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Age and Gender Specific Associations between Hyperuricemia and Hypertension: A Cross-Sectional Study in Karachi

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ABSTRACT

Hyperuricemia is increasingly linked to hypertension and various metabolic disorders. **Objectives:** To investigate the relationship between hyperuricemia and various anthropometric indices among individuals newly diagnosed with hypertension, with an emphasis on identifying potential age- and gender-specific patterns. **Methods:** The cross-sectional study enrolled 370 newly diagnosed hypertensive adults (230 male and 140 female), aged 18 years and above, using stratified sampling. Anthropometric data, blood pressure, and serum uric acid levels were recorded. Serum uric acid (SUA) levels above 7 mg/dL in males and above 6 mg/dL in females were used to define hyperuricemia. SPSS version 22.0 was used for statistical analysis. Independent t-tests, Pearson's correlation, Chi-square tests, and ANOVA were applied to analyze the data, with a significance level of $p<0.05$. **Results:** The research found a 27.5% prevalence of hyperuricemia, significantly higher in male (33.9%) than female (17.1%) ($p<0.001$). Male had significantly elevated systolic BP ($p=0.043$), waist circumference ($p<0.001$), and serum uric acid levels ($p<0.001$). Serum uric acid showed positive correlations with systolic BP ($p=0.001$), diastolic BP ($p=0.007$), BMI ($p<0.001$), waist circumference ($p<0.001$), and age ($p=0.024$). Hyperuricemic individuals had significantly higher age, BP, BMI, and waist circumference (all $p<0.01$). Females with hyperuricemia were older ($p=0.04$) and more frequently in the >50 age group ($p=0.036$). **Conclusions:** It was concluded that male showed a higher prevalence of hyperuricemia, while older age was a significant factor for females. These findings suggest the importance of monitoring serum uric acid as an early marker for cardiovascular and metabolic risks, particularly in populations at risk based on gender and age.

INTRODUCTION

Hypertension is a persistent elevation in blood pressure, though diagnostic thresholds may vary slightly across guidelines. According to the European Society of Cardiology/European Society of Hypertension (ESC/ESH, 2018), hypertension is defined as blood pressure equal to or exceeding 140/90 mmHg. In contrast, the American College of Cardiology/American Heart Association (ACC/AHA, 2017) considers blood pressure values of 130/80 mmHg or higher as indicative of hypertension, based on interpretations from various clinical studies [1, 2]. It remains a major global public health challenge, as it contributes significantly to cardiovascular mortality [3]. Epidemiological data obtained from Pakistan reveal that hypertension affects around 26% of adults, with the condition being more prevalent in urban regions than in rural areas [4]. Uric acid is formed as a result of the breakdown of endogenous cellular components and the metabolism of dietary purines [5]. Initial scientific findings demonstrated that elevated

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uric acid levels are involved in causing hypertension by contributing to vascular dysfunction and increased blood pressure [6]. Several pathophysiological pathways have been proposed, including oxidative stress, endothelial dysfunction, and activation of the renin-angiotensin-aldosterone system (RAAS) [7]. Hypertension causes vascular damage by exerting harmful effects on blood vessels, and a rise in uric acid is similarly associated with vascular injury. SUA contributes to oxidative stress primarily by activating NADPH oxidases, which are major enzymes responsible for producing reactive oxygen species in vascular tissues. It also suppresses the activity of endothelial nitric oxide synthase, resulting in a decrease in nitric oxide. This reduction impairs vasodilation, increases vasoconstriction, and results in endothelial dysfunction [8]. Epidemiological studies suggest that uric acid levels above 7 mg/dL in men and 6 mg/dL in women are considered hyperuricemia, and are associated with a 1.5 to 2-fold increased risk of developing hypertension [9]. Though this link appears to vary by age and gender, with a study reporting stronger correlations in younger women [10]. In contrast, a Chinese study found the association to be more prominent in adult men and older women [11]. Pre-menopausal females usually have lower SUA levels in comparison to men, primarily due to the uricosuric effect of estrogen [12]. A longitudinal study has identified hyperuricemia as a risk factor for hypertension and a cause of metabolic syndrome across all age groups [13].

This study aims to examine the association between serum uric acid levels, blood pressure, and anthropometric indices in a newly diagnosed hypertensive population in Karachi.

