

Research Article

Inter arm systolic blood pressure difference is associated with a high prevalence of cardio vascular diseases

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ABSTRACT

Background: Blood pressure (BP) recordings often differ between arms. This study is aimed to observe the presence of inter-arm blood pressure difference and association with hypertension or diabetes. The objective of the study was to establish the prevalence of an inter-arm blood pressure difference and explore its association with obesity and cardiovascular disorder.

Methods: A cross-sectional study conducted at King George's Medical College, Lucknow, India among 100 first year MBBS students. After taking verbal consent the age, height, weight, waist circumference, hip circumference and family history of hypertension or diabetes were recorded.

Results: The systolic blood pressure on right arm was 118.8 ± 11.5 mmHg and 117.7 ± 7.72 mmHg left arm. Result significantly showed higher mean systolic blood pressure on right arm. There were 54, 17 and 29 participants with inter-arm systolic blood pressure difference of <5 mmHg, 5 to 10 mmHg and ≥ 10 mmHg, respectively. 10 subjects having BMI range between 25-29.9 and only one subject found obese (BMI >30). Out of 100 subjects, 11 subject having inter-arm systolic blood pressure difference ≥ 10 mmHg was associated with a family history of diabetes or hypertension.

Conclusions: Presence of inter-arm blood pressure difference with having family history of hypertension or diabetes is more susceptible to develop cardiovascular disorder in future.

Keywords: Hypertension, Inter-arm difference, Body mass index, Waist-hip ratio

INTRODUCTION

A difference in blood pressure readings between arms can be observed in various general populations.^{1,2} The importance of measuring blood pressure in both arms is initially to prevent the misdiagnosis of hypertension due to normal differences in blood pressure between the arms. Blood pressure readings in the right and left arms that differ by a few mm of Hg are quite normal but more than 10 mm of Hg could suggest trouble and should be measured in both arm on subsequent visit.³ Studies also reported 10% of the patients had an inter-arm difference of 10 mm/Hg or greater (Fotherby, et al).⁴ Most

recommendations on blood pressure measurements and hypertension have stated that blood pressure should be measured in both arms and that the arm with the highest value should be used for subsequent measurements.⁵⁻⁸

In the event of a significant (>10 mmHg) and consistent SBP difference between arms, the arm with the higher BP values should be used." It has been suggested that differences in right and left arm pressures may be caused by undiagnosed peripheral vascular disease affecting the vasculature of the upper limbs and may therefore predict an increased risk of cardiovascular disease.⁹ In a recent meta-analysis of 20 studies, a systolic blood pressure

difference of more than 15 mm Hg between the right and left arm was associated with a 2.5 greater risk of peripheral vascular disease, a 1.7 fold increase in cardiovascular mortality, and a 1.6 higher risk of all-cause death (Clark et al, 2012). Systolic inter-arm blood pressure difference of more than 15 mmHg is associated with peripheral vascular disease, increased cardiovascular mortality and all cause mortality. It has been suggested that inter-arm blood pressure difference may also be associated with an increased propensity for strokes.

Differences in blood pressure between arms may have a number of causes such as handedness subclavian artery stenosis, aortic aneurism, aortic coarctation, vasculitis, fibromuscular hyperplasia, connective tissue disorders, and thoracic outlet compression. Most common diagnostic entity would be subclinical atherosclerosis as suggested by the increased likelihood of finding an interarm difference in hypertension and peripheral arterial disease.¹⁰

Objective

1. To find out relationship of interarm pressure difference.
2. To find out relationship of anthropometric variables with interarm pressure difference.
3. To find out relationship with interarm pressure difference with family history of diabetes and hypertension.

