National Journal of Physiology, Pharmacy and Pharmacology

RESEARCH ARTICLE

Interarm blood pressure difference: Magnitude and prevalence in healthy adults

Jiji Inassi, Razeena K C, Jowhara P V

Department of Physiology, Government Medical College, Kozhikode, Kerala, India

Correspondence to: Razeena K C, E-mail: dr.razeena@gmail.com

Received: June 10, 2017; **Accepted:** June 22, 2017

ABSTRACT

Background: Hypertension is one of the major preventable causes of premature morbidity and mortality worldwide. Measurement of blood pressure (BP) is the most common investigation performed in primary care setting to manage the vast majority of hypertensive patients. BP measurement guidelines recommend that BP should be assessed in both arms at the initial visit to prevent misdiagnosis of hypertension. The interarm difference (IAD) in BP has received increasing attention in recent years because a difference of >10 mm of Hg has been found to be a potential marker of peripheral vascular disease and predictor of cardiovascular disease. **Aim and Objectives:** This study was conducted to determine the prevalence and magnitude of IAD in healthy adults. **Materials and Methods:** A total of 200 normal healthy adults were recruited for the study. BP was assessed by automatic blood pressure monitor after 5 min rest. **Results:** In this study, prevalences of the IAD were found to be 19.0% for systolic > or =10 mmHg, 4.5% for systolic > or =20 mmHg, and 6.0% for diastolic >or =10 mmHg. **Conclusion:** IAD exists in a substantial number of healthy adults. A difference of >10 mm of Hg systolic or diastolic BP should be investigated further as it is found to have a prognostic value for predicting cardiovascular events. Hence, we conclude that IAD is a simple, noninvasive and sensitive method of detecting individuals prone for cardiovascular morbidities.

KEY WORDS: Interarm Difference; Hypertension; Cardiovascular Morbidity

INTRODUCTION

Arterial blood pressure (BP), an important indicator of a person's health status, is measured to screen for hypertension which is a major modifiable risk factor for stroke, coronary heart disease, and renal failure. Hypertension is directly responsible for 57% of all stroke deaths and 24% of all coronary heart disease deaths in India.[1] Hypertension exerts an escalating economic burden on health-care systems in India.[2,3] At present, the estimated prevalence of hypertension in India is about 33% in urban and 25% in rural areas.[4] Most are not even aware that they have hypertension, which makes the scenario rather horrid.

Access this article online	
Website: www.njppp.com	Quick Response code
DOI: 10.5455/njppp.2017.7.0620122062017	

The gold standard for measurement of arterial pressure is a direct intra-arterial measurement with a catheter. However, this technique is not practical or appropriate for repeated measurements in nonhospitalized patients or asymptomatic individuals. The indirect method of measurement is commonly used for large-scale public health screenings because it is practical, simple, low in cost, and noninvasive. The WHO Expert meeting held on 3 December 2003 in Geneva, Switzerland, supported the use of affordable, accurate and independently validated electronic devices in clinical practice. In light of the toxicity of mercury, it is recommended that mercury BP measuring devices be

gradually phased out in favor of affordable, validated, and professional electronic devices as these become available.[5]

American Heart Association guidelines recommend the measurement of BP in both arms at the initial visit and treatment of hypertension based on the BP in the arm with the higher value.[6] However, knowledge of the prevalence of interarm difference (IAD) in BP and relevance to its accurate measurement remains poor. Framingham Heart Study (FHS) defined increased interarm systolic BP (SBP) difference as ≥10 mmHg using the average of initial and repeat BP measurements obtained in both arms.[7] A prospective, observational study by Lane et al. provided evidence for significant differences in mean absolute interarm SBP and diastolic BP (DBP) which emphasizes the importance of measuring BP in both arms.[8] A study conducted in young healthy individuals showed statistically significant difference in interarm SBP and DBP.[9] Although IAD can occur in healthy people, it may also be indicative of a significant underlying disease process.

FHS demonstrated that interarm SBP difference was associated with a significantly increased hazard of incident cardiovascular events in the multivariable-adjusted model (hazard ratio 1.38; 95%, CI: 1.09-1.75), even when the absolute difference in arm SBP is modest.[7] Apart from utilizing IAD to diagnose and treat hypertension diagnosis and treatment, it can also be used to screen pathological disease processes and the progression of certain diseases. Any disease process that causes chronic limb ischemia can lead to IAD. Atherosclerosis and peripheral vascular disease are the most common pathological causes of chronic limb ischemia leading to IAD.[10,11] Diseases such as aortic dissection, large vessel vasculitis, and systemic lupus erythematosus have an atherosclerotic process that can cause limb ischemia (and therefore also lead to IAD).[12,13] Fibromuscular dysplasia and vessel compression can cause limb ischemia even though they do not have an atherosclerotic process.[14,15]

All the above studies emphasize the significance of recognizing baseline IAD so that hypertension, as well as other disease processes, can be detected earlier and hence managed more effectively. Although prevalence and magnitude of IAD among Western population is available, little is known regarding the magnitude and prevalence of IAD in Indian population. If the prevalence is high, it is important to establish the need for bilateral arm BP screenings on all patients for early detection and effective management of hypertension and prevention of cardiovascular risk.

This study was conducted to determine the prevalence and magnitude of IAD in healthy adults.

MATERIALS AND METHODS

A cross-sectional study was conducted at Government Medical College, Kozhikode, for 3 months. 200 normal healthy adults of the age group 30-65 years with body mass index (BMI) <30 kg/m^2 were included in the study. They were selected from the staff and bystanders in the various ward of this institution. Diabetics, obese subjects with BMI >30 kg/m^2, those with peripheral arterial disease, arrhythmia or any chronic/major illness were excluded.

