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Serum Uric Acid Status in Obese and Non-Obese Individuals

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ABSTRACT

Background: Obesity is a major public health problem associated with several metabolic disorders and chronic diseases. Increasing evidence suggests that elevated serum uric acid is closely linked with obesity and may contribute to metabolic complications through mechanisms involving insulin resistance. This study assessed serum uric acid levels in obese individuals and evaluated their association with anthropometric indices.

Methods: A hospital-based observational case-control study was conducted in the Department of Medicine, Chitradurga Medical College and Research Institute, from June 2025 to May 2026. Eighty participants aged ≥30 years were enrolled, including 40 obese cases and 40 age-matched non-obese healthy controls. Body mass index (BMI), waist circumference, hip circumference, and waist-hip ratio were measured using standard methods. Serum uric acid was estimated by the uricase method. Statistical analysis included the Chi-square test, unpaired *t*-test, and Pearson correlation, with $p<0.05$ considered statistically significant.

Results: Obese individuals had significantly higher serum uric acid levels than controls (5.3 ± 1.2 vs. 4.2 ± 1.6 mg/dL; $p<0.001$). BMI, waist circumference, hip circumference, and waist-hip ratio were also significantly elevated in the obese group. Serum uric acid demonstrated a significant positive correlation with waist circumference and positive associations with other obesity-related anthropometric parameters, indicating a strong relationship between adiposity and hyperuricemia.

Conclusion: Serum uric acid levels are significantly elevated in obese individuals and are positively associated with indices of obesity. Routine assessment of serum uric acid may help identify obese individuals at greater risk of metabolic complications. Larger longitudinal studies are warranted to confirm these findings and clarify their clinical significance.

Key-words: Obesity, Uric acid, metabolic syndrome, BMI, Hyperuricemia, Serum uric acid

INTRODUCTION

Obesity is a disease in which excess amount of fat accumulated in the body. Obesity imposes adverse effect on various organs and leads to health crisis like diabetes, hypertension, renal dysfunction, cardiac disease, etc. Obesity is most commonly caused by excessive food intake, lack of physical activity, medical problems, etc [1,2]. According to World Health Organization (WHO) guidance, people are considered obese when the BMI is above 30 Kg/m^2.

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From 1975 to 2016, the incidences of obesity increase more than four folds from 4% to 18% globally. Prevalence of obesity among all age group including children and teenagers are increasing at an alarming rate in India [3,4].

Uric acid is the final product of purine metabolism in humans. Uric acid is formed in the liver and excreted in urine through the kidney. Uric acid is a byproduct of the continual process in the body, where old cells are broken down and new one are formed. In neutral or basic pH solution, uric acid (pKa=5.4) exists predominantly as urate by deproteination of the nitrogen at position 3.2 Urate is significantly more soluble than uric acid; however a number of urate salts are known to crystallize in physiological environment which are deposited within soft tissues.

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Hyperuricemia is a disease related to obesity with metabolic derangements in human. Uric acid is produced in liver and excreted through kidneys in urine. Serum uric acid levels in male are slightly higher than the females. This may be due to the effect of sex hormones. Estrogen (Female sex hormone) decreases serum uric acid in females by increased excretion of uric acid through kidneys. Androgen (Male sex hormone) raises the serum uric acid levels in males [5-7]. In adults, uric acid level vary with height, body weight, blood pressure, kidney function and alcohol intake. US had identified a strong association between elevated uric acid and obesity [2,8]. Obesity is an initiator of insulin resistance. In obese individuals, adipose tissue produces molecules like non esterified fatty acids, cytokines, etc. These molecules may directly end up in initiation of insulin resistance [8]. Hyperinsulinemia is induced by insulin resistance and is also consequence of obesity [9].

