Journal of Cardiovascular Disease Research
ISSN: 0975-3583, 0976-2833 VOL15, ISSUE01, 2024

A Comparative Study of Serum Lipids and Uric Acid Levels in Prehypertensive and Normotensive Patients

Thammannagari Dinesh[1*], Jagadish K L[2], Uma M A[3], Daivala Sanjana[4]

[1*]PG cum Junior Resident, Department of General Medicine. PESIMSR, Kuppam, Chittoor District, Andhra Pradesh.
[2]Assistant professor, Department of General Medicine, PESIMSR, Kuppam, Chittoor district, Andhra Pradesh.
[3]Professor and Hod, Department of General Medicine, PESIMSR, Kuppam, Chittoor district, Andhra Pradesh.
[4]PG cum Junior Resident, Department of General Medicine, PESIMSR, Kuppam, Chittoor District, Andhra Pradesh.

Corresponding Email: [1*]dineshthammanna@gmail.com

Abstract
Background: Hyperuricemia is the condition which is characterized by abnormal elevation of serum uric acid level, which is defined by serum concentration of uric acid of more than 6.8 mg/dL. The present study is aimed to study of serum uric acid and serum lipid levels in prehypertensive patients in a tertiary care hospital and to study serum uric acid and serum lipid levels in prehypertensive patients and serum uric acid as a possible risk factor for hypertension.
Methods: A cross-sectional study was conducted among Prehypertensive patients attending General Medicine department in a tertiary care centre. The sample size calculated was 89. A proforma containing general details of patients, history, clinical examination including bp readings, systemic examination and blood investigations was used to collect the data. Two or more seated blood pressure readings 1 hr apart using manual sphygmomanometer with appropriate cuff size and patient comfortably sitting in chair and average of Bp readings taken. Fasting lipid profile, Serum uric acid were collected.
Results: On comparison it is observed that mean Total cholesterol among pre hypertensives was 221 ± 12.8 mg/dl which was greater than that among without prehypertension which was 172 ± 15.8mg/dl. Thus, Total cholesterol is more in prehypertension and it was statistically proven to be significant. On comparison it is observed that mean serum UA levels among pre hypertensives was 7.64 ± 0.62mg/dl which was far more than that among without prehypertension which was 5.02± 1.07mg/dl. Thus, serum UA levels is more in prehypertension and it was statistically proven to be significant.
Conclusions: Early prevention of hyperuricemia and dyslipidemia can reduce the incidence of associated cardiovascular disease. The finding of this study should be taken into consideration to implement preventive interventions on identified predictors in hypertensive patients.

Keywords: Lipid Profiles, Tertiary Care Centre, Uric Acid, Prehypertension.

1. Introduction

According to the Eighth Joint National Committee (JNC VIII) guidelines, hypertension is characterized by systolic or diastolic blood pressure exceeding 140/90 mmHg. This condition poses a significant threat to cardiovascular health and is a major contributor to global mortality. Hypertension is broadly classified into two categories: primary hypertension, which lacks a specific underlying cause and accounts for approximately 90% of cases, and secondary

hypertension, which is linked to underlying medical conditions such as renal, vascular, thyroid, or adrenal diseases.[1] The hypertension prevalence is a global concern, affecting an estimated 1.13 billion people worldwide. This number is projected to increase to 1.5 billion by 2025. [2,3] It is essential to understand these distinctive elements for the development of targeted public health interventions and policies to address the challenges of hypertension management. Dyslipidemia is linked to an elevated risk of hypertension. This imbalance of lipids is defined by elevated total cholesterol, low-density lipoprotein (LDL), and triglyceride levels together with lower high-density lipoprotein (HDL) levels. [4, 5]

According to earlier research, excess triglycerides and lipids contribute to atheroma formation on blood vessel walls, impairing flexibility and potentially leading to hypertension. Notably, a significant portion of individuals with hypertension exhibit moderate blood cholesterol levels of 200–239 mg/dL. [6, 7] For several reasons, it is essential to research hypertension in men, particularly in the age group of 45–60. There are notable sex- specific differences in how hypertension presents, with men exhibiting a higher prevalence compared to women.