After obtaining the approval of Institutional Ethics Committee, subjects in the above-mentioned study group were evaluated in detail taking prior informed consent. Age, height, and weight were noted down. The subjects were allowed to rest for 5 min after which BP was recorded in the sitting position, using an appropriate-sized cuff with the subject's arm kept at heart level during the measurement. Interarm BP difference was assessed sequentially in both arms, with automatic BP monitor Omron HEM-7120. Two readings were taken at intervals of at least 1 min, and the average of those readings was used to represent the subject's BP.

BMI was calculated based on the formula bodyweight in kilograms divided by height in meters squared.

Statistical analysis was performed.

Data were analyzed using Statistical Package for Social Sciences. The descriptive statistics and the prevalence of interarm BP difference along with 95% confidence interval were calculated.

RESULTS

About 33.5% of subjects were identified in the age group of 40-49 years, followed by 32.5% of subjects who belonged to age group of 50-59 years. The average age of all subjects was 49.40 ± 6.98 years while average body mass index was 24.22 ± 2.60 kg/m^2.

In this study, prevalences of the IAD were found to be 19.0% for systolic > or =10 mmHg (95%, CI: 12.61-25.38%), 4.5% for systolic > or =20 mmHg (95%, CI: 1.3.0-7.6%), and 6.0% for diastolic > or =10 mmHg (95%, CI: 2.0-9.9%) (Table 1). Out of 103 male and 97 female subjects, 21 males (20.4%) and 17 females (17.5%) were found to have IAD for SBP ≥10 mmHg while 5 males (4.9%) and 4 females (4.1%) were found with IAD for SBP ≥20 mmHg. DBP ≥10 mmHg was recorded in 5 males (4.9%) and 7 females (7.2%). The mean absolute IAD was 7.62 ± 5.53 and 4.3 ± 3.03 mmHg for SBP and DBP, respectively.

Table 1: Magnitude and prevalence of IAD

Magnitude (mm of Hg)	Prevalence
SBP > or =10	19.0% (95%, CI: 12.61-25.38%)
SBP > or =20	4.5% (95%, CI: 1.3.0-7.6%)
Diastolic > or =10	6.0% (95%, CI: 2.0-9.9%)

SBP: Systolic blood pressure

DISCUSSION

Hypertension is found to be one of the major causes of premature morbidity and mortality throughout the developed and developing countries.[16] Several clinical trials have shown that lowering BP can reduce CV risk by 20-25% for myocardial infarction, 35-40% for stroke, and by 50% for heart failure.[17] Hypertension evaluation and treatment guidelines[18,19] and BP measurement guidelines[20,21] recommend assessing BP in both arms (at least during initial examination). Failure to recognize an IAD in BP may delay the diagnosis or confound the treatment of hypertension if the lower reading arm is measured.

This study provides an understanding of the presence and significance of interarm difference in BP. In this study, prevalences of the IAD were found to be 19.0% for systolic > or =10 mmHg, 4.5% for systolic > or =20 mmHg, and 6.0% for diastolic > or =10 mmHg which is in agreement with the findings of a review by Clark and colleagues who reported prevalence rates of IAD as 19.6% systolic > or =10 mmHg, 4.2% systolic > or =20 mmHg, and 8.1% diastolic > or =10 mmHg.[22] Lane et al. also found clinically significant interarm differences in SBP of >10 and >20 mmHg as 20% and 3.5%, respectively; diastolic differences of >10 and >20 mmHg were present in 11% and 3.5%, respectively.[8] However, a meta-analysis on the prevalence of IAD has shown a very variable proportion of subjects (1.4-38%) with IAD more than 10 mmHg.[7,23-27]

Various pathological causes have been considered as leading to an increase in interarm BP differences such as atherosclerosis, vasculitis, fibromuscular hyperplasia, connective tissue, and thoracic outlet compression.[10-15] In the absence of anatomic obstruction, interarm differences in SBP were thought to be related to some intrinsic property of the cardiovascular system. Studies by Canepa et al. showed that interarm difference in SBP was based on alterations in arterial stiffness.[28] Increased arterial stiffness or a loss of compliance increases pressure oscillations, resulting in a disproportionate increase in SBP. Canepa et al. used carotid-femoral pulse wave velocity (cf-PWV) as a measure of arterial stiffness. Their studies showed that cf-PWV was higher in individuals with interarm BP ≥10 mmHg.

An increase in arterial stiffness is associated with progression of IAD, an increase in incident hypertension as well as an increase in cardiovascular morbidity and mortality.[29] Hence, vascular stiffness could be considered as a major target for the treatment of arterial hypertension and efforts are required to identify and correct this major contributor to cardiovascular disease. This study thus supports the need to detect an IAD in BP to identify subjects who are at risk of cardiovascular events and to assure provision of appropriate care.

Limitations of the Study

Due to lack of long-term follow-up, we were unable to reach conclusions regarding the long-term implications of the findings.

CONCLUSION

The presence of significant interarm SBP and DBP differences suggests that the BP should be taken in both arms at the initial consultation and it should become a core component of initial BP measurement in primary care. If an interarm difference in SBP is found, the higher of the two readings should be used for subsequent measurements.

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How to cite this article: Inassi J, Razeena KC, Jowhara PV. Interarm blood pressure difference: Magnitude and Prevalence in healthy adults. Natl J Physiol Pharm Pharmacol 2017;7(11):1186-1189.

Source of Support: Nil, **Conflict of Interest:** None declared.