METHODS

A cross-sectional observational study was designed and carried out in department of Physiology, King George medical college Lucknow, India among first year MBBS student aged 17-24 year. 100 subjects were randomly selected for the study. Prior consent of subjects for clinical details has taken into account. After taking verbal consent and explaining the purpose of the study anthropometric measurement including height, weight, waist circumference, hip circumference and waist-Hip ratio were recorded. Family history of Diabetes, hypertension and other chronic diseases also recorded. Blood pressure of both the arm is recorded in supine position by auscultatory method of BP measurement by mercury sphygmomanometer under standardized protocol after taking 10 min rest to the subject. Measurement has taken in the arm first presented without prompting, and the cuff was then swapped to the other arm and another measurement taken. Relationship between blood pressure and different anthropometric measurement were investigated in linear model.

Data analysis

We entered anonymised data on an excel spread sheet and used SPSS Predictive Analytics Software Statistics v18.0.0 for analysis.

RESULTS

A total of 100 healthy subject with a mean age of 20.5 years (range: 17-24 years) were included. Systolic blood pressure on arms is given in Table 1. Systolic blood pressure on the two arms was 118.8±11.5 mmHg and 117.7±7.72 mmHg on the right and left arm, respectively (Table 1). Result significantly showed higher mean systolic blood pressure on right arm.

Table 1: Association of subjects with blood pressure and inter arm pressure.

Mean Systolic	Rt. Arm	118.8 (SD-11.5)
	Lt. Arm	117.7 (SD-7.72)
Inter Arm Pressure Difference	<5 mm Hg	54 Subjects
	5 - 9 mm Hg	17 Subjects
	≥10 mm Hg	29 Subjects

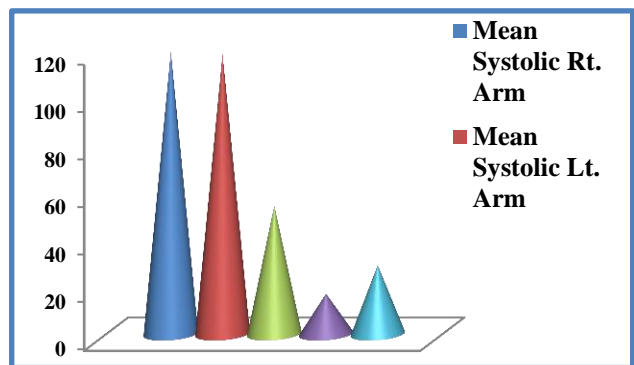


Figure 1: Association of subjects with blood pressure and inter arm pressure.

There were 54, 17 and 29 participants with inter-arm systolic blood pressure difference of <5 mmHg, 5 to 10 mmHg and ≥10 mmHg, respectively (Table 1).

Table 2 showed that majority (89%) of subjects having normal body mass index (BMI). 10 subjects having BMI range between 25-29.9 and only one subject found obese (BMI >30). 46% of subject have waist hip ratio of >0.90 and 54% of subject showed WHR <0.89.

Table 2: Association of subjects with BMI and WHR.

BMI	18.5-24.9	89 Subjects
	25-29.9	10 Subjects
	>30	1 Subject
WHR	<0.89 (No risk)	54 Subjects
	>0.90 (Low risk)	46 Subjects

In total of 100 subject, 11 subject having inter-arm systolic blood pressure difference ≥10 mmHg was associated with a family history of Diabetes or hypertension and rest of subjects having an inter-arm systolic blood pressure difference <9 mmHg. Result

showed significantly increased risk to develop peripheral vascular or coronary event in future (Table 3).

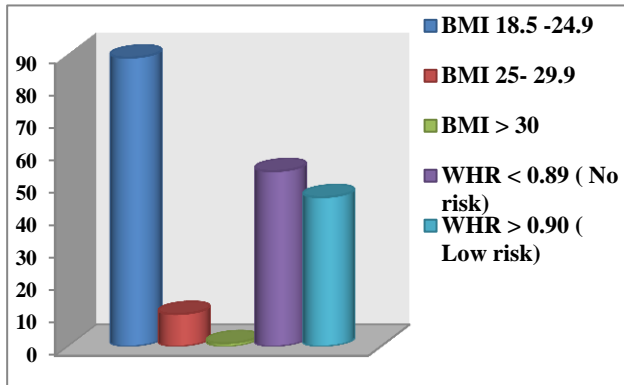


Figure 2: Association of subjects with BMI and WHR.

