

Inter-arm Blood Pressure Difference as an Emergent Risk for Pre-hypertension

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ABSTRACT

Objective: This study was aimed to determine the frequency of pre-hypertension and hypertension along with its association with inter-arm difference of blood pressure.

Methodology: It was a cross sectional study conducted at Aziz Fatimah Medical and Dental College Faisalabad. Students of age ranged 19-21 years were enrolled by convenience sampling technique for screening of pre-hypertension and hypertension. Blood pressure was recorded from both arms by using sphygmomanometer and inter-arm differences were estimated. Mean±SD for continuous variables, frequency and percentages for categorical variables and chi square for association between pre-hypertension, hypertension and inter-arm difference was analyzed by SPSS 21.

Results: Study comprised of 100 students with mean age 19.79±1.18 years. Of total 47% were females and 53% was male population. Mean systolic (p value =0.0002*) and diastolic (p value =0.000*) blood pressure of the two arms were significantly different. Of total population, 27% and 13% of population had pre-hypertension and hypertension respectively. Mean systolic inter-arm difference was significantly higher among the hypertensive subjects as compared to pre-hypertensive subjects, (p value =0.0001*). No significant difference was noted with respect to diastolic inter-arm difference (p value =0.93). Greater percentage of normotensive subjects have systolic inter-arm difference <10mmHg as compared to this most of the subjects with hypertension and pre-hypertension have systolic inter-arm difference of >15mmHg. Significant association between hypertension and systolic inter-arm difference was noted (p value =0.025)

Conclusion: Pre-hypertension and hypertension is prevalent among young adults. High systolic inter-arm difference was significantly associated with pre-hypertension and hypertension.

KEYWORDS: Diastolic blood pressure, Hypertension, Inter-arm differences, Pre-hypertension.

INTRODUCTION

Burden of the pre-hypertension on health care system has consistently increased globally especially in developing countries. It is one of the key precursors for developing hypertension in young adults and subsequent cardiovascular disorders in later life.¹ Prevalence of pre-hypertension and hypertension in Pakistan is reported as 55% and 18.9% respectively which is increasing at an alarming rate due to sedentary life styles, diet high in calories, low in fruits and

vegetables.² Hypertension has been considered as a silent killer and attributed to life threatening complications.³ Pre-hypertension and subsequent hypertension is an independent risk factor for ischemic stroke, left ventricular hypertrophy and other cardiovascular events.⁴ Most of the young adults remain undiagnosed and progress to severe consequences. Early detection and management of hypertension are thus of extreme importance to reduce the rate of mortality and morbidity.⁵ It is evident that by identifying the pre-hypertensive and hypertensive subjects earlier can reduce the chances of progression to severe cardiovascular disorders by modifying life style.

Early treatment with antihypertensive medications can achieve better control in young adults within a shorter period as compared to older adults.⁵ Inter-arm difference (IAD) of blood pressure has received increasing attention after finding its association with peripheral vascular disease and increasing cardiovascular morbidity.⁶ Previous recent studies have reported that inter-arm systolic difference of

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>10mmHg predisposes to vascular diseases with reduced survival rate.⁶ The revised clinical guideline from the National Institute of Health and clinical Excellence (NICE) considers an inter-arm difference of <10mmHg systolic to be normal and a difference of >15mmHg to be associated with vascular diseases.⁷ Due to the increasing prevalence of hypertension in young population, it is to be recommended by NICE to estimate blood pressure bilaterally as routine part of hypertension assessment in primary care, which reduces the risk of misdiagnosis of hypertension.⁷ Systolic IAD can be useful in early screening of hypertension and cardiovascular diseases. The progression of pre-hypertension to hypertension can be avoided by healthy life style and dietary modifications⁴. This study was aimed to determine the frequency of pre-hypertension and hypertension along with its association with inter-arm difference of blood pressure.

METHODOLOGY

This was cross-sectional study, conducted at Aziz Fatimah Medical and Dental College Faisalabad during June to September 2019. Study population comprised of 100 medical students of age ranged 19-21 years. Ethical approval from the institutional ethical committee (IEC) was obtained prior the study. Medical students of 1st-2nd year MBBS were screened for pre-hypertension and hypertension selected by convenient sampling technique. Subjects with known history of cardiovascular diseases were excluded from the study. Informed consent was taken from each participant and confidentiality was assured. Height in meters and weight in kilograms were recorded by stadiometer. (ZT- 160) BMI was estimated by Quetelet’s index: BMI =weight in kg/ height in m².⁸ Subjects were allowed to relax for 5 minutes and then the recording of blood pressure was carried out in a comfortable environment.

Blood pressure was assessed simultaneously in both arms. Three readings were taken with 1 minute interval by using sphygmomanometer with appropriate sized cuff, with subject arm supported at heart level as recommended by American Heart Association (AHA).⁹ Average of three readings was recorded for estimation of IAD. Prior the recording of blood pressure, zero error of the apparatus was checked. Systolic blood pressure was noted with the onset of clear Korotkoff sounds and with the disappearance of these sounds, diastolic blood pressure was recorded.