The investigation of hypertension in men allows for the identification of distinct risk factors, etiological factors, and health implications. Age-specific variations in hypertension have also been documented, with the risk increasing with age. Focusing on this age group allows for a better understanding of age-related patterns and correlations, leading to more targeted preventive measures and interventions. Additionally, given the significant health concern of hypertension in older men, this study may help uncover the factors contributing to its high prevalence by offering insights to guide public health efforts. Lastly, understanding sex and age-specific differences enables the customization of preventive strategies and interventions through lifestyle modifications, targeted screening, or specialized treatments tailored to the needs of this specific population. [8]

Hyperuricemia is the condition which is characterized by abnormal elevation of serum uric acid level, which is defined by serum concentration of uric acid of more than 6.8 mg/dL.[9] Hyperuricemia has long been observed to be related to certain diseases including hypertension, coronary heart disease, chronic renal disease, peripheral vascular disease, stroke, congestive heart failure, obesity, and metabolic syndrome.[10] Hyperuricemia is regarded as an important public health issue due to its progressively increasing prevalence worldwide, reaching up to 20% in general population.[11,12] In the USA, the prevalence of hyperuricemia among general population exceeds 20%,[13] while it reaches up to 25% in China.[14] In Australia, the overall prevalence of hyperuricemia was reported to be 16.6%.[15] This high prevalence in various populations contributes significantly to increased risk of morbidity and mortality.[16] Higher levels of serum uric acid are generally observed with increasing age, and are attributed to either higher synthesis, lower excretion, or both.[17–19]

Synthesis of uric acid is controlled by the liver, which regulates the conversion of endogenous nucleo-proteins and exogenous dietary purine sources into uric acid. On the other hand, the renal system controls the excretion of uric acid from the body via certain urine-forming factors, including glomerular filtration, renal plasma flow, as well as tubular exchange.[19] The association between hyperuricemia and hypertension had long been observed.[20] Hyperuricemia has been identified as an risk factor for the hypertension.[21,22] However, the direct causality between hypertension and hyperuricemia is still debatable, partly owing to the complicated and multi-factorial etiology of hypertension, and to the presence of multiple confounding factors among patients with hypertension.[23]

Aim and Objectives

1. The present study is aimed to study of serum uric acid and serum lipid levels in prehypertensive patients in a tertiary care hospital.

2. To study serum uric acid and serum lipid levels in prehypertensive patients and serum uric acid as a possible risk factor for hypertension.

2. Material and Methods

A cross-sectional study was conducted among Prehypertensive patients attending General Medicine department, PESIMSR, Kuppam for period of 18 months. The prevalence from a previous study done by Singh et all [24] was 63%.Using the formula $4pq/l^2$ the sample size calculated was 89 (at 95% confidence interval and 10% absolute precision). The sample was selected using purposive sampling method

Inclusion Criteria: Group A consists of 45 prehypertensive individuals with SBP 120-139 or DBP 80-89 among elderly and blood pressure between 90th-95th percentile in children and adolescents. Group B consists of 45 normotensive individuals with systolic pressure <120 mm hg and DBP<80 mm hg

Exclusion Criteria: Patients with Diabetes mellitus, Ischemic heart disease, Renal disease, History and presence of jaundice, Chronic liver disease, Familial hyperlipidemia, Patients on lipid-lowering drugs, Smoking, Alcoholics, Obese BMI >25, Gout, Drugs causing hyperuricemia were excluded.

A proforma containing general details of patients, history, clinical examination including bp readings, systemic examination and blood investigations was used to collect the data. Two or more seated blood pressure readings 1 hr apart using manual sphygmomanometer with appropriate cuff size and patient comfortably sitting in chair and average of Bp readings taken. Fasting lipid profile, Serum uric acid were collected.

