(International Print/Online Journal)

SJIF IMPACT FACTOR: 5.565
PUBMED-National Library of Medicine ID-101739732

ISSN (Print): 2209-2870
ISSN (Online): 2209-2862

International Journal of Medical Science and Current Research (IJMSCR)
Available online at: www.ijmscr.com
Volume 5, Issue 2, Page No: 1312-1327
March-April 2022

IJMSCR

Possible Correlation Between Serum Uric Acid And Blood Pressure In Different Age Groups

[1] Dr. Niyaz Ahmad, [2] Dr. Taranpreet Kaur, [3]Dr.Jaykrat Chaudhary, [4] Dr. Ankita singh, [5] Dr. Amit Verma

[1]Associate Professor, 2Assistant Professor, 3Resident [4]Intern, [5]Professor & HOD

[1,2,3,5]Department of General Medicine Practice, Shri Mahant Indiresh Hospital, Shri Guru Ram Rai Institute of Medical and Health Sciences (SGRRIM&HS), Patel Nagar, Dehradun-248001, Uttrakhand (India)

[4] Department of Clinical Pharmacy, Shri Guru Ram Rai Institute of Technology & Sciences, Patel Nagar, Dehradun-248001, Uttrakhand(India)

***Corresponding Author:**
Dr. Niyaz Ahmad
Department of General Medicine Practice, Shri Mahant Indiresh Hospital, Patel Nagar, Dehradun

Type of Publication: Original Research Paper
Conflicts of Interest: Nil

Abstract:

In this study we found positive correlation between serum uric acid and blood pressure in adults but maximum correlation between SBP and serum uric acid was found in <40 year age group, while between DBP and serum uric acid was found in 40-60 year age group. Correlation between SBP and serum uric acid was more strong in females of study group while between DBP and serum uric acid was more strong in males of study group. mean serum uric acid was found to be more in study group and elevated serum uric acid was found in 92% patients of study group. This study suggests specific age/gender groups which would obtain maximum benefit from treatment of hyperuricemia for the prevention and treatment of hypertension.

Keywords: DBP,SBP,Hyperuricemia, Hypertention

Introduction:

The prevalence of hypertension is increasing worldwide and is an important contributor to cardiovascular diseases (CVDs) and premature death [1-2]. In the past years, an upward trend of hypertension prevalence has been reported in general and young adults [3-5]. Hypertension in adults is most common form of cardiovascular disease. The prevalence of hypertension grows higher with aging resulting in an increase in morbidity and mortality through various events such as myocardial infarction, heart failure, stroke and renal failure.[6-9]. Serum uric acid (SUA) is the end product of purine metabolism. It's over production and decreased excretion via kidneys are one of the main causes of hyperuricemia in humans [10]. So far, there are three uric acid/urate transporters (URAT1/SLC22A12, GLUT9/SLC2A9, and ABCG2/BCRP) that have been reported to play crucial roles in the regulation of SUA and their abnormal functions lead to hypouricemia and/or hyperuricemia [11]. Among them, common abnormalities of ABCG2 exporter has been shown to be a major cause of hyperuricemia and gout. It has been reported that ABCG2 dysfunction causes renal urate under excretion and inducing hyperuricemia [12]. In addition, ABC variants have been reported to show stronger effects on hyperuricemia than main environmental risk factors such as obesity, age, and alcohol drinking [13]. Hyperuricemia prevalence is increasing rapidly in the world communities; emerging evidence indicates that hyperuricemia is now more common in the developing nations along with the developed nations

[14]. Increased SUA has been found to be associated with CVDs, gout, metabolic syndrome and renal dysfunction [15]. SUA was found to be positively associated with the number of metabolic syndrome included hypertension [16]. Serum uric acid was originally linked with hypertension in the 1870s. For years, this association was attributed to the effect of renal vasoconstriction to reduce urinary excretion of uric acid. More recently, uric acid has been proposed to have a causal role in hypertension. [17]. Hyperuricemia would seem to fulfill Koch's postulates as a causal risk factor for hypertension. Studies in animal models suggest that hyperuricemia may be particularly important in early hypertension [18], and similarly studies in humans show that the strongest association of hyperuricemia is with early hypertension such as observed in adolescents [19].

Uric Acid:

Uric acid (2,6,8 trioxypurine-C5H4N4O3) is an organic compound that is endogenously produced by animals as a purine metabolite. It is formed by the liver and mainly excreted by the kidneys (65-75%) and intestines (2535%). UA is the end product of purine metabolism in humans due to the loss of uricase activity, which led to humans having higher UA levels than other mammals [74,75]. Due to its double bonds, uric acid has excellent antioxidant capacity, and it can be responsible for 2/3 of total plasma antioxidant capacity [76,77]. Because it is a weak acid that have a high dissociation constant, uric acid circulates in plasma (pH 7.4) predominantly (98%) in the form of a monovalent sodium salt (urate) [78]. It shows low solubility in water (as well as in plasma), and it would theoretically reach plasma saturation in the concentration of 6.4 mg/dL, which may not occur because solubility increase is provided by its binding to proteins, namely albumin, which is its main transporter. Protein-bound uric acid shows plasma solubility that is 70% higher than in its free state. [79]

Aim & Objective:

To establish a possible correlation between serum uric acid and blood pressure in adults.

Material And Methods:

The proposed study was designed as a cross sectional observational study titled "POSSIBLE CORRELATION BETWEEN SERUM URIC ACID AND BLOOD PRESSURE IN DIFFERENT AGE GROUPS" be carried out in the Department of Internal Medicine in Shri Guru Ram Rai Institute of Medical and Health Sciences and Shri Mahant Indiresh Hospital (SMIH), Dehradun and included a 200 subjects with hypertension attending both in-patient and outpatient department of medicine and 100 controls.

An informed written consent from the patient and or legal guardian was taken from all the patients included in the study. Diagnostic criteria. Diagnosis of hypertension was made according to JNC-7 guidelines of hypertension. Elevated serum uric acid was defined as serum uric acid >7mg/dl in males and >6mg/dl in females.

Study duration-18 months.

Inclusion Criteria:

1. Age ≥18 years
2. All hypertensive patients
3. Both sex

Exclusion Criteria:

1. History of gout
2. renal disease
3. Anti-hyperuricemic and diuretic drug intake

Study Planing:

A thorough history was taken with special emphasis on Individuals having age 18 years or more not have any history of gout and renal diseases and anti-hyperuricemic or diuretic drug intake. Blood pressure was measured in all subjects by trained professionals using a aneroid sphygmomanometer. All patients investigated for SERUM URIC ACID LEVEL, LIPID PROFILE, FBS, ECG, URINE ROUTINE AND MICROSCOPIC EXAMINATION. Additional investigation was done as per requirement.

