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Cross-sectional study of the prevalence of inter-arm blood pressure difference in offspring of normotensive and hypertensive parents among students of tertiary care teaching hospital, Hyderabad

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ABSTRACT

Background: Hypertension (HTN) incidence and progression are monitored by regular blood pressure (BP) measurement; one of the most ignored components of regular check-up is the measurement of inter-arm difference (IAD) in BP. **Aims and Objectives:** The objective of this study was to estimate the prevalence of IAD in BP among offspring of hypertensive parents compared to normotensive parents. **Materials and Methods:** This cross-sectional study was conducted on 100 male students at Osmania Medical College, Hyderabad, Telangana for a period of 6 months. After IEC clearance, the subjects were divided into two groups, 50 students in each group: Group I had offspring with hypertensive parents and Group II had offspring with normotensive parents. Age, height, weight, and body mass index (BMI) were recorded. IAD was calculated as the difference between BP (Systolic BP [SBP] and diastolic BP [DBP]) in the right arm and left arm. Subjects with a history of structural, functional cardiovascular disease disorders, endocrine disorders, Diabetes mellitus, and addictions such as smoking and alcohol were excluded from the study. Data were statistically analyzed using Microsoft Excel software. **Results:** Among 100 subjects, Group I and II IAD in SBP was 8.68 ± 6.02 and 5.00 ± 3.24 ($P < 0.0002$), respectively, and Group I and II IAD in DBP was 5.12 ± 4.48 4.79 ± 3.56 ($P < 0.7117$), respectively. BMI of the two groups is almost within the similar range (23.44 ± 4.04, 22.098 ± 3.15, respectively) and not statistically significant ($P = 0.0694$), a positive correlation of 0.12, 011 was found between BMI, systolic IAD,and diastolic IAD, respectively. **Conclusion:** The above results show a significant association between IAD in systolic BP and family history of HTN.

Key words: Atherosclerosis; Blood pressure; Cross-sectional studies; Hypertension; Male; Peripheral vascular diseases

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INTRODUCTION

One well-known risk factor for the development of hypertension (HTN), which can lead to deadly cardiovascular consequences including acute myocardial infarction or stroke, is atherosclerosis.[1] Worldwide; HTN affects more than 1.1 billion individuals. The number of individuals with HTN worldwide has been rising over time, and by 2025, 1.56 billion people are expected to have the condition.[2] New blood pressure (BP) categories are: (1) normal (<120 systolic and <80 mmHg diastolic), (2) elevated (120–129 systolic and <80 mmHg diastolic), (3) stage 1 HTN (130–139 systolic or 80–89 mmHg diastolic), and stage 2 HTN (≥140 systolic or ≥90 mmHg diastolic).[3] Measurement of the inter-arm difference (IAD) in BP is one of the most neglected aspects of routine BP

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checks, which are used to track the condition's occurrence and evolution. There are several ways to detect and monitor high BP. A physical examination finding that can be easily seen is IAD in BP.[4] It is critical to detect patients with it, which not only acts as a precursor to future vascular disorders but also prevents missed diagnoses and can take preventative measures such as limiting salt intake, exercising regularly, and consuming less oil.

IAD in BP of 10 mmHg or greater is considered as increased IAD in BP.[4] Significantly large IAD is considered as a marker for the diagnosis of peripheral artery diseases and is expected to be related with HTN and other cardiovascular risks. Like a lowered ankle-brachial pressure index and ambulatory BP monitoring, understanding the existence and implications of an IAD is unquestionably essential for an accurate diagnosis and prognosis of HTN.[5]

Although the etiology of essential HTN is unknown, both genetic and environmental factors play important roles in the pathophysiologic mechanisms in modern societies.[6] It is established that offspring of HTN patients are at risk. There is strong evidence of early cardiac morphologic changes (greater left ventricular wall thickness and mass) and altered peripheral vascular capacity and responsivity to pressor stimuli among normotensive individuals with a positive family history.[7] Independent of body mass index (BMI), the association of HTN prevalence among positive family history was double the value of that found in persons with a negative family history. Henceforth, Teenagers with hypertensive 1st-degree relatives constitute a special risk group that should be closely monitored.[8] Medical graduates are the future of our countries health care system therefore screening them would be an important tool to assess the prevalence of cardiovascular risk among them advice lifestyle modification accordingly.