Procedure for Data Collection

In prehypertensive group after obtaining written informed consent, patient details are collected. This includes demographic details, associated co-morbidities and detailed clinical examination including blood pressure readings using manual sphygmomanometer with appropriate cuff size and patient comfortably sitting in chair and systemic examination. Investigations (serum uric acid and fasting lipid profile)

Done by the treating team are also noted. No additional investigations will be ordered. In normotensive group after obtaining written informed consent, patient details are collected. This includes demographic details, associated co-morbidities and detailed clinical examination including blood readings using manual sphygmomanometer with appropriate cuff size and patient comfortably sitting in chair and systemic examination. Investigations (serum uric acid and fasting lipid profile) done by the treating team are also noted. No additional investigations will be ordered.

The study was approved by Institutional Ethics Committee of PES Institute of Medical Sciences and Research (Ref No. PESIMER/IHEC/C-65/2022 dated 30.09.2022) the data will be entered into MS Excel 2007 version and further analyzed using SPSS (version 20.0; SPSS Inc., Chicago IL, USA). For descriptive analysis, the categorical variables will be analyzed by using frequency and percentages and the continuous variables will be analyzed by calculating mean ± Standard Deviation. For inferential analysis, the numerical data were analyzed using "t- test", the categorical data were analyzed using Chi square test was applied and "p" <0.05 will be considered as statistically significant.

3. Results

90 patients attending Department of General Medicine were enrolled. Out of 90 patients, 45 were patients with prehypertension i.e., patients whose SBP was 120 – 139, DBP was 80 – 89mmHg and 45 patients were normotensive patients

Table 1: Socio-Demographic Factors, Family History and Bmi Wise Distribution

Socio-demographic factor		Pre hypertensive	Normotensive	Total	P value
Age (Mean)		40.27 (12.57)	43.98 (10.7)	42.1 (11.8)	0.351
Gender	Male	23 (51.1)	20 (44.4)	43 (47.8)	0.531
	Female	22 (48.9)	25 (55.6)	47 (52.2)	
Family history	Present	15 (33.3)	12 (26.7)	27 (30)	0.498
	Absent	30 (66.7)	33 (73.3)	63 (70)	
BMI (Mean)		23.5 (1.22)	22.6 (1.23)	24.8 (2.12)	<0.001

Mean age of study participants was 42.1± 11.8 yrs. Mean age of Normotensive patients was 43.98 ± 10.7 years. Mean age of pre hypertensive patients was 40.27 ± 12.57 years. Normotensives were aged more than pre hypertension patients but was not statistically significant. Male and female participants were almost same i.e., 47.8 vs 52.2%. In Pre hypertensives male were more while in Normotensives Females were high. Family history of hypertension was present in 30 % of the study participants, among normotensives 26.7% had family history of hypertension while in prehypertensive patients 33.3% had family history. Thus patients with family history of hypertension are more prone for pre hypertension but was proven statistically insignificant. Mean BMI among prehypertensive was 23.5 ± 1.22kg/m2 which was slightly more than that among without prehypertension which was 22.6 ± 1.23kg/m2. Thus BMI is the predictor of prehypertension and it was statistically proven to be significant. (Table 1)

Table 2: Comparison of Vital Parameters between Pre Hypertensives and Normotensives

vital parameters	Pre hypertensive	Normotensive	Total	P value
SBP	128 (5.6)	110 (5.4)	119 (10.7)	<0.001
DBP	83.2 (2.5)	72.7 (4.9)	77.9 (6.5)	<0.001
Pulse rate	89.4 (9.7)	84.9 (11.8)	87.2 (11.0)	0.049

Mean SBP of our study participants was 119 ±10.7mm Hg. On comparison, it is observed that mean SBP among prehypertensives was 128 ± 5.58mm Hg which was more than that among without prehypertension which was 110 ± 5.43mm Hg. Thus,SBP is more in prehypertension and it was statistically proven to be significant. Mean DBP of our study participants was 77.9± 6.53mm Hg. On comparison it is observed that mean DBP among pre hypertensives was 83.2 ± 2.5mm Hg which was far more than that among without prehypertension which was 72.7 ± 4.9mm Hg. Thus, DBP is more in prehypertension and it was statistically proven to be significant. Mean Pulse rate of our study participants was 87.2 ± 11beats/min. On comparison that mean pulse rate among pre hypertensives was 89.4 ± 9.7 beats /min which was more than that among without prehypertension which was 84.9 ± 11.8beats /min. Thus, pulse rate is more in prehypertension and it was statistically proven to be significant. (Table 2)

