, Nansseu JR. Prevalence of elevated blood pressure in children and adolescents in Africa: a systematic review and meta-analysis. The Lancet Public Health. 2017 Aug 1;2(8):e375-86.
5. Zhang Y, Moran AE. Trends in the prevalence, awareness, treatment, and control of hypertension among young adults in the United States, 1999 to 2014. Hypertension. 2017 Oct;70(4):736-42.
6. Meng K, Chen J, Li X, Wu Y, Fan W, Zhou Z, He Q, Wang X, Fan X, Zhang Y, Yang J. Flexible weaving constructed self-powered pressure sensor enabling continuous diagnosis of cardiovascular disease and measurement of cuffless blood pressure. Advanced Functional Materials. 2019 Feb;29(5):1806388.
7. McManus RJ, Mant J, Franssen M, Nickless A, Schwartz C, Hodgkinson J, Bradburn P, Farmer A, Grant S, Greenfield SM, Heneghan C. Efficacy of self-monitored blood pressure, with or without telemonitoring, for titration of antihypertensive medication (TASMINH4): an unmasked randomised controlled trial. The Lancet. 2018 Mar 10;391(10124):949-59.
8. Kallioinen N, Hill A, Horswill MS, Ward HE, Watson MO. Sources of inaccuracy in the measurement of adult patients' resting blood pressure in clinical settings: a systematic review. Journal of hypertension. 2017 Mar;35(3):421.
9. Kenny GP, Poirier MP, Metsios GS, Boulay P, Dervis S, Friesen BJ, Malcolm J, Sigal RJ, Seely AJ, Flouris AD. Hyperthermia and

cardiovascular strain during an extreme heat exposure in young versus older adults. Temperature. 2017 Mar 31;4(1):79-88.
10. Ji H, Kim A, Ebinger JE, Niiranen TJ, Claggett BL, Merz CN, Cheng S. Sex differences in blood pressure trajectories over the life course. JAMA cardiology. 2020 Mar 1;5(3):255-62.
11. Nolan PB, Carrick-Ranson G, Stinear JW, Reading SA, Dalleck LC. Prevalence of metabolic syndrome and metabolic syndrome components in young adults: A pooled analysis. Preventive medicine reports. 2017 Sep 1;7:211-5.
12. Douma LG, Gumz ML. Circadian clock-mediated regulation of blood pressure. Free radical biology and medicine. 2018 May 1;119:108-14.
13. Bello NA, JAEGER B, BOOTH III JN, Abdalla M, Anstey DE, Pugliese DN, Lewis CE, Gidding SS, Lloyd-Jones D, SCHWARTZ JE, SHIKANY JM. Associations of Awake and Asleep Blood Pressure and Blood Pressure Dipping with Abnormalities of Cardiac Structure: The Coronary Artery Risk Development in Young Adults (CARDIA) Study. Journal of hypertension. 2020 Jan;38(1):102.
14. Zhou B, Bentham J, Di Cesare M, Bixby H, Danaei G, Cowan MJ, Paciorek CJ, Singh G, Hajifathalian K, Bennett JE, Taddei C. Worldwide trends in blood pressure from 1975 to 2015: a pooled analysis of 1479 population-based measurement studies with 19· 1 million participants. The Lancet. 2017 Jan 7;389(10064):37-55.
15. Tarumi T, Zhang R. Cerebral blood flow in normal aging adults: cardiovascular determinants, clinical implications, and aerobic fitness. Journal of neurochemistry. 2018 Mar;144(5):595-608.
16. Lin H, Guo Y, Zheng Y, Di Q, Liu T, Xiao J, Li X, Zeng W, Cummings-Vaughn LA, Howard SW, Vaughn MG. Long-term effects of ambient PM2. 5 on hypertension and blood pressure and attributable risk among older Chinese adults. Hypertension. 2017 May;69(5):806-12.
17. Jackson SL, Cogswell ME, Zhao L, Terry AL, Wang CY, Wright J, Coleman King SM, Bowman B, Chen TC, Merritt R, Loria CM. Association between urinary sodium and potassium excretion and blood pressure among adults in the United States: National Health and Nutrition Examination Survey, 2014. Circulation. 2018 Jan 16;137(3):237-46.
18. Choi HM, Kim HC, Kang DR. Sex differences in hypertension prevalence and control: analysis of the 2010-2014 Korea National Health and Nutrition Examination Survey. PLoS One. 2017 May 25;12(5):e0178334.
19. Jordan J, Kurschat C, Reuter H. Arterial hypertension: diagnosis and treatment. Deutsches Ärzteblatt International. 2018 Aug;115(33-34):557.
20. Alsnes IV, Vatten LJ, Fraser A, Bjørngaard JH, Rich-Edwards J, Romundstad PR, Åsvold BO. Hypertension in pregnancy and offspring cardiovascular risk in young adulthood: prospective and sibling studies in the HUNT Study (Nord-Trøndelag Health Study) in Norway. Hypertension. 2017 Apr;69(4):591-8.
21. Dias AR, de Souza KA, Dos Santos KM, Tricot GK, de Araújo JA, Cambri LT, Arsa G. Higher blood pressure and lower cardiac vagal activity in obese young individuals in supine and seated position. Journal of Clinical and Translational Research. 2018 Jan 1;3(3):328.
22. Huang L, Trieu K, Yoshimura S, Neal B, Woodward M, Campbell NR, Li Q, Lackland DT, Leung AA, Anderson CA, MacGregor GA. Effect of dose and duration of reduction in dietary sodium on blood pressure levels: systematic review and meta-analysis of randomised trials. bmj. 2020 Feb 25;368.
23. Ashton RE, Tew GA, Aning JJ, Gilbert SE, Lewis L, Saxton JM. Effects of short-term, medium-term and long-term resistance exercise training on cardiometabolic health outcomes in adults: systematic review with meta-analysis. British journal of sports medicine. 2020 Mar 1;54(6):341-8.
24. He J, Irazola V, Mills KT, Poggio R, Beratarrechea A, Dolan J, Chen CS, Gibbons L, Krousel-Wood M, Bazzano LA, Nejamis A. Effect of a community health worker–led multicomponent intervention on blood pressure control in low-income patients in Argentina: a randomized clinical trial. Jama. 2017 Sep 19;318(11):1016-25.