Mercury level of the sphygmomanometer was observed in a direct line to avoid parallax error.⁹ Inter-arm difference of systolic and diastolic blood pressure

was calculated for further statistical analysis. All participants were categorized into three groups on the basis of their blood pressures i.e. normotensive, pre-hypertensive and hypertensive subjects.

As per Joint National Committee guidelines (JNC guidelines): Blood pressure <90/60 mmHg is considered low, blood pressure ranging 91/61 - 120/80 mmHg is normal. Blood pressure ranging 121/81 - 139/89 mmHg is labeled as pre-hypertension and ≥140 mmHg systolic or ≥90 mmHg diastolic blood pressure is labeled as hypertension.³

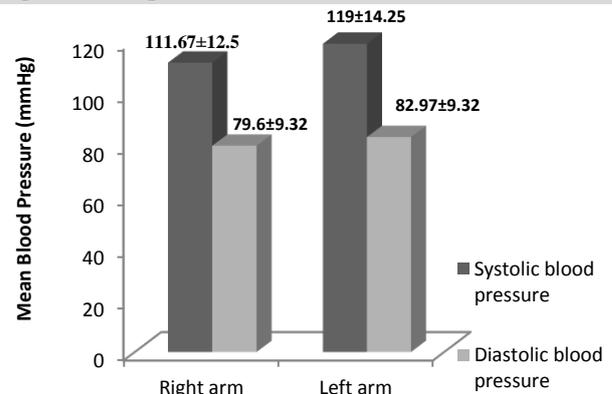
Inter-arm difference of blood pressure was categorized into <10 mmHg, 10-15 mmHg and >15 mmHg for analysis purpose. According to NICE systolic IAD blood pressure <10 mmHg is considered normal, >15mmHg of systolic IAD blood pressure are risk for cardiovascular disorders and peripheral vascular diseases.⁷

Statistical Analysis of data was done on SPSS 21. Continuous variables including systolic, diastolic blood pressures and IAD are presented as means±SD. Mean blood pressures between right and left arms were compared by paired student t-test. Mean IAD blood pressures among the normotensive, pre-hypertensive and hypertensive subjects were compared by ANOVA. Data is expressed as percentages for categorical variables like hypertension and pre-hypertension and various categories of systolic IAD. Chi-square (X²) test was used to evaluate association of hypertension and IAD.

RESULTS

Hundred medical students of both genders were screened for pre-hypertension and hypertension.

Figure 1: Comparison of Blood Pressure between Arms (n=100)



p value ≤0.05 is considered as significant, Systolic blood pressure p value = 0.0002* & Diastolic blood pressure p value =0.000*

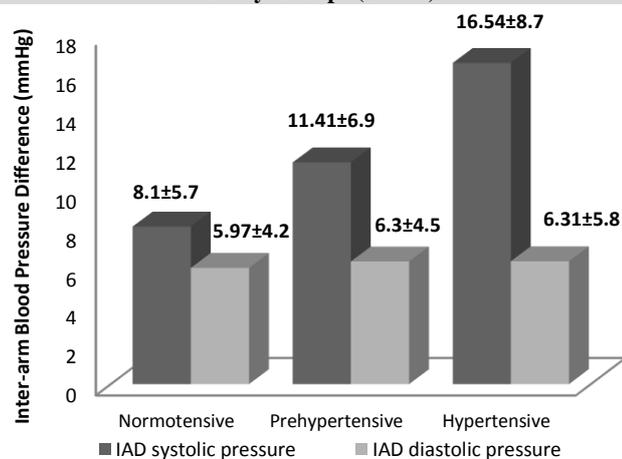
Mean±SD of age of the participant was 19.79±1.18 years. Mean age, height in meters, weight in kg and BMI were 19.79±1.18, 1.70±0.08, 68.35±15.14 and

DISCUSSION

23.44±3.71. Significant differences were observed in systolic (p value =0.0002*) and diastolic (p value =0.000*) blood pressure of the two arms, Figure 1.

Of total population, 60%, 27% and 13% were normotensive, pre-hypertensive and hypertensive subjects respectively. Mean systolic IAD was significantly higher among the hypertensive subjects followed by pre-hypertensive as compared to normotensive subjects (p value =0.0001*). No significant difference was noted with respect to diastolic IAD (p value =0.93), Figure 2.

Figure 2: Inter-arm Blood Pressure Difference among the Study Groups (n=100)



IAD, Inter arm difference, p value ≤0.05 is considered as significant. IAD systolic blood pressure, p value =0.0001*, IAD diastolic blood pressure, p value =0.93

As we found the significant difference only in systolic IAD among the three study groups, we analyzed its categories and we noted that greater percentage of normotensive subjects have systolic IAD <10mmHg as compared to this most of the subjects with hypertension and pre-hypertension have systolic IAD >15mmHg. Chi-square shows that there is a significant association between hypertension and systolic IAD, (p value =0.025*) Table-1.