Table 3: Comparison of Lipid Profile between Pre Hypertensives and Normotensives

lipid profile	Pre hypertensive	Normotensive	Total	P value
Total cholesterol	221 (12.8)	172 (15.8)	197 (28.7)	<0.001
Triglycerides	178 (10.6)	131 (10.3)	154 (25.9)	<0.001

HDL	47.8 (5.5)	72.2 (8.8)	60 (14.3)	<0.001
LDL	129 (14.1)	81.1 (11.2)	105 (27.4)	<0.001
VLDL	50.3 (9.1)	20.5 (5.9)	35.5 (16.8)	<0.001

Mean Total cholesterol of our study participants was 197 ± 28.7mg/dl. On comparison it is observed that mean Total cholesterol among pre hypertensives was 221 ± 12.8 mg/dl which was far more than that among without prehypertension which was 172 ± 15.8mg/dl. Thus, Total cholesterol is more in prehypertension and it was statistically proven to be significant. Mean Triglycerides of our study participants was 154 ± 25.9mg/dl. On comparison, it is observed that mean Triglycerides among pre hypertensives was 178 ± 10.6mg/dl which was far more than that among without prehypertension which was 131 ± 10.3mg/dl. Thus, Triglycerides is more in prehypertension and it was statistically proven to be significant. Mean HDL of our study participants was 60 ± 14.3mg/dl. On comparison it is observed that mean HDL among pre hypertensives was 47.8 ± 5.54mg/dl which was far less than that among without prehypertension which was 72.2 ± 8.77mg/dl. Thus, HDL is less in prehypertension and it was statistically proven to be significant. Mean LDL of our study participants was 105 ± 27.4mg/dl. On comparison it is observed that mean LDL among pre hypertensives was 129 ± 14.1mg/dl which was far more than that among without prehypertension which was 81.1 ± 11.2mg/dl. Thus, LDL is more in prehypertension and it was statistically proven to be significant. Mean VLDL of our study participants was 35.45 ± 16.8mg/dl. On comparison, it is observed that mean VLDL among pre hypertensives was 50.3 ± 9.09mg/dl which was far more than that among without prehypertension which was 20.5 ± 5.99mg/dl. Thus, VLDL is more in prehypertension and it was statistically proven to be significant. (Table 3)

Table 4: Comparison of Serum Uric Acid Level between Pre-Hypertensives and Normotensives

serum uric acid level		Pre hypertensive	Normotensive	Total	P value
Mean Uric acid		7.64 (0.62)	5.02 (1.07)	6.33 (1.58)	<0.001
Hyperuricemia	Present	20 (44.4)	3 (6.7)	3 (25.6)	<0.001 OR (11.2, 95% CI: 3.02-41.5)
	Absent	25 (55.6)	42 (93.3)	67 (74.4)	

Mean Serum Uric acid levels of our study participants was 6.33± 1.58mg/dl. On comparison, mean serum Uric acid levels among pre hypertensives was 7.64 ± 0.62mg/dl, which was far more than that among without prehypertension which was 5.02± 1.07mg/dl. Thus, serum Uric acid levels is more in prehypertension and it was statistically proven to be significant. With the serum uric acid levels we investigated, all the participants were categorized into patients with and without Uricemia. Patients with and without Uricemia were compared with patients with and without prehypertension. Among the patients with prehypertension, 44.4% of patients had hyperuricemia while among normotensives only 6.7% had hyperuricemia. Thus statistically significant association between hyperuricemia and prehypertension was observed. Presence of Hyperuricemia has 11.2 times risk of having pre hypertension. (Table 4)

Table 5: Correlation between Serum Uric Acid and Associated Factors

Associated factor	Correlation coefficient	P value
SBP	0.72	<0.001
DBP	0.65	<0.001
TC	0.78	<0.001

TG	0.83	<0.001
HDL	-0.79	<0.001
LDL	0.83	<0.001
VLDL	0.8	<0.001

Table 5 shows the correlation matrix between Lipid profile, SBP, DBP and Serum Uric Acid with pre hypertension. It was observed that Serum uric acid has strongly positive significant association with Lipid profile and Blood pressure along with presence of prehypertension. Serum Uric acid was negatively associated with HDL which was statistically significant. (Table 5)

4. Discussion

A cross-sectional study was conducted to assess the role of serum uric acid and lipid profile in pre hypertensive patients.