Increased insulin levels activates the uric acid transporters such as urate/anion exchanger (URAT1), multispecific anion transporter (OAT4 & OAT10) and organic anion and urate transporter (OAT1 & OAT3) in the renal tubules. This results in decreased excretion of uric acid by the renal system which in turn leads to increased serum uric acid levels [10,11]. Degree of insulin resistance is inversely proportional to the renal excretion of uric acid [12]. Chen *et al* study reported a significant resistance in obese population [13].

Hyperinsulinemia may also decrease the rate of oxidative phosphorylation activity resulting in elevated adenosine levels. This promotes purine degradation which end up in elevated serum uric acid levels [14,15].

In obese individuals, adipose tissue promotes fatty acid synthesis, which is linked to de novo purine synthesis through increased activity of the hexose monophosphate (HMP) shunt pathway. This process enhances purine degradation, resulting in increased uric acid production. Consequently, obesity contributes to insulin resistance, which further promotes hyperuricemia. Therefore, the present study aimed to evaluate serum uric acid levels in obese individuals, compare them with those of healthy non-obese controls, and assess the association between serum uric acid levels and obesity in the study population.

MATERIALS AND METHODS

Study design and participants- This observational case-control study was conducted in the Department of Medicine, Chitradurga Medical College and Research Institute, Chitradurga, over a period of 10 months from June 2025 to May 2026. Ethical clearance was obtained from the Institutional Ethics Committee before commencement of the study. Written informed consent was obtained from all participants after explaining the study protocol. A total of 80 participants aged ≥30 years were enrolled, including 40 obese patients (26 males and 14 females) attending the Medicine Outpatient Department as cases and 40 age-eligible healthy non-obese individuals as controls.

Inclusion and exclusion criteria- Healthy non-obese individuals aged ≥30 years were included as controls, whereas obese patients aged ≥30 years were included as cases. Pregnant and lactating women and participants with diabetes mellitus, hypertension, renal dysfunction, cardiac disease, Cushing syndrome, malignancy, or chronic alcoholism were excluded from the study.

Anthropometric measurements- Height was measured using a wall-mounted stadiometer with an accuracy of 0.1 cm, while body weight was recorded using an electronic weighing scale with participants wearing light clothing and no footwear. Body mass index (BMI) was calculated as weight (kg)/height (m^2), and obesity was defined according to the World Health Organization criteria (BMI ≥30 kg/m^2). Waist and hip circumferences were measured using a non-elastic measuring tape according to WHO recommendations, and waist-to-hip ratio (WHR) was calculated by dividing waist circumference by hip circumference.

Biochemical analysis- Venous blood samples were collected and centrifuged to obtain serum. Serum uric acid concentration was estimated on the day of sample collection by the uricase method using a Biosystems automated analyzer. The reference range for serum uric acid was 3.0–7.0 mg/dL for males and 2.0–6.0 mg/dL for females.

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Statistical analysis- Data were expressed as mean ± standard deviation (SD). Differences between the study groups were analyzed using the Chi-square test for categorical variables and the unpaired Student's t-test for continuous variables. Pearson's correlation analysis was performed to evaluate the relationship between serum uric acid and anthropometric parameters. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 80 participants were included in the study, comprising 40 obese cases and 40 non-obese healthy controls. The obese group consisted of 26 males and 14 females, while the control group included 23 males and 17 females. The mean age of the obese group was 46±9.7 years compared with 37±10.8 years in the control group.

Table 1 presents the demographic, anthropometric, and biochemical characteristics of the study participants. The obese group showed significantly higher BMI (34.3±2.3 kg/m² vs. 22.2±1.8 kg/m²), waist circumference (97±7.8 cm vs. 77±6.3 cm), hip circumference (108±7.2 cm vs. 86±9.2 cm), and waist-hip ratio (0.93±0.05 vs. 0.87±0.07) compared with the non-obese controls (all $p<0.001$). Serum uric acid levels were also significantly elevated in obese individuals (5.3±1.2 mg/dL) compared with controls (4.2±1.6 mg/dL, $p<0.001$), indicating a significant association between obesity and increased serum uric acid levels.

