



# Association of Hyperuricemia and Raised Atherogenic Index of Plasma with Hypertension



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Submission: July 06, 2017; Published: July 10, 2017

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## Abstract

**Background:** Among the non-communicable disease, CVD is one of the major reasons of mortality all over the world. Hypertension is an important contributor to cardiovascular disease, stroke and kidney disease.

**Objective:** To evaluate the association of serum uric acid and atherogenic index of plasma with hypertension.

**Method:** A total of 100 individuals were selected as study subjects based on predefined enrollment criteria. Among them 50 diagnosed cases of hypertension were selected as cases and 50 normotensive healthy individuals as controls. Serum uric acid and serum lipid profile were measured in all study subjects. Atherogenic index of plasma was calculated by the formula  $\log(TG/HDL-C)$ .

**Result:** The study population mostly belonged to 36 to 45 years of age group. The mean age of hypertensive patients was  $40.78 \pm 4.00$  years and that of controls was  $39.58 \pm 4.12$  years. The study found that the mean levels of serum TG ( $205.24 \pm 56.74$  mg/dl) in hypertensive patients were significantly higher than those of controls whereas mean level of HDL-C ( $42.10 \pm 12.27$  mg/dl) in hypertensive patients were lower than those of controls. The mean AIP in the hypertensive patients was ( $0.68 \pm 0.19$ ) significantly higher ( $p < 0.001$ ) than that of controls ( $0.43 \pm 0.22$ ). In the study 70% of the hypertensive subjects were found to be hyperuricemic whereas 08% of the normotensive subjects were hyperuricemic which was statistically significant. The hypertensive subjects showed a positive significant ( $r = 0.437$   $p = 0.002$ ) correlation between AIP and SUA.

**Conclusion:** From the study it is evident that hyperuricemia and high AIP are associated with hypertension.

**Abbreviations:** CVD: Cardiovascular Disease; NCD: Non-Communicable Diseases; WHO: World Health Organization; BSMMU: Bangabandhu Sheikh Mujib Medical University; SSMC: Sir Salimullah Medical College; TG: Triglyceride; HTN: Hypertension; CHD: Coronary Heart Disease; HDL-C: High Density Lipoprotein-Cholesterol; AIP: Atherogenic Index of Plasma; DBP: Diastolic Blood Pressure; SBP: Systolic Blood Pressure; SPSS: Statistical Package for Social Science

## Introduction

Cardiovascular disease (CVD) is a major cause of global mortality and is a serious health problem in developed as well as in developing countries. In Bangladesh, deaths due to non-communicable diseases (NCD), especially chronic diseases are increasing at an alarming rate. Among them CVD, cancers, chronic respiratory diseases, and diabetes are responsible for an increasing number of deaths [1]. CVD has become a significant

burden on the health care service in Bangladesh. World Health Organization (WHO) reported that 27% of total deaths in Bangladesh were due to CVD [2]. CVD is the highest among all causes of death followed by diseases of the respiratory system [3].

Several risk factors have been identified for the development of CVD such as smoking, high blood pressure, high blood

cholesterol, serum uric acid (SUA) [4], diabetes mellitus [5] and family history of CVD [6]. Among various risk factors hypertension (HTN) is identified as one of the modifiable risk factors for cardiovascular and kidney diseases [7]. HTN increases the risk for a variety of cardiovascular diseases including stroke, coronary artery disease, heart failure and peripheral vascular disease [8]. Among individuals aged 40 to 90 years, each 20/10 mmHg rise in blood pressure doubles the risk of fatal coronary events [9]. HTN accounts for an estimated 54 percent of all strokes and 47 percent of all ischemic heart diseases globally [10].

Atherogenic Index of Plasma (AIP) is used to assess the cardiovascular risk. People with high AIP have a higher risk for coronary heart disease (CHD) than those with low AIP. Triglyceride (TG) and high density lipoprotein-cholesterol (HDL-C) in AIP reflect the balance between the atherogenic and anti-atherogenic lipoproteins respectively. It has been suggested that AIP values of  $-0.3$  to  $0.1$  are associated with low,  $>0.1$  to  $0.24$  with medium and above  $0.24$  with high CVD risk [11].