In this study Mean age of study participants was 42.1± 11.8 yrs. In the study by M.A-W. Abdul-Razzaq et al [25] Age of participants ranged from (21-90) years, with a mean age of (47.21 ± 12.53) years and a median age of (48.5) years. In the study by Timerga A, Haile K [26]

On comparison it is observed that mean BMI among prehypertensives was 23.5 ± 1.22kg/m2 which was slightly more than that among without prehypertension which was 22.6 ± 1.23kg/m^2. Thus BMI is the predictor of prehypertension and it was statistically proven to be significant. In the study by Ali et al [27] the average BMI for all participants was 24 ± 4 kg/m2 with no significant difference between the gender groups. The mean value of WC was 85 ± 7 with a significant difference between male and female ($p < 0.05$) subjects. In the study by M.A-W. Abdul-Razzaq et al [25] (35%) of hypertensive and (37%) of non-hypertensive had BMI of overweight (25-29.9).

In the study by Timerga A, Haile K [26] When we come to BMI level, about half (44.1% (119)) of participants were overweight and 138(51.1%) were centrally obese. The mean ±standard deviation (SD) of the central obesity and BMI was 98.26± (8.22) and 26.2± (3.22) respectively. This was supported with similar studies conducted in Ethiopia, Japan and Bangladesh. [27, 28]

The possible explanation could be higher BMI and being centrally obese or excessive body fat may be related to excessive uric acid production and its poor excretion, due to insulin resistance, resulting in impaired uric acid metabolism to the level of hyperuricemia. Those patients with insulin resistance secrete larger amounts of insulin to maintain an adequate glucose metabolism in negative feedback mechanism and the kidney responds to the high insulin levels by decreasing uric acid clearance, probably linked to insulin-induced urinary sodium retention in centrally obese patients. Meanwhile, hyperuricemia in turn can induce obesity by enhancing liver and peripheral fat production. [29, 30, 31]

Mean Total cholesterol was compared between patients with and without prehypertension. Mean Total cholesterol of our study participants was 197 ± 28.7mg/dl. On comparison it is observed that mean Total cholesterol among pre hypertensives was 221 ± 12.8 mg/dl which was far more than that among without prehypertension which was 172 ± 15.8mg/dl. Thus, Total cholesterol is more in prehypertension and it was statistically proven to be significant. In the study by Prem Kumar Arora et al [32] lipid profile was compared between hypertensives and normotensives. Mean serum total cholesterol values were highly significant in hypertensive subjects (235.36±32.36mg/dL) as compared to the healthy control subjects (152.36±12.01mg/dL) and the results were similar to current study. Similar results were observed in the study by Sushma et al [33] in which significantly higher levels of serum Triglycerides, serum Cholesterol, serum LDL-Cholesterol.

Triglycerides was compared between patients with and without prehypertension. Mean Triglycerides of our study participants was 154 ± 25.9mg/dl. On comparison it is observed that mean Triglycerides among pre hypertensives was 178 ± 10.6mg/dl which was far more than that among without prehypertension which was 131 ± 10.3mg/dl. Thus, Triglycerides is more in prehypertension and it was statistically proven to be significant. The study by Prem Kumar Arora et al [32] mean serum TG level was 110.36±16.12 mg/dl in healthy control subjects, and 215.23±35.36 mg/dl in hypertensive patients. This difference was highly significant. In accordance to our study, Saha MS et al (2006) [34] also reported a statistically highly significant relation in serum TG level in hypertensive subjects (184.77±5.97 mg/dL) as compared to the healthy controls (142.73±6.68 mg/dL).