Study Technique:

Blood pressure was measured on both the arms in a sitting position after the participant rested for 5 minutes. The first blood pressure measurement was discarded to avoid possible effects of anxiety, and the average value of second and third measurements had count for systolic and diastolic blood pressure. The participants were requested to avoid smoking, coffee,

Volume 5, Issue 2; March-April 2022; Page No 1312-1327

and tea for 30 minutes before blood pressure measurement.

For lipid profile and SUA level:- It was determined calorimetrically using commercially available diagnostic kits.

For FBS: 5ml of fasting blood sample was collected and centrifuged. sample was analyzed for the measurement of plasma glucose by glucose oxidase-peroxidase method.

For ECG: 12 lead ECG and simultaneous rhythm strip recorded at 25mm/s with a gain setting of 10mm/mv.

Result:

Table 1: Baseline characteristics of study group (n = 200)-

CASE	MEAN+/-SD
AGE	59.81 ± 14.11
SERUM URIC ACID	7.88 ± 1.32
SBP	146 ± 24.48
DBP	87.19 ± 11.57
TC	174.12 ± 60.78
TG	183.92 ± 86.19
HDL	47.84 ± 7.85
LDL	121.85 ± 64.69
FBS	137.92 ± 60.91

Table 2: Baseline characteristic of control group(N=100)-

CONTROL	MEAN
AGE	44.37 ± 15.59
SERUM URIC ACID	4.21 ± 1.07
SBP	111.20 ± 8.14
DBP	70.42 ± 7.88
TC	119.85 ± 45.09
TG	137.39 ± 58.48
HDL	38.88 ± 19.78
LDL	75.79 ± 24.32
FBS	108.93 ± 43.96

Volume 5, Issue 2; March-April 2022; Page No 1312-1327

Table 3: Age wise distribution of study and control group

		Cases	Control	Total	p-value
		No.	No.		
AGE GROUP	< 40	15	43	58	0.0001
	41-60	78	39	65	
	> 60	107	18	49	
Total		200	100	300	

Shows that among 200 cases 15 cases in age <40 yrs ,78 cases in age 41-60 yrs, 107 cases in age >60 yrs . In control group among 100 control 43 control in age < 40 yrs , 39 control in 41-60 yrs and 18 control in age > 60 yrs . In study group most of patients were in age group of > 60 yrs . In control group most of patients were in age group of < 40 yrs. Most of hypertensive patients were in age group of age > 60 yrs.

Table 4: Gender wise distribution of study and control group

		Cases	Control	Total	p-value
		No.	No.		
SEX	F	97	42	139	0.287
	M	103	58	161	
Total		200	100	300	

Shows that in study group 97 were female and 103 were male , and in control group 42 were female and 58 were male . this has no statistical significance.

Table 5 : Associated comorbidities in study and control group

		Cases	Control	Total	p-value
		No.	No.		
T2DM	NO	133	88	221	0.0001
	YES	67	12	79	
CVA	NO	139	99	238	0.0001
	YES	61	1	62	
CAD	NO	186	99	285	0.025
	YES	14	1	15	

In study group 67 patient had type 2 diabetes, 61patient had history of CVA,14 patient had history of CAD. In control group12 patient had type 2 diabetes, 1 had history of CVA, 1 had history of CAD. Most of patients in study group had associated type 2 diabetes, CAD, CVA. This is found to be statistically significant with p value of 0.0001, 0.0001. 0.025 Respectively.

Volume 5, Issue 2; March-April 2022; Page No 1312-1327

Table 6: Blood pressure classification in study and control group

		Cases	Control	Total
Blood pressure classification	Normal	35	74	109
	Pre-HTN	36	26	62
	Stage 1 HTN	64	0	64
	Stage 2 HTN	65	0	65
Total		200	100	300

Shows out of 200 cases 35 had normal blood pressure, 36 had pre-hypertension, 64 had stage 1 hypertension, 65 had stage 2 hypertension. Out of 100 control 74 had normal blood pressure, 26 had pre-hypertension.

Table 7: Comparison of serum uric acid in different stage of hypertension

SERUM URIC ACID	Blood pressure classification	Mean ± SD	p-value
	Normal	6.5 ± 0.104	0.001
	Pre-HTN	7.1 ± 0.194	
	Stage 1 HTN	7.5 ± 0.199	
	Stage 2 HTN	9.28 ± 1.4	
		7.8 ± 1.3	

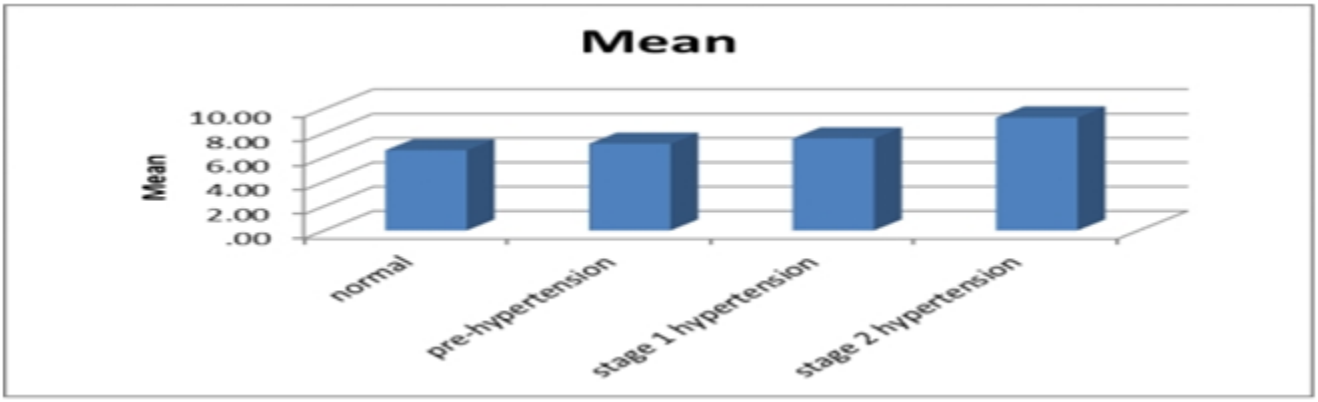


Figure 1: Shows mean of serum uric acid in normal blood pressure group was 6.5, in pre-hypertensive group was 7.1,in stage 1 hypertension group was 7.5 and in stage 2 hypertension group was 9.28.which was statistically significant with a p value of 0.001.