Table 1: Inter-arm Systolic Difference (n=100)

Clinical Variables	Inter-arm Difference			p value
	<10 mmHg n (%)	10-15 mmHg n (%)	>15 mmHg n (%)	
Pre-hypertension (n=27)	19 (70.4%)	2 (7.4%)	6 (22.2%)	0.025*
Hypertension (n= 13)	7 (53.8%)	1 (7.7%)	5 (38.5%)	
Normotensive (n=60)	54 (90%)	1 (1.7%)	5 (8.3%)	

Association was analyzed by X² test. p value ≤0.05 is considered as significant.

Present study highlights the significance of inter-arm difference in blood pressure and its association with hypertension. Pre-hypertension and hypertension in young age group is an emerging common health issue worldwide.¹ Its prevalence is continuously raising due to adoption of sedentary and unhealthy life style and increasing trends towards obesity in youngsters.² Huge burden on health care system due to increased prevalence of hypertension and its consequences require serious consideration.⁹

There is need of early screening and identification of youngsters at high risk of pre-hypertension and hypertension to adopt proper possible preventive measures and management to prevent its detrimental consequences.⁹ Evidences are available showing that subjects having systolic IAD blood pressure greater than 15mmHg possess high risk for hypertension and subsequent cardiovascular diseases. The current study highlights the recent recommendations by NICE that blood pressure should be measured in both arms to avoid the misdiagnosis of hypertension.⁷

This study was designed to screen the pre-hypertension and hypertension among the young adults and to elucidate its association with IAD of blood pressure. We found that 27% and 13% of total study participants had pre-hypertension and hypertension respectively. Previous study conducted in Faisalabad is in agreement with current results as they found pre-hypertension in similar age group and reported that the 48% of obese youngsters in their study had pre-hypertension.⁹ Another study conducted in Lahore had reported pre-hypertension in 55% of young adults.¹⁰ Study conducted in six coastal villages of India by Kini S and his colleagues also supported present results and documented 45.2% of young subjects with pre-hypertension in their study.¹¹ Our results are also consistent with study conducted in Saudi Arabia that reported 14.6% and 29.2% prevalence of hypertension and pre-hypertension among the age group 15-24.⁵

Current study found significantly higher systolic IAD in hypertensive subjects followed by pre-hypertensive in contrast to subjects with normal blood pressure (p value =0.01*). This is confirmed by Sharma B and his colleague, who reported significant higher mean systolic inter-arm blood pressure difference among patients with cardiovascular diseases in contrast to normal subjects.¹² Present study did not find significantly higher diastolic IAD in hypertensive as compared to subjects with normal blood pressure (p value= 0.93). On contrary to this, Mehlsen J study had reported the significant increase in systolic as well as

diastolic inter-arm difference in hypertensive subjects.¹³ A report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines also supports the current study as they documented the association of higher systolic blood pressure with cardiovascular diseases independently of diastolic blood pressure. On contrary to this diastolic blood pressure has not been associated with cardiovascular disorders after adjustment for systolic blood pressure.¹⁴ Current study found that 90% subjects with normal blood pressure had ≤ 10 mmHg systolic IAD, in contrast to this only 70% and 53% of pre-hypertensive and hypertensive subjects had ≤ 10 mmHg IAD. We also found that 38.5% and 22.2 % of hypertensive and pre-hypertensive subjects have >15 mmHg of IAD systolic blood pressure as compared to this only 8.3% of normotensive were fell in this category. The current findings may be justified with the report of Canepa et al who documented that systolic IAD >10 mmHg could result in increased arterial stiffness which leads to development of hypertension and cardiovascular disorders.¹⁵ The similar findings were observed in the study of Kim and his colleagues.⁴ Present study also found significant association between raised systolic IAD and hypertension, this is supported by Su HM et al, who also documented association of systolic IAD >10 mmHg with hypertension and obesity.¹⁶ Future studies on a larger scale are required for early screening of young adults at risk of hypertension and to evaluate association between inter-arm blood pressure difference and hypertension. This study emphasizes the need for continuous efforts in early screening, prevention and control of hypertension in young population.

Limitations: Small sample size is the limitation of the study which may not represent the whole population. We cannot establish the causal association in this study due to its cross section design.

CONCLUSION

Pre-hypertension and hypertension is prevalent among young adults and are significantly associated with increase in systolic inter-arm difference.

Recommendation: Screening of pre-hypertension and hypertension should be arranged in colleges and universities at national level to identify the young students having this ailment. Bilateral blood pressure should be measured during the routine medical checkups for early detection of subjects at risk of hypertension.

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Conflicts of Interest: None.

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Author's Contribution:

Dr. Javaria Manzoor	Study design and data collection, manuscript writing, formulation of tables and graphs and approval.
Dr. Rooha Tariq	Data collection, manuscript writing and approval. Accountable for the integrity of the data.
Dr. Muhammad Absar Alam	Data analysis and interpretation, article review and approval.