It is a well-established fact that the development of BP has a genetic propensity.[9,20] There are several mechanisms proposed to explain the relation between HTN and a positive family history of HTN, including increased renal sodium reabsorption, low urinary kallikrein excretion, elevated uric acid level, high fasting plasma insulin concentrations, high-density low-density lipoprotein sub-fractions, fat pattern index, and oxidative stress, as well as shared environmental factors such as high sodium intake.[10,21] Normotensive individuals with a positive family history have strong evidence of early cardiac morphologic changes (greater left ventricular wall thickness and mass) and altered peripheral vascular capacity and responsivity to pressor stimuli.[9-13] IAD in BP aids in the identification, monitoring, and better prognosis of HTN at an earlier stage.[14,22]

Several studies have been done for screening HTN among the asymptomatic population in India with various methods, and there are very few studies done in India to evaluate the association of family history of HTN with raised IAD of BP. This study focuses on quite accessible method that is IAD for screening the offspring of hypertensive parents.

Aims and objectives

Aim

The aim of this study was to estimate the prevalence of IAD in BP in offspring of hypertensive parents compared to normotensive parents.

Objectives

The objectives of the study are as follows:

1. To record arterial BP (Systolic BP [SBP], diastolic BP [DBP]) in both right and left arms in: Group I – offspring of hypertensive parents and Group II – offspring of normotensive parents.
2. To compare and correlate the prevalence of
   a. Systolic IAD (SIAD) between right arm systolic BP (RSBP) and left arm systolic BP (LSBP)
   b. Diastolic IAD (DIAD) between right arm diastolic BP (RDBP) and left arm diastolic BP (LDBP) in Groups I and II.

MATERIALS AND METHODS

After Ethics committee clearance, in this cross-sectional comparative study medical students at Osmania Medical College, Hyderabad were included in the study, beginning in October 2021 until March 2022 for a period of 6 months. Another inclusion criterion for the study population was a family history of HTN in either of the parent's students with a history of alcohol, smoking, any medication, obesity, any structural, functional cardiovascular disease (CVS) disorders, endocrine disorders, diabetes mellitus, and any other chronic illness was excluded from the study. Female students to overlook hormonal influences were excluded from the study.

Wilfully enrolled 100 students in this study were divided into two groups, 50 students in each group: Group I with hypertensive parents and Group II with normotensive parents. Age, height, weight, and BMI were recorded using a stadiometer.

BP measurement was done in a quiet room with the subject in the sitting position after at least 5 min of rest during the afternoon. Arterial BP (SBP and DBP) measured by tying cuff to arm at the level of the heart, in both sides simultaneously using an automatic sphygmomanometer (Omron HEM7124 model), whilst using conventional devices values have to be recorded sequentially.[22,23]

Henceforth, the Inter-arm BP difference was measured at the same instant using automated machines.

Weinberg et al., classified the inter-arm BP difference characteristic as follows: <5 mmHg as normal, 5–10 mmHg as low risk, 10–15 mmHg as moderate risk, and >15 mmHg as high risk for any vascular event.[4] The same has been used for classifying the inter-arm BP difference in this study.

Statistical analysis

Data was statistically analyzed using Microsoft Excel software. The prevalence of IAD in BP was calculated using percentages and categorized into interval scale of IAD as 0–5, 5–10, 10–15, and 15–20 mm of Hg. Chi-square test and unpaired t-test were used to find the significance between mean values of IAD in BPs between two groups. The BMI of the two groups is almost within the similar range and not statistically significant. For all statistical analyses, the significance level was set at P<0.05.