Table 8: Comparison of serum uric acid in study and control group

		Cases		Control		Total	Chi-square value	p-value
		Cases	Cases	Control	Control			
SERUM URIC ACID group	Normal	17	9%	94	94%	94	273.786	0.0001
	Hyperuricemia	183	92%	6	6%	206		
Total		200	100%	100	100%	300		

Volume 5, Issue 2; March-April 2022; Page No 1312-1327

Out of 200 case 183 case has high serum uric acid levels. Out of 100 control 6 has high serum uric acid levels. This is found to be statistically significant with p value of 0.0001

Table 9: Comparison of lipid profile in study and control group

LIPID PROFILE	CASES	CONTROL	p-value
	Mean ± SD	Mean ± SD	0.000
Total Cholesterol	174.12 ± 60.78	119.85 ± 45.09	0.000
TG	183.94 ± 86.19	137.39 ± 58.48	0.000
HDL	47.84 ± 7.85	38.88 ± 19.78	0.000
LDL	121.85 ± 64.69	75.79 ± 24.32	0.000

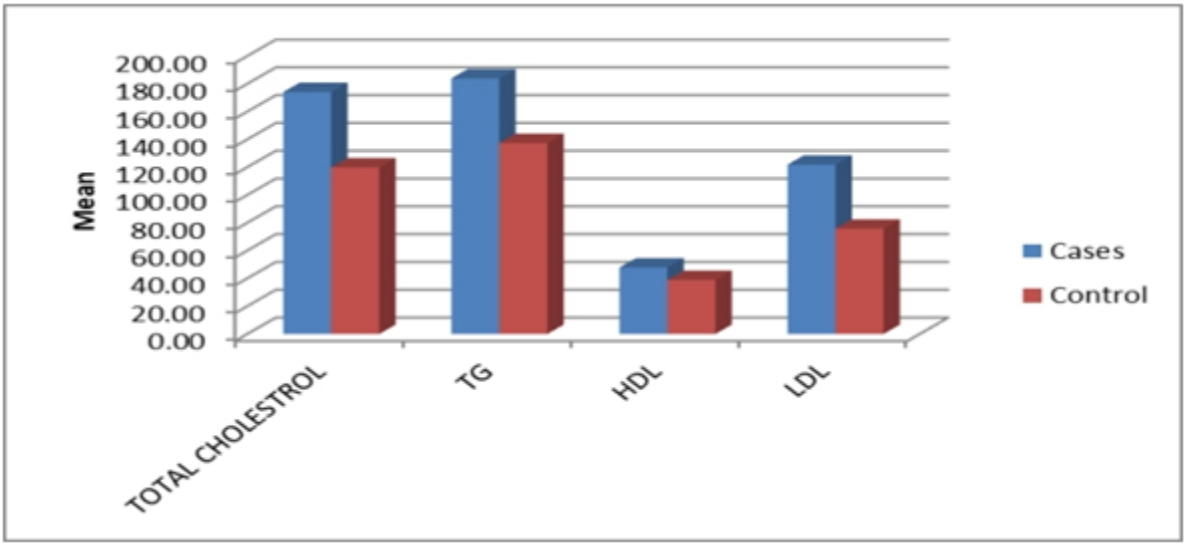


Figure 2: Shows mean of lipid profile in study group was more than mean in control group with p-value of 0.001. which was statistically significant.

Table 10 : Comparison of ECG in study and control group

		Cases	Control	Total	p-value
		No.	No.		
ECG GROUP	Abnormal	71	0	71	0.0001
	Normal	129	100	229	
Total		200	100	300	

Out of 200 patients of study group 71 had abnormal ECG, 129 had normal ECG , Out of 100 patients of control group all had normal ECG .This was found to be statistically significant with p value of 0.0001

Volume 5, Issue 2; March-April 2022; Page No 1312-1327

Table 11: Urine abnormality in study and control group

		Cases	Control	Total	p-value
		No.	No.		
URINE R/M GROUP	Abnormal	39	10	49	0.036
	Normal	161	90	251	
Total		200	100	300	

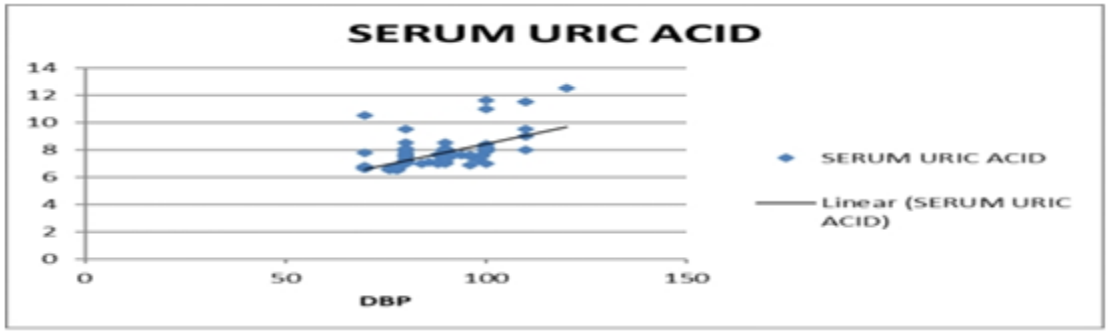
Shows that Out of 200 patients of study group 161 had normal urine examination, 39 had abnormal urine examination. Out of 100 patients of control group 90 had normal urine examination, 10 had abnormal urine examination .This was found to be statistically significant.

Table 12: Fasting blood sugar in study and control group

		Cases	Control	Total	p-value
		No.	No.		
FBS group	Normal	52	58	110	0.0001
	Impaired glucose tolerance	71	29	100	
	High	77	13	90	
Total		200	100	300	

Shows that out of 200 case 52 had normal blood glucose,71 had impaired glucose tolerance,77 had high glucose level .In control group out of 100 control 58 had normal glucose level,29 had impaired glucose level and 13 had high glucose level. p value of 0.0001 which is found to be statistically significant.

Table 13: Correlation of SBP and DBP with various parameters in male study group



MALE		SERUM URIC ACID	TOTAL CHOLESTROL	TG	HDL	LDL	FBS
SBP	Pearson Correlation	0.862	0.202	0.005	0.022	-0.028	-0.024
	p-value	0.000	0.041	0.957	0.827	0.778	0.812
	N	103	103	103	103	103	103
DBP	Pearson Correlation	0.590	0.177	0.048	0.022	0.001	-0.028
	p-value	0.000	0.074	0.631	0.826	0.994	0.780
	N	103	103	103	103	103	103

Volume 5, Issue 2; March-April 2022; Page No 1312-1327

Shows correlation between serum uric acid and SBP in males of study group .which was found to be statistically significant with pearson correlation of 86.2% and p-value of 0.001.