Uric acid is another important risk factor for CVD. The increase in the SUA level was identified as an independent factor for the cardiovascular death [12]. Uric acid is a major factor for the development of CVD in hypertensive patients [4,13]. It has been reported that 25-40% of patients with untreated HTN have high SUA levels. In the Framingham Heart Study, each increase in SUA by  $1.3$  mg/dl was found to be associated with the development of HTN with an odd ratio of  $1.17$  [14]. SUA has been shown to aggravate both dyslipidemia and hyperglycaemia [13,15]. A study conducted in India, showed that the SUA level is positively associated with AIP [16]. The aim of this study is to see the correlation between SUA and AIP with HTN.

### Method

This case-control analytical study was carried out in the Department of Biochemistry, Sir Salimullah Medical College (SSMC), Dhaka during the period of July 2012 to May 2014. Fifty hypertensive patients of any sexes and above 30 years old patients of out-door at Bangabandhu Sheikh Mujib Medical University (BSMMU) and SSMC were included in the study as cases. Fifty age and sex matched non-hypertensive subjects were also taken from medical or paramedical staff, attendants of patients, persons coming to hospital for fitness purpose and outdoor patients of minor illness.

Patients with diabetes mellitus, thyroid disorder, heart disease, renal impairment, liver disease were excluded from the study population. Patients taking drug therapy such as thiazide and loop diuretics, cytotoxic drug, antitubercular drug, low dose aspirin, antioxidant as well as taking medications targeted to reduce uric acid level and lipid lowering drug also excluded from study. Smoker and alcohol abused were also excluded.

A complete physical and relevant clinical examination was performed. Blood pressure was measured in a sitting position after resting for at least 15 minutes. Average of two measurements at 15 minute interval was taken. Hypertension was defined as a Diastolic Blood Pressure (DBP)  $\geq 90$  mmHg and or Systolic Blood Pressure (SBP)  $\geq 140$  mmHg. Laboratory investigation of serum TG, HDL-C and uric acid were done. AIP of all study subjects was calculated. Hyperuricemia was defined as serum uric acid concentration  $>7$  mg/dl in male and  $>6$ mg/dl in female. Collected data were checked, edited, processed and statistical analysis were performed using Statistical Package for Social Science (SPSS) version 12.0.

### Results

In the hypertensive group, 26 (52.0%) were male and 24 (48.0%) were female and in the control group 29 (58.0%) were male and 21 (42.0%) were female. The mean age of hypertensive patients was  $40.78 \pm 4.00$  years and that of controls was  $39.58 \pm 4.12$  years (Table 1). The mean systolic BP were  $145 \pm 10$  mmHg and  $115 \pm 9$  mmHg in hypertensive and control subjects respectively; the mean diastolic BP were  $87 \pm 6$  mmHg and  $77 \pm 6$  mmHg in hypertensive and control subjects respectively. Both systolic and diastolic BP was significantly higher in the hypertensive group than that of control group (Table 2). Serum TG was significantly higher compared with those of controls. Serum HDL-C was lower in the hypertensive subjects compared with that of controls. AIP in the hypertensive patients was significantly higher when compared with that of controls (Table 3). Serum uric acid level in hypertensive patients was found to be significantly higher when compared with that of controls. 70% of the hypertensive subjects were hyperurecemic whereas 08% of the normotensive subjects were hyperurecemic which was statistically significant (Table 4). The study showed a positive significant correlation between AIP and SUA ( $r= 0.437$ ,  $p= 0.002$ ) in hypertensive subjects (Figure 1).