RESULTS

Students in Group I (with Hypertensive parents) had a significant raise in SIAD in BP in comparison to Group II (with normotensive parents) (P<0.0002). The prevalence SIAD more than 10 mmHg is greater in Group I compared to Group II. In Table 1, demographic and study parameters are presented along with mean and P-values, whereas in Tables 2 and 3 show the distribution of SIAD and DIAD, respectively. Table 4 depicts the correlation between BMI and SIAD, and DIAD, respectively. The distribution of data among DIAD and SIAD, they were divided using an interval scale of measurement of with a difference of 5 mmHg between each interval, The tools that were used were chosen after a lot of research and studies about the differences in inter-arm BP in young, healthy people.[26]

Table 1: Study parameters – mean and P-values

Parameters	Group I (n=50)	Group II (n=50)	P-value
Age (in years)	19.63±1.96	19.64±1.31	0.9524
Height (cm)	171.76±5.44	168.16±6.06	0.1171
Weight (kg)	69.26±12.61	64.88±9.36	0.0603
BMI	23.44±4.04	22.098±3.15	0.0694
RSBP mm of Hg	124.42±11.44	124.694±9.81	0.8990
LSBP mm of Hg	121.92±12.79	122.612±9.86	0.7599
SIAD mm of Hg	8.68±6.02	5.00±3.24	0.0002
RDBP mm of Hg	78.9±8.92	76.3673±7.57	0.1501
LDBP mm of Hg	77.38±8.34	76.48±8.23	0.5818
DIAD mm of Hg	5.12±4.48	4.79±3.56	0.7117

RSBP: Right systolic blood pressure, LSBP: Left systolic blood pressure, SIAD: Systolic inter-arm difference, RDBP: Right diastolic blood pressure, DIAD: Diastolic inter-arm difference, P<0.05 considered significant student t-test. All parameters are statistically not significant except for SIAD

Table 2: Distribution of SIAD in Group I and Group II

SIAD	Group I (n=50) (%)	Group II (n=50) (%)
0–5	34 (17)	56 (28)
5–10	22 (11)	36 (18)
10–15	34 (17)	6 (3)
15–20	10 (5)	2 (1)

P=0.0076 (Chi-square test), SIAD: Systolic inter-arm difference using an ordinal scale of difference of 5 mmHg between each interval

Table 3: Distribution of DIAD in Group I and Group II

DIAD	Group I (n=50) (%)	Group II (n=50) (%)
0-5	66 (33)	58 (29)
5-10	24 (12)	36 (18)
10-15	4 (2)	4 (2)
15-20	6 (3)	2 (1)

P=0.48 (Chi-square test), DIAD: Diastolic inter-arm difference

DISCUSSION

When comparing students in Group I (parents with HTN) to Group II (parents with normotension), there was a significant increase in SIAD in BP (P<0.0002). Group I had a higher distribution of SIAD >10 mmHg than Group II. In The two groups, other parameters such as LSBP, RSBP, LDBP, RDBP, DIAD, and BMIs are nearly comparable and do not significantly differ from one another (P=0.0694).

In the present study, prevalence of SIAD ≥10 is higher in Group I (66%) compared to Group II (44%). Hence in this study raised IAD in BP shows a statistically significant association with a Family History of HTN which is in accordance with the study done by Kurian et al.,[18] and Methre et al.[20]

On the other hand, the DIAD is higher among children of hypertensive parents when compared to children of normotensive parents and was found to have no statistical difference (P=0.7), as was in cross-sectional study done by Methre et al.,[20] among the 300 healthy individuals.