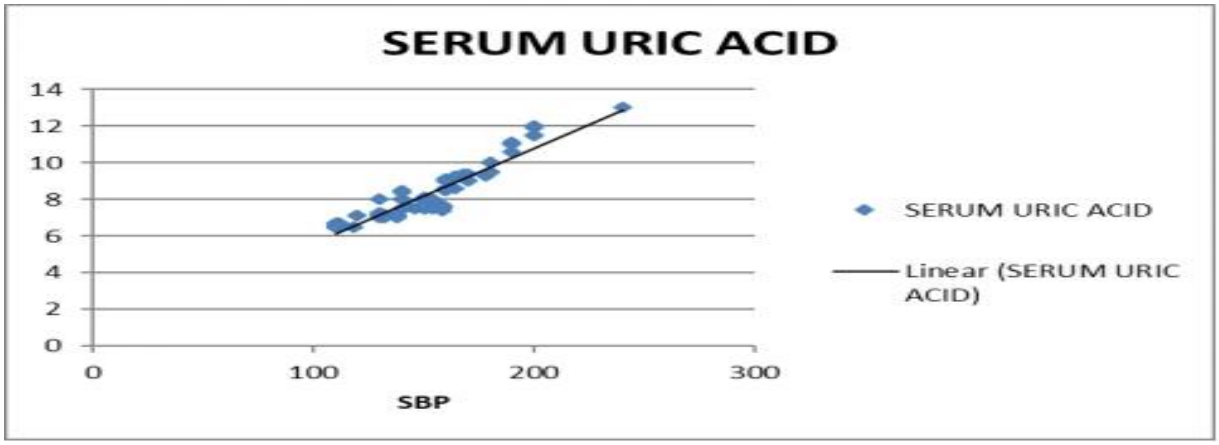
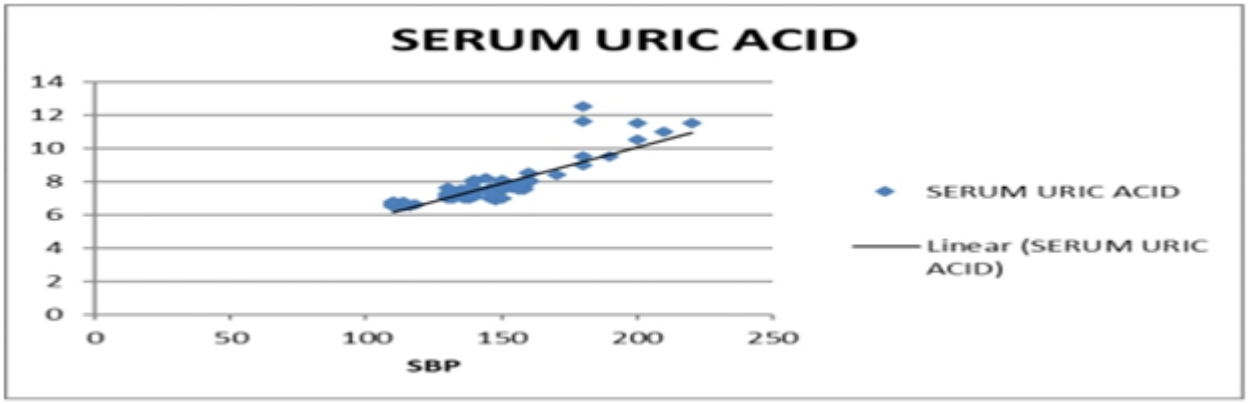


Figure 3 : Shows correlation between serum uric acid and DBP in males of study group .which was found to be statistically significant with pearson correlation of 59% and p-value of 0.001.

Table 14 : Correlation of SBP and DBP with various parameters in female of study group.



FEAMLE		SERUM URIC ACID	TOTAL CHOLESTROL	TG	HDL	LDL	FBS
SBP	Pearson Correlation	0.935	0.108	0.002	-0.055	0.032	0.058
	p-value	0.000	0.294	0.983	0.595	0.756	0.575
	N	97	97	97	97	97	97
DBP	Pearson Correlation	0.540	0.095	0.070	-0.140	-0.049	0.093
	p-value	0.000	0.354	0.497	0.170	0.635	0.367
	N	97	97	97	97	97	97

Figure 4: Shows correlation between serum uric acid and SBP in females of study group .which was found to be statistically significant with person correlation of 93.5% and p-value of 0.001.

Volume 5, Issue 2; March-April 2022; Page No 1312-1327

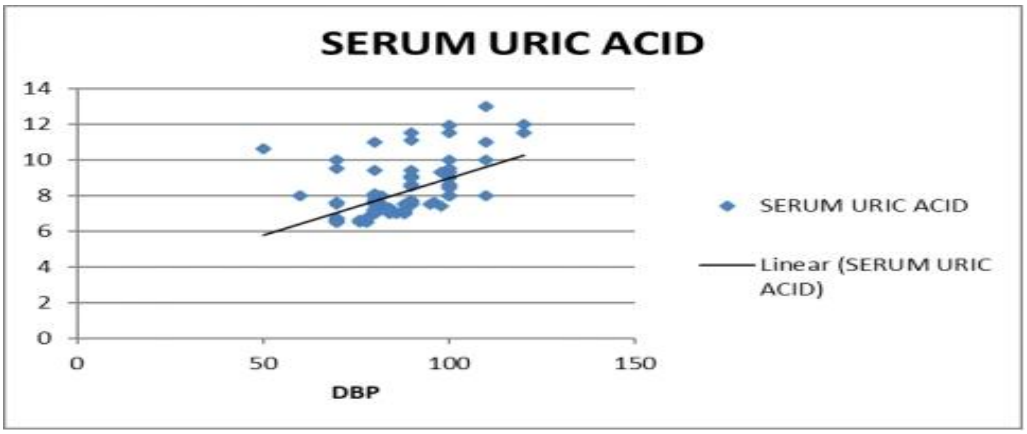


Figure 5 : Shows correlation between serum uric acid and DBP in females of study group .which was found to be statistically significant with pearson correlation of 54% and p-value of 0.001.

Table 15 :Correlation of SBP and DBP with various parameters in <40 year age study group.

age < 40		SERUM URIC ACID	TOTAL CHOLESTROL	TG	HDL	LDL	FBS
SBP	Pearson Correlation	0.938	-0.133	-0.481	0.232	-0.510	-0.329
	p-value	0.000	0.637	0.070	0.406	0.052	0.231
	N	15	15	15	15	15	15
DBP	Pearson Correlation	0.493	0.278	-0.351	-0.131	-0.257	-0.243
	p-value	0.062	0.315	0.200	0.641	0.355	0.384
	N	15	15	15	15	15	15