METHODS

This is a cross-sectional analytical study aimed at examining the associations between hyperuricemia and hypertension among newly diagnosed hypertensive individuals in Karachi. The research took place during three months (December 2024 to February 2025) at Fazaia Ruth Pfau Medical College. Ethical approval was obtained from the Ethical Review Committee of Fazaia Ruth Pfau Medical College under protocol number FRPMC-IRB-2024-69, following the ethical standards of the Declaration of Helsinki and its subsequent amendments. This research included 370 newly diagnosed hypertensive participants who met the demographic criteria of being 18 years or older, with both male and female represented. This study utilized Open Epi software to determine its sample size since this program remains common across epidemiological research. The assessment used the 95% confidence level formula together with a 5% margin of error for proportion estimation. The Karachi adult population contains approximately 26% of hypertension cases [14]. The researchers chose participants through stratified sampling, which included both genders and different age groups. The investigation included healthy adults newly diagnosed with hypertension between 18 and 60 years old, with no history of kidney disease, diabetes, stroke, cardiovascular conditions, metabolic disorders, or the use of medications affecting blood pressure or serum uric acid levels. Participants were also required to provide informed consent in the local language. The study excluded participants who were smokers, pregnant or breastfeeding, used antihypertensive or antihyperuricemic drugs, had a history of gout or cardiovascular issues, kidney disease, diabetes, lipid disorders, or any other ongoing health conditions. Individuals who were unable to provide informed consent or those with recent acute illness or infection were also excluded. The study involved the collection of demographic, anthropometric, and biochemical data. The participants underwent evaluation early in the day following a minimum 12-hour fasting period. Participants provided their demographic characteristics, including age and gender, together with medical status and lifestyle patterns, including physical activity levels and dietary patterns, by following a structured questionnaire. The investigation used three anthropometric measurements for height and weight assessment by a Secastadiometer, while weight measurements were acquired by an electronic digital weighing machine. Body mass index was generated from height measured in meters squared and weight in kilograms. Waist circumference was calculated to 1 cm using a tape placed at the mid-position between the lower margin of the last rib and the iliac crest. A body mass index (BMI) of 30 kg/m^2 or higher was taken, while central obesity was identified by a waist circumference of more than 94 cm in men and 80 cm in women. Researchers measured hypertension twice through the OMRON 907 automated sphygmomanometer during a minimum five-minute rest period. The two blood pressure readings were averaged to use in analysis where hypertension was indicated by a systolic pressure of 140 mmHg or higher and/or a diastolic pressure of at least 90 mmHg. The Mindray BS-200E biochemical analyzer measured serum uric acid levels from blood samples obtained through venipuncture. The research data were explored by GraphPad Prism version 8.0.2 through a system of recording options. The research presented data as mean ± standard deviation (SD), together with categorical data displayed through simple percentages. The Shapiro-Wilk test was used to assess normality before applying parametric tests such as the t-test and ANOVA. To assess differences between groups, the researchers employed the t-test and one-way analysis of variance (ANOVA) for continuous variables, and the chi-square test for categorical variables. Pearson's correlation analysis was used to explore the relationships between age, BMI, blood

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pressure, and serum uric acid levels. A p-value of 0.05 or less was considered statistically significant. Consent was secured from the study individuals before their inclusion in the study. Data confidentiality assurances were provided to study participants before the researchers performed complete dataset anonymization before analysis. All participants received information about their freedom to join the research study voluntarily and their ability to leave with no negative repercussions.

RESULTS

The research included 370 study participants, comprising 230 male and 140 female, for analysis. Normality of the data was assessed using the Shapiro-Wilk test, confirming that all continuous variables were normally distributed. The results indicated that all variables, including age, systolic and diastolic blood pressure, body mass index (BMI), waist circumference, and serum uric acid levels, were normally distributed, with p-values greater than 0.05. Specifically, the p-values for age (p=0.065), systolic BP (p = 0.082), diastolic BP (p=0.091), BMI (p=0.073), waist circumference (p=0.086), and serum uric acid (p=0.079) all exceeded the 0.05 threshold, confirming the assumption of normality. The study displays the essential demographic information for all study participants. The research included both male and female individuals, with a mean age of 38.7 ± 11.6 years for males and 39.2 ± 12.1 years for females. Men exhibited higher systolic blood pressure levels, reaching 136.4 ± 13.9 mmHg, compared to female, who registered 132.7 ± 15.3 mmHg (p=0.043). The waist circumference findings demonstrated significant gender differences, with men measuring 94.8 ± 10.6 cm and women 88.7 ± 11.4 cm (p<0.001). Male participants also maintained higher uric acid concentrations, averaging 6.8 ± 1.1 mg/dL, while female participants had lower levels at 5.5 ± 1.0 mg/dL (Table 1).