Mean HDL was compared between patients with and without prehypertension. Mean HDL of our study participants was 60 ± 14.3mg/dl. On comparison it is observed that mean HDL among pre hypertensives was 47.8 ± 5.54mg/dl which was far less than that among without prehypertension which was 72.2 ± 8.77mg/dl. Thus, HDL is less in prehypertension and it was statistically proven to be significant. The study by Prem Kumar Arora et al [32] the mean values for HDL was 27.23±6.02 mg/dL for hypertensive subjects whereas 43.21±5.36 mg/dl for healthy control subjects, respectively.

Mean LDL was compared between patients with and without prehypertension. Mean LDL of our study participants was 105 ± 27.4mg/dl. On comparison it is observed that mean LDL among pre hypertensives was 129 ± 14.1mg/dl which was far more than that among without prehypertension which was 81.1 ± 11.2mg/dl. Thus, LDL is more in prehypertension and it was statistically proven to be significant. The study by Prem Kumar Arora et al [32] The Mean serum LDL values were highly significant in hypertensive subjects (154.36±31.26 mg/dL) as compared to the healthy control subjects (95.36±16.02mg/dL).

Mean VLDL was compared between patients with and without prehypertension. Mean VLDL of our study participants was 35.45 ± 16.8mg/dl. On comparison, mean VLDL among pre hypertensives was 50.3 ± 9.09mg/dl, which was far more than that among without prehypertension which was 20.5 ± 5.99mg/dl. Thus, VLDL is more in prehypertension and it was statistically proven to be significant. Oparil et al [35] explained different mechanisms through which dyslipidemias may cause hypertension over time.

Mean Serum UA level was compared between patients with and without prehypertension. Mean Serum Uric acid levels of our study participants was 6.33± 1.58mg/dl. On comparison, it is observed that mean serum UA levels among pre hypertensives was 7.64 ± 0.62mg/dl which was far higher than that among without prehypertension which was 5.02± 1.07mg/dl. Thus, serum Uric acid levels is more in prehypertension and it was statistically proven to be significant. In the study by M.A-W. Abdul-Razzaq et al [25] Serum uric acid level was found to be significantly more among hypertensive compared to non-hypertensive. Mean difference between the two groups was (0.61) mg/dL.

The current study had shown that (11.59%) of hypertensive had hyperuricemia compared to (1.41%) of non-hypertensive. These findings were comparable to the findings by El-Yassin et al. shown (11%) of cases had hyperuricemia while (9%) of control had hyperuricemia.[36] Patients with and without Uricemia were compared with patients with and without prehypertension. Among the patients with prehypertension, 44.4% of patients had hyperuricemia while among normotensives only 6.7% had hyperuricemia. Thus statistically significant association between hyperuricemia and prehypertension was observed. Presence of Hyperuricemia has 11.2 times risk of having pre hypertension.

In the study by M.A-W. Abdul-Razzaq et al [25] regarding hyperuricemia, a total of (9) patients had uric acid level higher than 6.8 mg/dL, constituting (6.43%) of total study participants. Proportion of patients with hyperuricemia was found to be significantly higher among

hypertensive compared to non-hypertensive. Also a similar study was done Nobel Medical College, Biratnagar district of Nepal where the magnitude of hyperuricemia was found to be 28.57%. [37]

5. Conclusions

Early prevention of hyperuricemia and dyslipidemia can reduce the incidence of associated cardiovascular disease. The finding of this study should be taken into consideration to implement preventive interventions on identified predictors in hypertensive patients. Taking fruit and vegetable, and promoting physical exercise and determinations of serum uric acid level in adult essential hypertensive patients was recommended to minimize the emergence of hyperuricemia. The most important management of these derangements can best be achieved by averting the underlying pathophysiologic events.