The latest American Heart Association defined Isolated systolic HTN defined as elevated SBP (≥140 mmHg) and low DBP (<90 mmHg) is common in young and in elderly people. In young individuals, including children, adolescents, and young adults, isolated systolic HTN is the most common form of essential HTN. However, it is also particularly common in the elderly, in whom it reflects stiffening of the large arteries.[24]

Clark et al., in their metal analysis, have pointed out independent associations between elevated SIADs in BP and Cardiovascular events.[25]

Table 4: Correlation between BMI, SIAD, and DIAD

Parameters	BMI	DIAD	SIAD
BMI	1		
DIAD	0.116327	1	
SIAD	0.125141	0.201659	1

*SIAD: Systolic inter-arm difference, BMI: Body mass index, correlation factor – r=0.12, *DIAD: diastolic inter-arm difference, correlation factor – r=0.11

On investigating BMI with IAD, it was found that there is a positive correlation with both SIAD (r=0.12) and DIAD (r=0.11) which is also conferred by the study done by Kurian et al.,[18] and Methre et al.[20]

An IAD more than 10 mmHg is a significant indicator of increased arterial stiffness, which is associated with the progression of BP increase and an increase in the incidence of HTN. Moreover, an increase in arterial stiffness is associated with increased cardiovascular morbidity and mortality.[13,15]

According to Igarashi et al., Inter-arm BP difference is not necessarily related only to anatomical right and left vascular circulation but could also be linked to the random presence of stenotic lesions due to atherosclerosis and was strongly associated with peripheral artery disease and the results also showed that the extent and severity of myocardial ischemia increases with higher inter-arm BP difference.[16]

Canepa et al., demonstrated that carotid-femoral pulse wave velocity a measure of arterial stiffness, was higher in individuals with inter-arm BP ≥10 mmHg and therefore concluded that significant IAD in SBP is associated with increased arterial stiffness that imposes an increased burden on small resistance vessels with the resultant increase in myogenic activity and remodeling and an increase in peripheral vascular resistance.[17] Kim et al., reported that there is a relationship between increased SIAD and the risk or comorbidity of CVS and cerebrovascular disease.[19]

The pathophysiologic processes of essential HTN in contemporary civilizations are influenced by both hereditary and environmental variables, even though the exact cause of the condition is unclear.[6] It is known that children of people with HTN are at danger. Among normotensive people with a favorable family history, there is compelling evidence of early cardiac morphologic alterations (increased mass and thickness of the left ventricle), as well as impaired peripheral vascular function and responsiveness to pressor stimuli.[7] Our study also concluded that the prevalence of IAD is more among children of a family history of HTN.

If IAD is not identified, HTN is underdiagnosed. A little BP underestimate might miss a significant clinical diagnosis. If the same hand is not used in clinical studies for BP monitoring, there may be more variances, which might lower the study's power. Our research exposed the drawbacks of using a single arm to measure BP. It demonstrated the importance of IAD as well. In addition to being a diagnostic tool, IAD may also be used to forecast risk factors for extracranial and intracranial artery disease. It can be applied as a clinical indicator for embolism, thrombosis, atherosclerosis, and stenosis. This study suggests that during standard clinical practice, BP should be measured in both arms. It also recommends that medical and paramedical personnel be involved in raising awareness about IAD. In addition, our study recommends routine BP monitoring for all family members with a positive family history, as well as lifestyle change and the preservation of the follow-up record for future use.

Limitations of the study

The limitations of this study are as follows it was done only students of medical college as it was a time-bound study and it does not include female subjects. Another confounding factor in this study was BMI. Comparable research with a larger community sample size might offer superior external validity to ours.

CONCLUSION

From the present study, it is concluded that there is a significant association between IAD in SBP and family history of HTN, indicating chances of development of cardiovascular and peripheral vascular diseases in the future. Therefore, it is suggested that during the initial assessment BP should be measure simultaneously in both the arms. Hence, also, regular screening for HTN in offspring of hypertensive parents may be done, and educating them about the importance of Healthy lifestyle like regular exercise, healthy diet with fruits and vegetables.

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PM- Design of the study, literature review, implementation of the study protocol, data collection, manuscript preparation; **SKA-** Concept, design, data analysis, editing, and manuscript revision; **AROS-** literature review and manuscript preparation; **MM-** Definition of intellectual content, data collection, Manuscript preparation, review manuscript, data interpretation and submission.

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