Table 1: Comparison of demographic, anthropometric, and biochemical parameters between obese and non-obese participants

Parameters	Controls	Obese group	p-value
Gender	M-23 F-17	M-26 F-14	-
Age	37 ± 10.8	46 ± 9.7	-
BMI	22.2 ± 1.8	34.3 ± 2.3	<0.001
Waist circumference	77 ± 6.3	97 ± 7.8	<0.001
Hip circumference	86 ± 9.2	108 ± 7.2	<0.001
Waist Hip Ratio	0.87 ± 0.07	0.93 ± 0.05	<0.001
Serum uric acid	4.2 ± 1.6	5.3 ± 1.2	<0.001

Fig. 1 demonstrates a positive correlation between serum uric acid levels and waist circumference among obese participants. As waist circumference increased, serum uric acid levels also tended to increase. The observed correlation was statistically significant ($r=0.350$, $p<0.05$), suggesting that central obesity is associated with elevated serum uric acid concentrations.

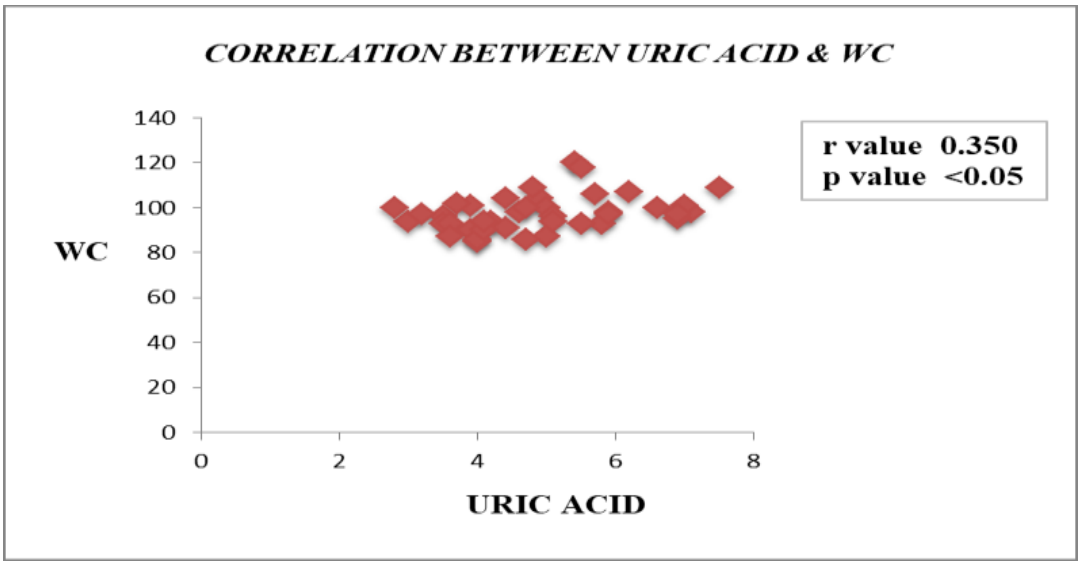

Fig. 1: Correlation between serum uric acid and Waist circumference

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Fig. 2 illustrates the relationship between serum uric acid levels and waist-hip ratio in obese participants. The scatter plot shows a positive trend, indicating that participants with higher waist-hip ratios generally exhibited higher serum uric acid levels. This finding further supports the association between abdominal adiposity and hyperuricemia observed in the present study.