6. References

1. James PA, Oparil S, Carter BL, et al (2014). 2014 evidence-based guideline for the management of high blood pressure in adults. JAMA 311, 507. doi: 10.1001/jama.2013.284427
2. Kingue S, Ngoe CN, Menanga AP, et al (2015). Prevalence and risk factors of hypertension in urban areas of cameroon: A nationwide population-based cross-sectional study. The Journal of Clinical Hypertension 17, 819–824. doi: 10.1111/jch.12604.
3. Nawi AM, Mohammad Z, Jetly K, et al (2021). The prevalence and risk factors of hypertension among the urban population in Southeast Asian countries: A systematic review and meta-analysis ed. Salvetti M. International Journal of Hypertension 2021, 1–14. doi: 10.1155/2021/6657003.
4. Islam S, Choudhury KN, Mainuddin A, et al (2014). Serum lipid profile and its association with hypertension in Bangladesh. Vascular Health and Risk Management 327. doi: 10.2147/VHRM.S610 19
5. Astana PRW, Triyono A (2018). Gambaranprofil lipid padapasienhipertensi di KlinikSaintifikasiJamuHortusMedicusTawamangu. JurnalFarmasiGalenika (Galenika Journal of Pharmacy) (e-Journal). Available at: https://docplayer.info/ 72814612-Gambaran-profil-lipid-pada-pasien-hipertensi-di-klinik-saintifikasi-jamu-hortusmedicu stawangmangu-peristiwan-r-widhi-astana-1-dan-a gus-triyono-1.html
6. Kusmiati M, Pratiwi D (2015). Gambaranprofil lipid padapasien yang mengalamihipertensi di DesaSetiajaya Kota Tasikmalaya. KesehatBakti Tunas Husada. Available at: https://ejurnal.univer sitas-bth.ac.id/index.php/P3M_JKBTH/article/vie w/15/15.
7. Maryati H (2017). The correlation of cholesterol levels with blood pressure hypertension patients in SidomulyoRejoagung Village District PlosoJombang. JurnalKeperawatan. doi: 10.22219/jk.v 8i2%20Juli.4030.
8. Choi HM, Kim HC, Kang DR (2017). Sex differences in hypertension prevalence and control: Analysis of the 2010-2014 Korea National Health and Nutrition Examination Survey ed. Spracklen CN. PLoS One 12, e0178334. doi: 10.1371/journal.pone.0178334.
9. Benn C, Dua P, Gurrell R et al. Physiology of Hyperuricemia and Urate Lowering Treatments. Frontiers in Medicine. 2018; 5:160.
10. Becker M, Jolly M. Hyperuricemia and Associated Diseases. Rheumatic Disease Clinics of North America. 2006; 32:275–293.