Table 1: General Features of Research Participants (n=370)

Features	Males (n=230)	Females (n=140)	p-Value
Age (Years)	38.7 ± 11.6	39.2 ± 12.1	0.842
Systolic BP (mmHg)	136.4 ± 13.9	130.7 ± 15.3	0.043*
Diastolic BP (mmHg)	84.2 ± 11.3	85.9 ± 12.1	0.248
BMI (kg/m^2)	26.4 ± 4.2	27.3 ± 5.1	0.07
Waist Circumference (cm)	94.8 ± 10.6	88.7 ± 11.4	<0.001**
Serum Uric Acid (mg/dL)	6.8 ± 1.1	5.5 ± 1.0	<0.001**

** Indicates p<0.01 (high statistical significance), * Indicates p<0.05 (statistical significance)

Results present that among the 370 participants, 78 male (33.9%) and 24 female (17.1%) were found to have hyperuricemia. The analysis of the study subjects showed that the prevalence of hyperuricemia reached 27.5% (Table 2).

Table 2: Prevalence of Hyperuricemia by Gender

Hyperuricemia Criteria	Males (n=230)	Females (n=140)	Total (n=370)
SUA >7.0 mg/dL (M), >6.0 (F)	78 (33.9%)	24 (17.1%)	102 (27.5%)

Findings present a positive statistical relationship between SUA and systolic BP (r=0.18, p=0.001), diastolic BP (r=0.14, p=0.007), BMI (r=0.21, p<0.001), and waist circumference (r=0.27, p<0.001). The research data revealed a statistically significant age-related relationship (r=0.12, p=0.024) between SUA values (Table 3).

Table 3: Correlation of Serum Uric Acid (SUA) with Clinical Parameters (n=102)

Parameters	Pearson's r	p-value
Age (Years)	0.12	0.024*
Systolic Blood Pressure (mmHg)	0.18	0.001**
Diastolic Blood Pressure (mmHg)	0.14	0.007**
BMI (kg/m^2)	0.21	<0.001**
Waist Circumference (cm)	0.27	<0.001**

** Indicates p<0.01 (high statistical significance) and * Indicates p<0.05 (statistical significance)

The study indicates that individuals with hyperuricemia (n=102) had a significantly higher mean age (42.1 ± 10.8 years) compared to those without hyperuricemia (38.5 ± 12.0 years) (p=0.008). Furthermore, those with hyperuricemia had significantly higher systolic BP (139.6 ± 13.2 mmHg vs. 131.2 ± 14.8 mmHg, p<0.001), diastolic BP (87.1 ± 11.2 mmHg vs. 83.2 ± 11.7 mmHg, p=0.003), BMI (28.6 ± 4.9 kg/m^2 vs. 26.4 ± 4.6 kg/m^2, p<0.001), and waist circumference (95.2 ± 10.9 cm vs. 89.1 ± 11.4 cm, p<0.001) (Table 4).

Table 4: Age Group Distribution of Male and Female with Hyperuricemia (HU)

Age Group (Years)	Males with HU (n=78)	Females with HU (n=24)	p-value (M vs. F)
18-30	9 (11.5%)	3 (12.5%)	0.932
31-40	28 (35.9%)	2 (8.3%)	0.018*
41-50	20 (25.6%)	8 (33.3%)	0.821
>50	17 (21.8%)	11 (45.8%)	0.036*

** Indicates p<0.01 (high statistical significance) and * Indicates p<0.05 (statistical significance)

Results present a comparative analysis of clinical parameters between hyperuricemic males and females. Among these parameters, only age showed a statistically significant difference, with females being older (44.3 ± 11.1 years) than males (40.8 ± 10.2 years) (p=0.04) (Table 5).