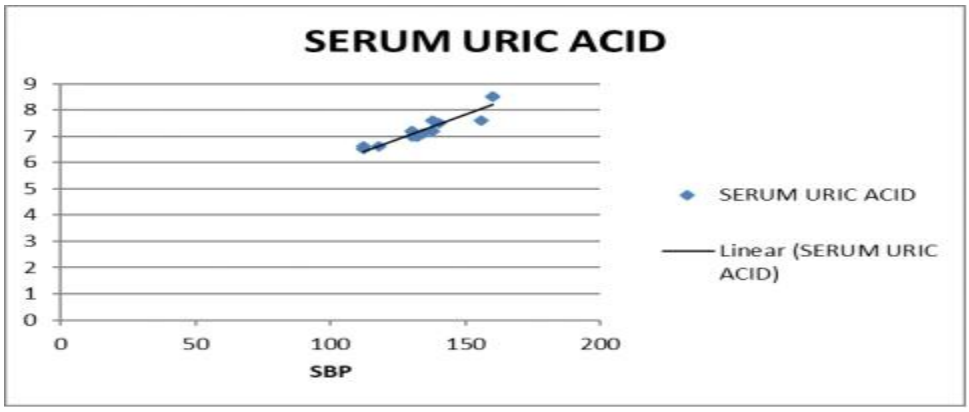


Figure 6 : Shows correlation between serum uric acid and SBP in <40 year study group .which was found to be statistically significant with person correlation of 93.8% and p-value of 0.001

Volume 5, Issue 2; March-April 2022; Page No 1312-1327

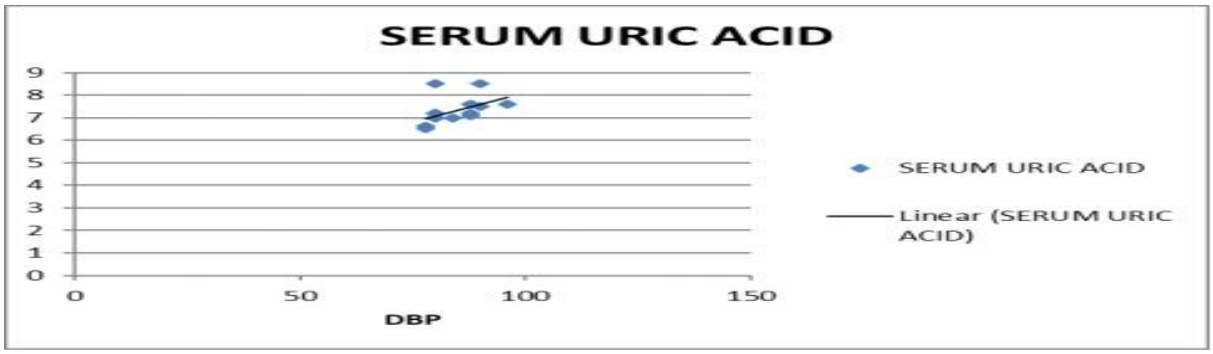


Figure 7 : Shows correlation between serum uric acid and DBP in <40 year study group .which was found to be statistically non significant .

Table 16 : Correlation of SBP and DBP with various parameters in 40-60 year age study group.

Age 41-60		SERUM URIC ACID	TOTAL CHOLESTROL	TG	HDL	LDL	FBS
SBP	Pearson Correlation	0.900	0.280	0.074	-0.155	0.038	-0.016
	Sig. (2-tailed)	0.000	0.013	0.520	0.176	0.738	0.891
	N	78	78	78	78	78	78
DBP	Pearson Correlation	0.637	0.158	0.069	-0.071	-0.045	0.049
	Sig. (2-tailed)	0.000	0.168	0.546	0.539	0.693	0.668
	N	78	78	78	78	78	78

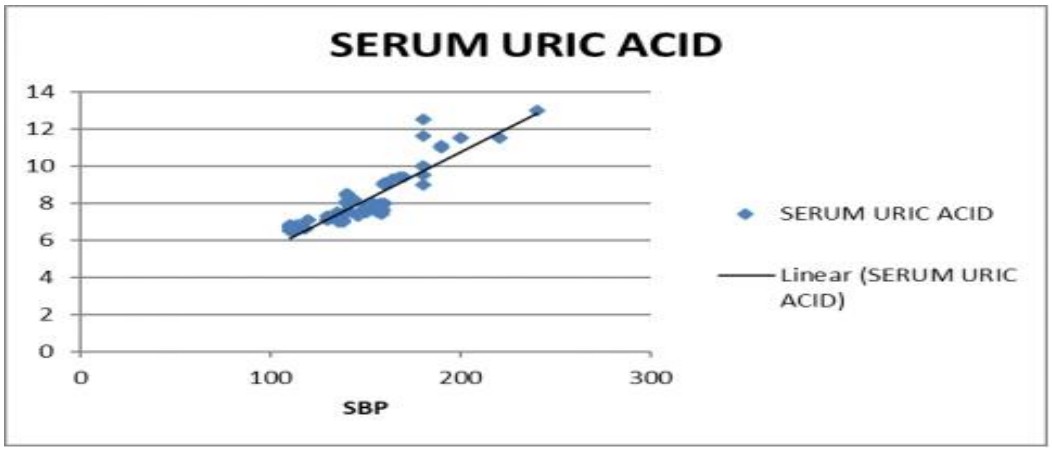


Figure 8 : Shows correlation between serum uric acid and SBP in 41-60 year study group .which was found to be statistically significant with pearson correlation of 90% and p-value of 0.001

Volume 5, Issue 2; March-April 2022; Page No 1312-1327

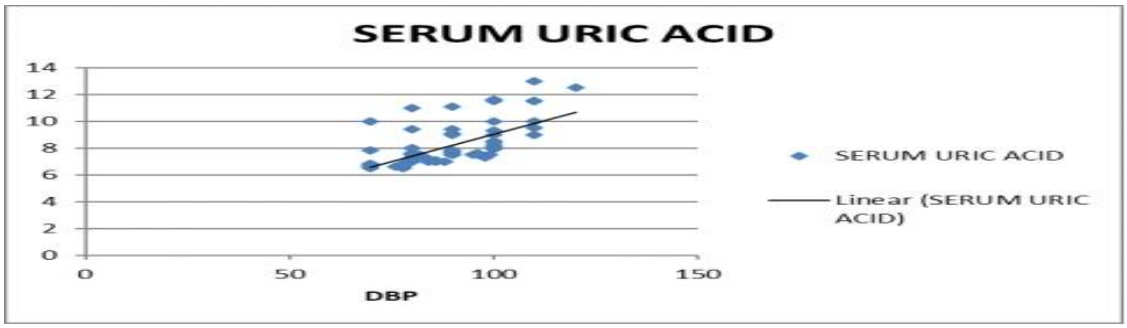


Figure 9: Shows correlation between serum uric acid and DBP in 41-60 year study group .which was found to be statistically significant with person correlation of 63.7% and p-value of 0.001.

Table 17: Correlation of SBP and DBP with various parameters in >60 year age study group.