Table 3: Blood pressure difference according to family history of DM/HTN.

F/H DM/HTN with pressure difference	<9 mm Hg	89 Subjects
	≥10 mm Hg	11 Subjects

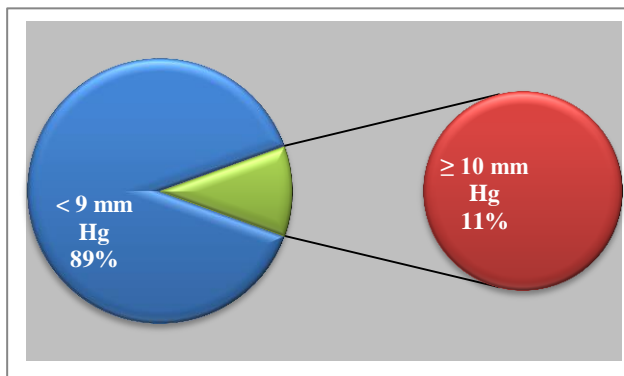


Figure 3: Blood pressure difference according to family history of DM/HTN.

DISCUSSION

The present study showed that systolic blood pressure is slightly higher in the right than in the left arm and that the pressure differs significantly more between the arms in subjects with family history of diabetes or hypertension.¹⁰ Gene RP, et al found no significant differences in systolic or diastolic blood pressure between genders or between right and left handed individuals.¹¹

Recently Gianfanco, et al in his study found that Interarm differences in systolic blood pressure differences are frequently observed in patients with diabetes mellitus and recommends routine measurement of interarm blood pressure differences to improve diagnostic and prognostic stratification of these.¹² But study of Clark C, et al revealed that differences in systolic blood pressure between arms can predict an increased risk of

cardiovascular events and all-cause mortality over 10 years in people with hypertension.¹³ The opposite findings reported by Lane D, et al, stated that the variation in mean inter-arm blood pressure was unrelated to age, sex, ethnicity, arm circumference, handedness, being hypertensive, diabetic, or previous history of cardiovascular disease.¹⁴

The term inter-arm difference was firstly recognized more than 93 years ago and employed by Cyriax EF.¹⁵ Our study is in agreement with two previous studies demonstrating a higher prevalence of interarm differences in hypertensive patients and in patients with known cardiovascular disease.^{16,17} Whereas the study by Lane, et al did not find any relation between interarm difference and the presence of hypertension, diabetes mellitus, or previous cardiovascular disease.¹⁴ The interarm difference was found to be age-dependent by two of the previous studies but not in ours.^{14,17} This dissimilarity could be ascribed to the fact that the previous studies included a larger age range with the youngest being 18 years old, while in our study most of the subjects of young age group.

In our study 11 subjects found inter-arm pressure difference >10 mmHg with having positive family history of hypertension or diabetes. These findings correlated with the findings of Igarashi, et al who observed that inter-arm pressure difference is often found in patients with suspected CAD, and is associated with significant CAD and peripheral artery disease. Thus inter-arm pressure difference may be regarded as a simple marker for coronary and peripheral artery diseases.¹⁸ The opposite findings reported by Lane D, et al, stated that the variation in mean inter-arm blood pressure was unrelated to age, sex, ethnicity, arm circumference, handedness, being hypertensive, diabetic, or previous history of cardiovascular disease.¹⁴

In view of inter arm pressure difference with anthropometry of study subjects, 10 obese (BMI 25-29.9) subjects having inter arm pressure difference greater than 10 mmHg or more correlated the finding of Ho-Ming Su, et al who observed that other factors; hypertension and obesity were also associated with an inter-arm difference in SBP of 10 mm Hg or more.¹⁹ The findings were also strongly supported by Clark CE et al and Clark CE, et al who reported that an inter-arm difference of 10 mm Hg or more in SBP was strongly associated with increased cardiovascular mortality.^{9,13}