Table 5: Comparative Analysis of Clinical Parameters between Male and Female

Parameters	Male (n=78)	Female (n=24)	p-value
Age (Years)	40.8 ± 10.2	44.3 ± 11.1	0.04*
Systolic BP (mmHg)	140.0 ± 13.2	138.0 ± 13.2	0.30
Diastolic BP (mmHg)	86.4 ± 11.0	87.8 ± 11.5	0.48

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BMI (kg/m^2)	28.1 ± 4.8	29.0 ± 5.1	0.36
Waist Circumference (cm)	96.5 ± 11.0	93.9 ± 10.7	0.17

** Indicates p<0.01 (high statistical significance) and * Indicates p<0.05 (statistical significance)

DISCUSSION

The level of link between high uric acid levels and elevated blood pressure exists with diverse changes in individuals, which include demographic characteristics like gender and age. Research shows that a rise in uric acid increases the risk of hypertension and heart diseases, but the exact cause-and-effect links remain under discussion [15]. The mechanistic link between elevated SUA and hypertension may involve uric acid-induced activation of the renin-angiotensin system and promotion of vascular inflammation. These pathways are thought to contribute to increased arterial resistance, which raises systolic BP [16]. This study investigated the gender and age associations between hyperuricemia and hypertension among healthy adults in Karachi. Our findings revealed that male had significantly higher mean serum uric acid (SUA) levels (6.8 ± 1.1 mg/dL) compared to female (5.5 ± 1.0 mg/dL), and a higher prevalence of hyperuricemia was also observed among male (33.9%) versus female (17.1%). Moreover, hyperuricemia emerged as an independent predictor of increased systolic blood pressure in male, whereas no such association was observed in female. Similarly, the previous literature also reported gender disparities in SUA levels. Men diagnosed with hyperuricemia (and mainly at middle-aged stages) exhibited elevated hypertension risks compared to men without the condition, but women showed no such link between hyperuricemia and hypertension. Additionally, the research showed that hyperuricemia functions independently as a risk factor to increase blood pressure levels in male patients but not in female patients [17]. A survey study from China found that serum uric acid (SUA) concentrations were greater in males compared to females. In men, increased SUA levels showed a positive correlation with hypertension. Among women, elevated SUA was significantly linked to both hypertension and diabetes. After controlling for possible confounders, SUA continued to be identified as an independent determinant of high blood pressure in male [18]. The ELSA-Brasil cohort research presented that the mean level of serum uric acid reached 6.3 mg/100 ml for men and 4.7 mg/100 ml for women, which demonstrates increased SUA in male patients.The prevalence of hyperuricemia increased more frequently among elderly women than elderly men, who showed similar SUA levels [19]. Another study found that postmenopausal women had significantly higher SUA levels compared to premenopausal women, possibly owing to the loss of estrogen's uricosuric effect [20].Moreover, a sex- and age-adjusted analysis in 2021 showed that hyperuricemia affected 13.6% of the population, but women had a notably lower rate of 2.6% than men at 24.3% based on serum levels exceeding 420mmol/L. She *et al.*, revealed that the elderly female population (≥60 years old) experienced higher HUA prevalence than middle-aged and younger women based on their findings [21]. This increase in prevalence in women after menopause supports the finding in our study that female over 50 years had a higher prevalence of hyperuricemia (45.8%) compared to male (21.8%), suggesting that postmenopausal women experience an increase in uric acid due to the loss of estrogen's protective effects [22]. Additionally, She *et al.*, also reported that the occurrence of HUA in males was significantly higher in the 2019 group across all age groups, with young men (20–39 years) showing the maximum prevalence [21].This trend is reflected in our study, where male aged 31–40 years had a considerably greater incidence of hyperuricemia (35.9%) compared to female (8.3%) in the same age group.In this study, serum uric acid (SUA) was linked with age, systolic and diastolic blood pressure, body mass index (BMI), and waist circumference (WC).These findings are in line with results from a study conducted in Ghana, which also observed significant positive relationships between SUA and factors such as age, BMI, and WC, particularly among women over the age of 45 [23].Furthermore, a broad-based research performed in China revealed that elevated body mass index (BMI) and waist circumference (WC) were significantly linked to a greater risk of developing new-onset hyperuricemia in individuals with hypertension [24]. The research from the United States established that the combination of hyperuricemia and overweight/obesity significantly increased the occurrence of hypertension, suggesting a synergistic effect between elevated SUA levels and increased body weight.Additionally, a longitudinal study from the Gusu cohort demonstrated that obesity precedes hyperuricemia, which in turn partially mediates the development of hypertension.The mediation analysis indicated that hyperuricemia accounted for a portion of the effect of obesity on both systolic and diastolic blood pressure, highlighting the intermediary role of elevated uric acid levels in the progression from obesity to hypertension [25].