> 60		SERUM URIC ACID	TOTAL CHOLESTROL	TG	HDL	LDL	FBS
SBP	Pearson Correlation	0.906	0.078	-0.042	0.095	-0.038	0.031
	Sig. (2-tailed)	0.000	0.425	0.666	0.329	0.697	0.752
	N	107	107	107	107	107	107
DBP	Pearson Correlation	0.450	0.076	0.041	-0.011	-0.007	-0.006
	Sig. (2-tailed)	0.000	0.437	0.676	0.912	0.940	0.951
	N	107	107	107	107	107	107

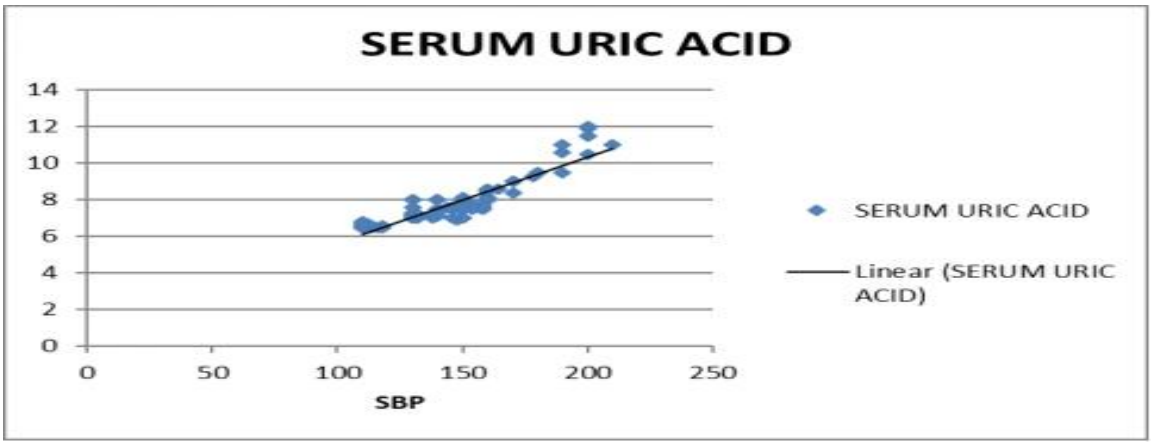


Figure 10 : Shows correlation between serum uric acid and SBP in >60 year study group .which was found to be statistically significant with person correlation of 90.6% and p-value of 0.001

Volume 5, Issue 2; March-April 2022; Page No 1312-1327

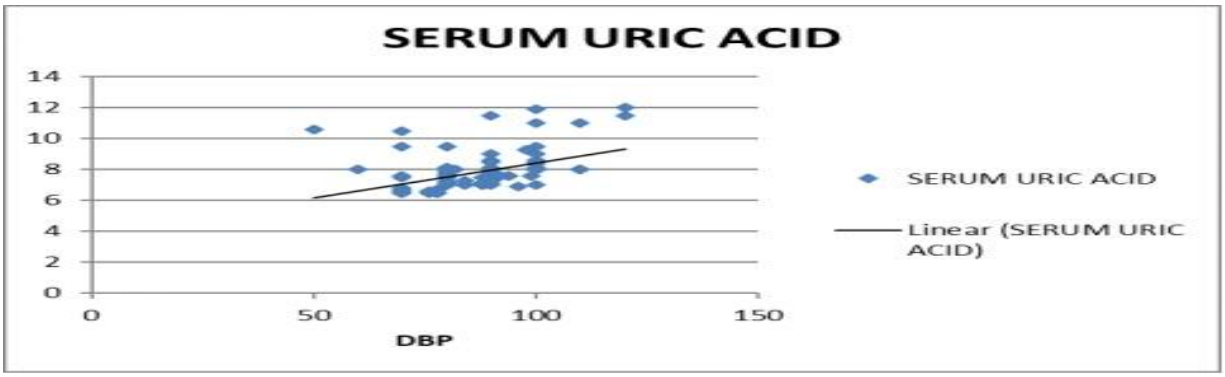


Figure 11: Shows correlation between serum uric acid and DBP in >60 year study group .which was found to be statistically significant with pearson correlation of 45% and p-value of 0.001

Table 18: correlation of Age, SBP, DBP with various parameters in study group.

Htn		SBP	DBP	SERUM URIC ACID	TOTAL CHOLESTROL	TG	HDL	LDL	FBS
AGE	Pearson Correlation	0.069	-0.023	0.037	-0.070	-0.056	0.057	-0.077	-0.033
	p-value	0.330	0.744	0.603	0.326	0.435	0.421	0.281	0.644
	N	200	200	200	200	200	200	200	200
SBP	Pearson Correlation	1.000	0.568	0.902	0.157	0.009	-0.018	-0.002	0.018
	p-value		0.000	0.000	0.027	0.904	0.795	0.977	0.802
	N	200	200	200	200	200	200	200	200
DBP	Pearson Correlation	0.568	1.000	0.542	0.122	0.054	-0.060	-0.020	0.031
	p-value	0.000		0.000	0.084	0.448	0.398	0.781	0.659
	N	200	200	200	200	200	200	200	200

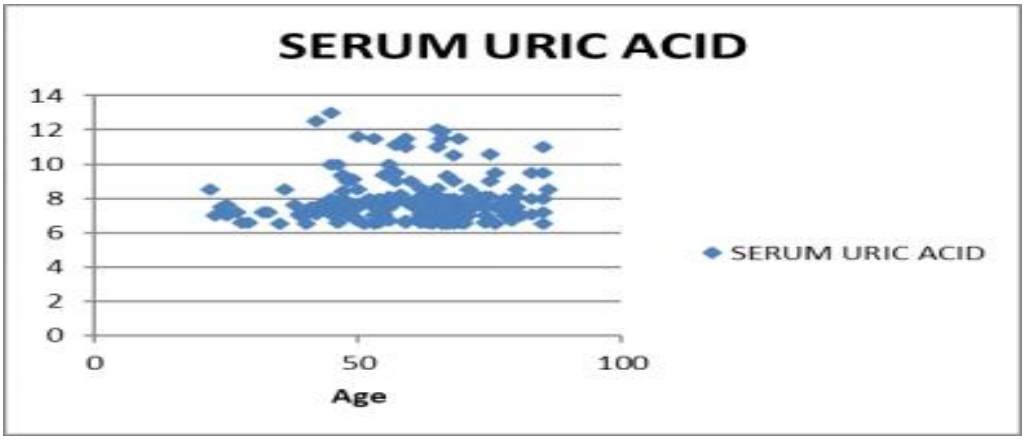


Figure 12: Shows correlation between serum uric acid and age .which was found to be statistically non significant with p value of 0.603.