11. Desideri G, Puig J, Richette P. The management of hyperuricemia with urate deposition. Current Medical Research and Opinion. 2015; 31(2):27–32.
12. Dong Z, Tian M, Li H et al. Association of Serum Uric Acid Concentration and Its Change with Cardiovascular Death and All-Cause Mortality. Disease Markers. 2020; 2020:7646384.
13. Zhu Y, Pandya Bh, Choi H. Prevalence of Gout and Hyperuricemia in the US General Population. Arthritis and Rheumatism. 2011; 63(10):3136–3141.
14. Liu H, Zhang X, Wang Y, and Liu B. Prevalence of hyperuricemia among Chinese adults: a national cross-sectional survey using multistage, stratified sampling. Journal of Nephrology. 2014; 27(6):653–658.
15. Ting K, Gill T, Keen H, Tucker G, Hill C. Prevalence and associations of gout and hyperuricaemia: results from an Australian population-based study. Internal Medicine Journal. 2016; 46(5):566–573.
16. Dong H, Xu Y, Zhang X, Tian S. Visceral adiposity index is strongly associated with hyperuricemia independently of metabolic health and obesity phenotypes. Scientific Reports. 2017; 7:8822.
17. Richette P, Bardin Th. Gout. The Lancet. 2010; 375:318–328.
18. Roddy E, Doherty M. Epidemiology of gout. Arthritis Research & Therapy. 2010; 12:223.
19. De Oliveira E, Burini R. High plasma uric acid concentration: causes and consequences. Diabetology& Metabolic Syndrome. 2012; 4:12.
20. Feig D, Kang D, Nakagawa T, Mazzali M, Johnson R. Uric Acid and Hypertension. Current Hypertension Reports. 2006; 8:111–115.
21. Kuwabara M, Niwa K, Nishi Y et al. Relationship between serum uric acid levels and hypertension among Japanese individuals not treated for hyperuricemia and hypertension. Hypertension Research. 2014; 37:785–789.
22. Agarwal V, Hans N, Messerli F. Effect of allopurinol on blood pressure: a systematic review and meta-analysis. Journal of Clinical Hypertension (Greenwich). 2013; 15(6):435–442.
23. Stewart D, Langlois V, Noone D. Hyperuricemia and Hypertension: Links and Risks. Integrated Blood Pressure Control. 2019; 12:43–62.
24. 70. Singh RB, Fedacko J, Pella D, Macejova Z, Ghosh S, de Amit K, Begom R, Tumbis ZA, Haque M, Vajpeyee SK, de Meester F, Sergey C, Agarwalo R, Muthusamy VV; Five City Study Group, Gupta AK. Prevalence and risk factors for prehypertension and hypertension in five Indian cities. ActaCardiol. 2011 Feb; 66(1):29-37.
25. M.A-W. Abdul-Razzaq et al., "Assessment of Serum Uric Acid Level in Patients with Systemic Arterial Hypertension" Iraq Med J | Vol. 6, No. 4, Autumn 2022: 167–172
26. Timerga A, Haile K (2021) Evaluation of uric acid disorders and associated factors in essential hypertensive patients at Wolkite University specialized hospital, Southern Ethiopia. PLoS ONE 16(9): e0256557. https://doi.org/ 10.1371/journal.pone.0256557
27. Ali N, Miah R, Hasan M, Barman Z, Mou AD. Association between serum uric acid and metabolic syndrome: a cross-sectional study in Bangladeshi adults. Sci Rep [Internet]. Springer US; 2020; 10:1–7. Available from: https://doi.org/10.1038/s41598-019-56847-4 PMID: 31913322
28. Woldeamlak B, Yirdaw K, Biadgo B. Hyperuricemia and its association with cardiovascular disease risk factors in type two diabetes mellitus patients at the University of Gondar Hospital, Northwest Ethiopia. J Int Fed ClinChem Lab Med. 2019; 30(3):325 39.

29. Li F, Wu J, Tan M, Wang M. Serum Uric Acid Levels and Metabolic Indices in an Obese Population: A Cross-Sectional Study. Diabetes, MetabSyndrObes Targets Ther. 2021; 14:627–35
30. Shirasawa T. Cross-sectional study of associations between normal body weight with central obesity and hyperuricemia in Japan. BMC EndocrDisord. 2014; 14:1–14.
31. Lee JH. Prevalence of hyperuricemia and its association with metabolic syndrome and cardiometabolic risk factors in Korean children and adolescents: analysis based on the 2016–2017 Korea National Health and Nutrition Examination Survey. Korean J Pediatr. 2019; 62(8):317–23. https://doi.org/10. 3345/kjp.2019.00444 PMID: 31319650
32. Prem Kumar Arora, Jayant Nath, "A Study on the Lipid Profile of Hypertensive Patients" International Journal of Medical and Biomedical Studies, Volume 6, Issue 03; March: 2022; Page No. 32-34.
33. Sushma et al., "Assessment of Serum Lipid Profile in Hypertensive Patients: A Case-Control Study" Int. j. clin. Biomed. res. 2020; 6(1):21-24].
34. Saha MS, Sana NK, Shaha RK. Serum Lipid Profile of Hypertensive Patients in the Northern Region of Bangladesh. J Bio Sci. 2006; 14:93-98.
35. Oparil S, Zaman MA, Calhoun DA. "Pathogenesis of hypertrnsion. Ann Intern Med 2003; 139:761-76.
36. El-Yassin H, Al-Sharifi Z, Al-Jebuori S. Prevalence of hyperuricemia and its correlation with cardiovascular risk factors in Iraqi subjects of karbalaa city. Journal of the Faculty of Medicine Baghdad. 2012; 54(1):83–87.
37. Kumar NL, Deepthi J, Rao YN, Deedi MK, Study of lipid profile, serum magnesium and blood glucose in hypertension. Biology and Medicine; 2010; 2(1): 6-16.