**Table 1:** Distribution of study subject according to sex.

Sex	Group		p value
	Hypertensive patients	Controls	
Male n (%)	26 (52.0)	29 (58.0)	0.546*
Female n (%)	24 (48.0)	21 (42.0)	
Age (Mean±SD)	$40.78 \pm 4.00$	$39.58 \pm 4.12$	0.142#

**Table 2:** Comparison of blood pressure between cases and controls.

Blood pressure	Group		p value
	Hypertensive patients	Control	
Systolic BP (mm Hg)	$145 \pm 10$	$115 \pm 9$	0.001
Diastolic BP (mm Hg)	$87 \pm 6$	$77 \pm 6$	0.001

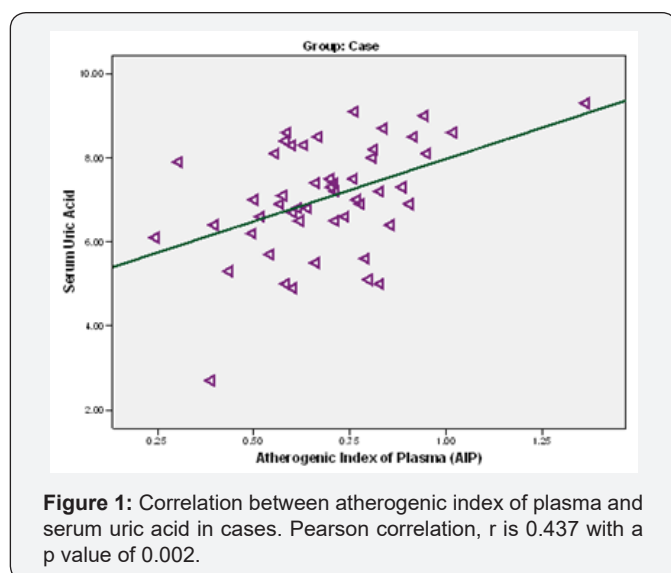
**Table 3:** Comparison of Atherogenic index of plasma between cases and controls.

Biochemical finding	Hypertensive patients (n=50)	Controls (n=50)	P value
TG(mg/dl)	205±56.74	136.84± 52.81	0.001
HDL-C (mg/dl)	42.10± 12.27	48.10± 12.43	0.017
AIP	0.68± 0.19	0.43±0.22	0.001

**Table 4:** Distribution of the study patients according to Hyperuricemia.

Hyperuricemia	Group		p value
	Hypertensive patients	Control	
Yes	35 (70.0)	4 (8.0)	0.001
No	15 (30.0)	46 (92.0)	
Total	50 (100.0)	50 (100.0)	

Odds Ratio is 26.83 (8.18 – 87.96)



### Discussion

The present study shows that serum TG was significantly higher in hypertensive patients than those of normotensive controls. Shah et al. [17] revealed similar findings of elevated serum TG when he compared TG, TC and LDL-C between the hypertensive subjects and controls. Similar observation was also reported in the study carried out by Sarkar et al. [18] Present study showed that serum HDL-C was significantly lower (p=0.017) in cases than controls and this finding agree with the finding of the study done by Al-Baldawi [19]. The multiple risk factor intervention trial in USA showed that for each decrease in HDL cholesterol of 1mg/dL (0.03mmol/L) was associated with an increase in the risk of CHD of 2% in men and 3% in women [20].

In this study, 70% had elevated level of SUA in cases. Garrick et al. [21] in their study observed that 31% of their study patients with hypertension had hyperuricemia.

In some studies hyperuricemia was found to be present in 40 to 60% of subjects with untreated hypertension [22,23]. Present study showed a close association of hyperuricemia with hypertension with an Odd Ratio of 26.83. A positive association between hypertension and serum uric acid has been shown by some other authors [24,25]. The present study observed significantly higher AIP ratio in cases than that of controls (p=0.001). Calin [26] in their study observed moderately increased AIP in hypertensive patients. Marwan et al. [27] also found that atherogenic index to be higher in hypertensive than normotensive subjects.

The hypertensive subjects showed a positive significant r= 0.437 (p= 0.002) correlation between AIP and SUA. Our findings that SUA is positively associated with AIP can be explained by the following facts: (a) elevated SUA has been well linked to increase in TG in various populations [28,29] and (b) the negative association between SUA and HDL-C has also been documented [30].

### Conclusion

From this study it can be concluded than hyperuricemia and raised atherogenic index of plasma is associated with hypertension.

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DOI: 10.19080/APBIJ.2017.03.555602

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