Volume 5, Issue 2; March-April 2022; Page No 1312-1327

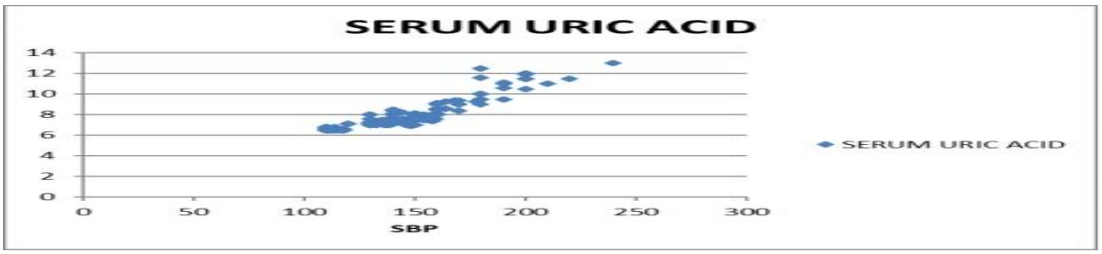


Figure 13: Shows correlation between serum uric acid and SBP in study group . which was found to be statistically significant with p value of 0.001.

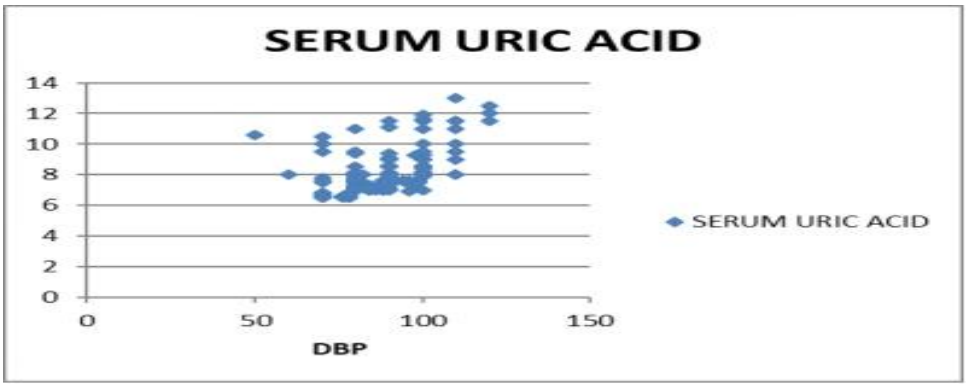


Figure 14 : Shows correlation between serum uric acid and DBP in study group. which was statistically significant with p value of 0.001.

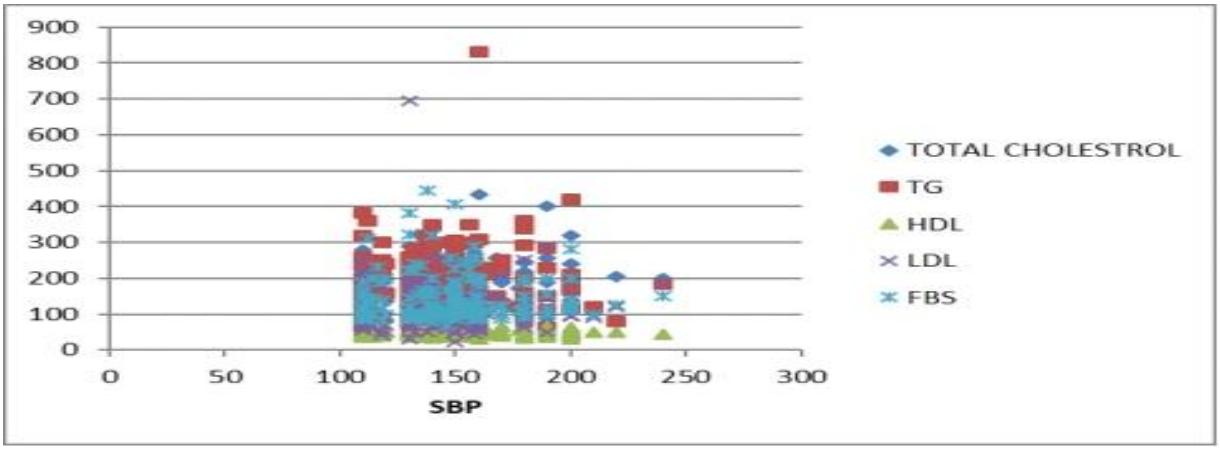


Figure 15 : Shows correlation of SBP with lipid profile in study group.correlation between SBP and TC was statistically significant with p value of 0.027.correlation between TG,HDL,LDL and uric acid was non significant.For urine routine and microscopic examination: collect the first morning urine in container which had wide base and opening of at least 4 cm and a secure lid , that hold at least 50ml of sample. Then urine centrifuged and solid components separated and see under microscope.

Volume 5, Issue 2; March-April 2022; Page No 1312-1327

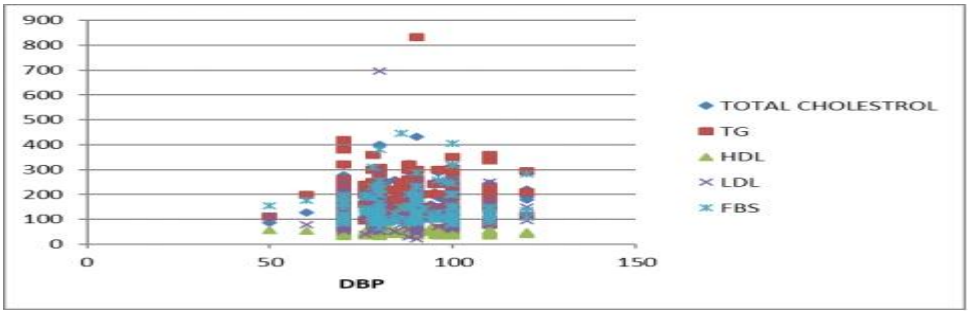


Figure 16: Shows correlation between DBP and lipid profile in study group. Which was statistically non significant.

Discussion:

It was planned as a cross sectional observational study and included 200 subjects suffering from HTN attending the inpatient and outpatient department of the institute. They were included in the study only if they satisfied the inclusion and exclusion criteria of the study. Once enrolled they were labeled as study group.

100 individuals were taken who had no history of HTN, they were labeled as control group. Study group had 200 hypertensive patients with comorbidities like T2DM,CVA,CAD.diagnosis of hypertension was made acc. to JNC 7 classification of hypertension .study and control group was divided in three age groups <40,41 to 60 and >60 years.

In this study we found positive correlation between serum uric acid and blood pressure in different age groups. The mean serum uric acid in study group was 7.88mg/dl and in control group was 4.21mg/dl which was statistically significant with a p value of 0.001.In the study group as the blood pressure increases from normal to pre hypertension to stage 1 HTN to stage 2 HTN serum uric acid also increases from 6.60 to 7.13 to 7.57 to 9.29 which was statistically significant with a p value of 0.001.In our study we found elevated serum uric acid (>7gm/dl in males ,>6gm/dl in females) in 92% patient of study group and only 6% patient of control group. which was found statistically significant with a p-value of 0.0001. Various study in the past was done which also suggest positive correlation between elevated serum uric acid and blood pressure. Nurshed ali et al.in 2019 done study on 225 bangladeshi adults. Which shows that SUA levels were significantly associated with hypertension ($p < 0.01$). Findings of this study indicate the significance of maintaining normal SUA level to prevent hypertension.