CONCLUSIONS

It was concluded that the gender- and age-specific variations observed in serum uric acid levels underline the importance of considering demographic factors in managing hyperuricemia. Given the increased risk of hypertension, particularly in men and postmenopausal women with hyperuricemia, early detection and targeted interventions are crucial for mitigating long-term cardiovascular risks. Upcoming research ought to focus on exploring the pathways linking hyperuricemia to hypertension and assessing the effectiveness of personalized treatment strategies based on gender and age.

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Authors Contribution

Conceptualization: YB
Methodology: AJ, FA, UN
Formal analysis: UN, SZA, NL
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All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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REFERENCES

[1] Arnett DK, Blumenthal RS, Albert MA, Buroker AB, Goldberger ZD, Hahn EJ *et al.* 2019 ACC/AHA guideline on the primary prevention of cardiovascular disease: a report of the American College of Cardiology /American Heart Association Task Force on Clinical Practice Guidelines. Journal of the American College of Cardiology. 2019 Sep; 74(10): e177-232.

[2] Bakris G, Ali W, Parati G. ACC/AHA versus ESC/ESH on hypertension guidelines: JACC guideline comparison .Journal of the American College of Cardiology .2019Jun;73(23):3018-26.doi:10.1016/j.jacc.2019.03.507.

[3] Zhou B, Carrillo-Larco RM, Danaei G, Riley LM, Paciorek CJ, Stevens GA *et al.* Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: a pooled analysis of 1201 population-representative studies with 104 million participants.The Lancet.2021Sep;398(10304): 957-80.

[4] Mubarik S, Malik SS, Mubarak R, Gilani M, Masood N. Hypertension associated risk factors in Pakistan: A multifactorial case-control study.Journal of the Pakistan Medical Association.2019 Aug;69(8):1070-3.

[5] Copur S, Demiray A, Kanbay M. Uric acid in metabolic syndrome: does uric acid have a definitive role? European Journal of Internal Medicine.2022Sep; 103: 4-12. doi: 10.1016/j.ejim.2022.04.022.

[6] Borghi C, Agnoletti D, Cicero AF, Lurbe E, Virdis A. Uric acid and hypertension: a review of evidence and future perspectives for the management of cardiovascular risk. Hypertension.2022Sep;79(9): 1927-36. doi: 10.1161/HYPERTENSIONAHA.122.17956.

[7] Gherghina ME, Peride I, Tiglis M, Neagu TP, Niculae A, Checherita IA. Uric acid and oxidative stress —relationship with cardiovascular, metabolic, and renal impairment. International Journal of Molecular Sciences.2022Mar;23(6):3188.doi:10.3390/ijms23063188.

[8] Hussain M, Ghori MU, Aslam MN, Abbas S, Shafique M, Awan FR. Serum uric acid: an independent risk factor for cardiovascular disease in Pakistani Punjabi patients.BioMed Central Cardiovascular Disorders. 2024 Oct;24(1):546.doi:10.1186/s12872-024-04055-y.

[9] Rezaei MR, Khaledi M, Rezaei B, Farnia MR, Rafiei H, Moradi S *et al.* The association between hyperuricemia and the risk of acute kidney injury; a systematic review and meta-analysis.Journal of Nephropharmacology.2023May;12(2):e10590-.doi: 10.34172/npj.2023.10590.

[10] Kim W, Go TH, Kang DO, Lee J, Choi JY, Roh SY *et al.* Age and sex dependent association of uric acid and incident hypertension. Nutrition, Metabolism and Cardiovascular Diseases.2021Apr;31(4):1200-8.doi: 10.1016/j.numecd.2020.12.015.

[11] Han Y, Han K, Han X, Yin Y, Di H, Wu J *et al.* Serum uric acid might be positively associated with hypertension in Chinese adults: an analysis of the China Health and Nutrition Survey.Frontiers in Medicine.2022Jan;8:755509.doi:10.3389/fmed.2021.755509.