CONCLUSION

Our study has shown that the inter-arm blood pressure difference is greater in individual having obesity or having family history of hypertension or diabetes. Such subjects are more susceptible to develop coronary artery disease or peripheral arterial disease in future. So inter-arm difference in blood pressure could be used as an indicator to predict susceptible individual.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Clark CE, Campbell JL, Evans PH, Millward A. Prevalence and clinical implications of the inter-arm blood pressure difference: a systematic review. *J Hum Hypertens*. 2006;20:923-31.
2. Cassidy P, Jones K. A study of inter-arm blood pressure differences in primary care. *J Hum Hypertens*. 2001;15:519-22.
3. NICE Hypertension: Clinical management of primary hypertension in adults CG127. 2011.
4. Fotherby MD, Potter JF. Blood pressure changes after stroke: abolishing the white-coat effect. *Stroke*. 1993;24(9):1422-3.
5. Mancia G, Fagard R, Narkiewicz K. The Task Force for the management of arterial hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC). ESH/ESC Guidelines for the management of arterial hypertension, *Journal of Hypertension*. 2013;31:1281-1357.
6. Guidelines Subcommittee. World Health Organization- International Society of Hypertension Guidelines for the Management of Hypertension, *Journal of Hypertension*. 1999;17:151-83.
7. Pickering TG, Hall JE, Appel LJ. 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. *Circulation*. 2005;111,5:697-716.
8. Williams B, Poulter NR, Brown MJ. Guidelines for management of hypertension: report of the fourth working party of the British Hypertension Society, 2004-BHS IV, *Journal of Human Hypertension*. 2004;18,3:139-85.
9. Clark CE, Campbell JL, Powell RJ, Thompson JF. The inter-arm blood pressure difference and peripheral vascular disease: cross-sectional study. *Fam Pract*. 2007;24(5):420-6.
10. Jesper M, Wiinberg N. Interarm Difference in Blood Pressure: Reproducibility and Association with Peripheral Vascular Disease. *International Journal of Vascular Medicine*. 2014;841542:4.
11. Pesola GR, Pesola HR, Nelson MJ, Richard E. Westfal: The Normal Difference in Bilateral Indirect Blood Pressure Recordings in Normotensive Individuals. *The American Journal of Emergency Medicine*. 2001;19(1):43-5.
12. Gianfranco P, Alberto Z. Diabetes: Measuring interarm blood pressure differences in diabetes. *Nature Reviews Endocrinology*. 2014;10:387-8.
13. Clark CE, Taylor RS, Shore AC, Campbell JL: The difference in blood pressure readings between arms and survival: Primary care cohort study. *BMJ*. 2012;344.
14. Lane D, Beevers M, Barnes N, Bourne J, John A, Malins S, et al: Inter-arm differences in blood pressure: when are they clinically significant? *J Hypertension*. 2002;20(6):1089-95.
15. Cyriax EF: Unilateral alterations in blood-pressure caused by unilateral pathological conditions: the differential blood pressure sign. *Q J Med*. 1920:148-64.
16. Amsterdam B, Amsterdam AL. Disparity in blood pressures in both arms in normals and hypertensives and its clinical significance. *New York State Journal of Medicine*. 1943;43:2294-300.
17. Orme S, Ralph SG, Birchall A, Lawson-Matthew P, McLean K, Channer KS. The normal range for inter-arm differences in blood pressure, Age and Ageing. 1999;28(6):537-542.
18. Igarashi Y, Chikamori T, Tomiyama H, Usui Y. Clinical significance of inter-arm pressure difference and ankle-brachial pressure index in patients with suspected coronary artery disease. *J Cardiol*. 2007;50(5):281-9.
19. Ho-Ming Su, Tsung-Hsien Lin, Po-Chao Hsu, Wen-Hsien Lee: Association of inter arm systolic blood pressure difference with atherosclerosis and left ventricular hypertrophy. *PLoS One*. 2012;7(8).

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