Conclusion:

1. Mean serum uric acid in study group was 7.88mg/dl and in control group was 4.21mg/dl which is statistically significant with a p-value of 0.001.
2. Elevated serum uric acid (>7mg/dl in males,>6mg/dl in females) was present in 92% patients of study group and 6% patients of control group.
3. In a study group as the blood pressure increases from normal→pre-HTN→ stage 1HTN→Stage 2 HTN, serum uric acid also increases from 6.5 to 9.2mg/dl. which was statistically significant with a p value of 0.001.
4. Mean serum uric acid in female was more than male study group which was Statistically significant with a p value of 0.001.
5. Positive Correlation was found between serum uric acid and blood pressure in different age groups. Maximum correlation of SBP and serum uric acid was found in <40 year age group and DBP and serum uric acid in 40 to 60 year age group.
6. No correlation was found between age and serum uric acid levels.
7. Positive Correlation was found between serum uric acid with SBP and DBP in male and female study group. But the correlation of SBP with serum uric acid was strong in female study group and DBP with serum uric acid was strong in male study.

Volume 5, Issue 2; March-April 2022; Page No 1312-1327

References:

1. Kit, B. K. et al. Prevalence of and trends in dyslipidemia and blood pressure among US children and adolescents, 1999–2012. JAMA Pediatr. 169, 272–279 [2015].
2. Sarki, A. M., Nduka, C. U., Stranges, S., Kandala, N.-B. & Uthman, O. A. Prevalence of Hypertension in Low- and Middle-Income Countries: A Systematic Review and Meta-Analysis. Medicine (Baltimore) 94, e1959 [2015].
3. Ali, N. et al. Hypertension prevalence and influence of basal metabolic rate on blood pressure among adult students in Bangladesh. BMC Public Health 18 [2018].
4. Chowdhury, M. A. B., Uddin, M. J., Haque, M. R. & Ibrahimou, B. Hypertension among adults in Bangladesh: evidence from a national cross-sectional survey. BMC Cardiovasc. Disord. 16 [2016].
5. Saquib, N., Saquib, J., Ahmed, T., Khanam, M. A. & Cullen, M. R. Cardiovascular diseases and type 2 diabetes in Bangladesh: a systematic review and meta-analysis of studies between 1995 and 2010. BMC Public Health 12, 434 [2012].
6. Feig DI, Johnson RJ. Hyperuricemia in childhood primary hypertension. Hypertension. [2003];42:247–52.
7. Coresh J, Wei GL, McQuillan G, Brancati FL, Levey AS, Jones C, et al. Prevalence of high blood pressure and elevated serum creatinine level in the United States: findings from the third National Health and Nutrition Examination Survey (1988–1994). Arch Intern Med. [2001];161:1207–16.
8. Park JK. Epidemiology of hypertension. J Korean Soc Hypertens. [1995];1:6–17.
9. Kim JS, Lee HC, Yoo WS, Yoo UH. Mean blood pressure, prevalence and epidemiologic characteristics of hypertension among representative Korean adult population. J Korean Soc Hypertens. [1998];4:89–98.
10. Remedios, C., Shah, M., Bhasker, A. G. & Lakdawala, M. Hyperuricemia: a reality in the Indian obese. Obes. Surg. 22, 945–948 [2012].
11. Matsuo, H. et al. Common Defects of ABCG2, a High-Capacity Urate Exporter, Cause Gout: A Function-Based Genetic Analysis in a Japanese Population. Sci. Transl. Med. 1, 5ra11–5ra11 [2009].
12. Matsuo, H. et al. ABCG2 dysfunction causes hyperuricemia due to both renal urate underexcretion and renal urate overload. Sci. Rep. 4, 3755 [2015].
13. Nakayama, A. et al. Common dysfunctional variants of ABCG2 have stronger impact on hyperuricemia progression than typical environmental risk factors. Sci. Rep. 4, 5227 [2015].
14. Chen, L. et al. Relationship between hyperuricemia and metabolic syndrome. J. Zhejiang Univ. Sci. B 8, 593–598 [2007].
15. Chang, C.-C. et al. Association between serum uric acid and cardiovascular risk in nonhypertensive and nondiabetic individuals: The Taiwan I-Lan Longitudinal Aging Study. Sci. Rep. 8 [2018].
16. Stibůrková, B., Pavlíková, M., Sokolová, J. & Kožich, V. Metabolic Syndrome, Alcohol Consumption and Genetic Factors Are Associated with Serum Uric Acid Concentration. PLoS One 9, e97646 [2014].
17. Feig D, Madero M, Jalal D, SanchezLozada LG, Johnson RJ. Uric acid and the origins of hypertension. J Peds. [2012];in press.
18. Watanabe S, Kang DH, Feng L, Nakagawa T, Kanellis J, Lan H, Mazzali M, Johnson RJ. Uric acid, hominoid evolution, and the pathogenesis of saltsensitivity. Hypertension. [2002];40:355–360.
19. Feig DI, Johnson RJ. Hyperuricemia in childhood primary hypertension. Hypertension. [2003];42:247–252.

Volume 5, Issue 2; March-April 2022; Page No 1312-1327

20. Roch-Ramel F, Guisan B: Renal Transport of Urate in Humans. News Physiol Sci [1999], 14:80-84.

21. Alvarez-Lario B, Macarron-Vicente J: Uric acid and evolution. Rheumatology (Oxford) [2010], 49:2010-2015.

22. Maxwell SR, Thomason H, Sandler D, Leguen C, Baxter MA, Thorpe GH, Jones AF, Barnett AH: Antioxidant status in patients with uncomplicated insulin-dependent and non-insulin-dependent diabetes mellitus. Eur J Clin Invest [1997], 27:484-490.

23. Sautin YY, Johnson RJ: Uric acid: the oxidant-antioxidant paradox. Nucleosides Nucleotides Nucleic Acids [2008], 27:608-619.

24. Liebman SE, Taylor JG, Bushinsky DA: Uric acid nephrolithiasis. Curr Rheumatol Rep [2007], 9:251-257.

25. Terkeltaub R, Bushinsky DA, Becker MA: Recent developments in our understanding of the renal basis of hyperuricemia and the development of novel antihyperuricemic therapeutics. Arthritis Res Ther [2006], 8(Suppl 1):S4.

26. Burack RC, Keller JB, Higgins MW: Cardiovascular risk factors and obesity: are baseline levels of blood pressure, glucose, cholesterol and uric acid elevated prior to weight gain? J Chronic Dis [1985], 38:865-872.

Volume 5, Issue 2; March-April 2022; Page No 1312-1327