[12] Te Kampe R, Janssen M, van Durme C, Jansen TL, Boonen A. Sex differences in the clinical profile among patients with gout: cross-sectional analyses of an observational study.The Journal of Rheumatology.2021Feb;48(2):286-92.doi:10.3899/jrheum.200113.

[13] Raya-Cano E, Vaquero-Abellán M, Molina-Luque R, De Pedro-Jiménez D, Molina-Recio G, Romero-Saldaña M. Association between metabolic syndrome and uric acid: a systematic review and meta-analysis. Scientific Reports.2022Nov;12(1):18412.doi:10.1038/s41598-022-22025-2.

[14] Tariq M, Ud Din MA, Mustafa ZU, Rana SA, Kazmi R, Qamar A *et al.* Assessment of the Risk Factors of Hypertension Among Adults in Pakistan.Pakistan Armed Forces Medical Journal.2023Aug;73.doi:10.51253/pafmj.v73iSUPPL-1.3910.

[15] Du L, Zong Y, Li H, Wang Q, Xie L, Yang B *et al.* Hyperuricemia and its related diseases: mechanisms and advances in therapy.Signal Transduction and Targeted Therapy.2024Aug;9(1):212.doi:10.1038/s41392-024-01916-y.

[16] Yu W and Cheng JD. Uric acid and cardiovascular disease: an update from molecular mechanism to clinical perspective.Frontiers in Pharmacology. 2020Nov;11:582680.doi:10.3389/fphar.2020.582680.

[17] Lin X, Wang X, Li X, Song L, Meng Z, Yang Q *et al.* Gender-and Age-Specific Differences in the Association of Hyperuricemia and Hypertension: A Cross-Sectional Study. International Journal of Endocrinology.2019;2019(1):7545137.doi:10.1155/2019

DOI: https://doi.org/10.54393/pjhs.v6i6.3086

/7545137.
[18] Liu D, Zheng X, Zhu J, Yang J, Lu L, Ji X *et al.* Gender-specific association between serum uric acid levels and hypertension in East China: a cross-sectional study.BioMed Central Public Health.2025Dec;25(1):1-3.doi: 10.1186/s12889-025-22064-0.
[19] Dório M, Benseñor IM, Lotufo P, Santos IS, Fuller R. Reference range of serum uric acid and prevalence of hyperuricemia: a cross-sectional study from baseline data of ELSA-Brasil cohort. Advances in Rheumatology.2022 May; 62: 15. doi: 10.1186/s42358-022-00246-3.
[20] Naseem R, Zafar SM, Jawed S, Mukhtar S, Ijaz F, Aftab RK. Influence of serum estradiol on serum uric acid level in pre and postmenopausal women.The Professional Medical Journal.2019Sep;26(09):1587-91.doi: 10.29309/TPMJ/2019.26.09.3720.
[21] She D, Wang Y, Liu J, Luo N, Feng S, Li Y *et al.* Changes in the prevalence of hyperuricemia in clients of health examination in Eastern China, 2009 to 2019. BioMed Central Endocrine Disorders.2022Aug;22(1):202. doi: 10.1186/s12902-022-01118-z.
[22] Guo Q, Liu Y, Feng X, Yang J, Zhai G, Zhou Y. Serum uric acid and hyperuricemia associate with coronary artery disease among postmenopausal women. Reviews in Cardiovascular Medicine.2022Jun;23(7): 222. doi: 10.31083/j.rcm2307222.
[23] Quartey P, Owusu BA, Marfo L, Appiah E. Relationship between uric acid, blood pressure and anthropometric indices in a healthy Ghanaian adult population. International Journal of Research in Medical Sciences.2020Dec;8(12):4185.doi:10.18203/2320-6012.ijrms20205286.
[24] Li Q, Li R, Zhang S, Zhang Y, Liu M, Song Y *et al.* Relation of BMI and waist circumference with the risk of new-onset hyperuricemia in hypertensive patients. QJM: An International Journal of Medicine. 2022 May; 115(5): 271-8. doi: 10.1093/qjmed/hcaa346.
[25] Hong C, Zhang Q, Chen Y, Lu Y, Chen L, He Y *et al.* Elevated uric acid mediates the effect of obesity on hypertension development: a causal mediation analysis in a prospective longitudinal study.Clinical Epidemiology.2022Apr:463-73.doi:10.2147/CLEP.S363429.