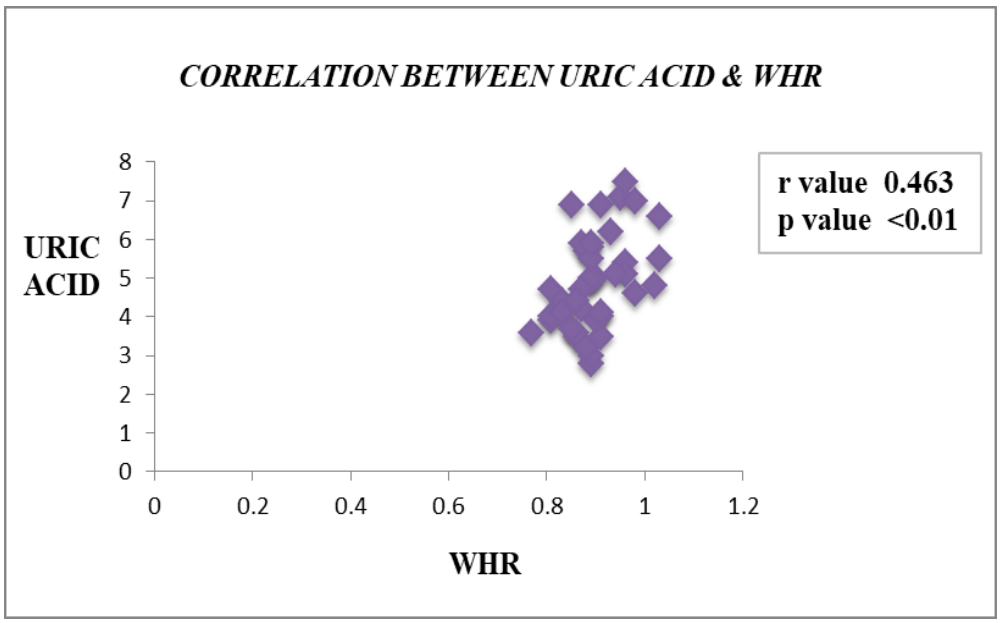

Fig. 1: Correlation between serum uric acid and waist hip circumference in the obese group

DISCUSSION

The present study demonstrated that obese individuals had significantly higher serum uric acid levels than non-obese healthy controls, indicating a strong association between obesity and hyperuricemia. The mean serum uric acid concentration was significantly elevated in the obese group, suggesting that increased adiposity may contribute to altered purine metabolism and reduced renal uric acid excretion. These findings are in agreement with previous studies that reported significantly higher serum uric acid levels among obese individuals, thereby supporting the hypothesis that obesity is an important determinant of hyperuricemia [14,15].

Anthropometric measurements also differed significantly between the two study groups. Body mass index (BMI), waist circumference, hip circumference, and waist-hip ratio were all significantly higher in obese participants than in healthy controls. These observations confirm the expected differences in body composition between the groups and further validate the classification of obesity in the present study. Similar findings have been reported by Miranda *et al.* and Amin-ul-Haq *et al*., who demonstrated significantly higher BMI among obese individuals compared with healthy controls [4,6].

Likewise, increased waist circumference and hip circumference observed in the present study are consistent with the findings reported by Mehmet Inanir and Akram *et al.* [3,17]. The higher waist-hip ratio recorded in the obese group also supports previous observations that central obesity is strongly associated with adverse metabolic alterations.

Correlation analysis further demonstrated that serum uric acid was positively associated with obesity-related anthropometric indices. A significant positive correlation was observed between serum uric acid and waist circumference, indicating that increasing central adiposity is accompanied by elevated serum uric acid levels. Similar observations have been reported previously, emphasizing waist circumference as an important predictor of hyperuricemia [16]. Positive correlations were also observed between serum uric acid and BMI, hip circumference, and waist-hip ratio, suggesting that increasing overall and abdominal adiposity is associated with progressive elevation of serum uric acid concentrations. Comparable findings have been documented by Onwubuya *et al.* and Mehmet Inanir, who also reported significant associations

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between serum uric acid and obesity-related anthropometric measurements [3,15].

The observed relationship between obesity and elevated serum uric acid levels may be explained by the metabolic changes associated with excessive adiposity. As discussed in the introduction, obesity promotes insulin resistance and compensatory hyperinsulinemia, which reduce renal uric acid excretion by increasing tubular urate reabsorption. In addition, increased fatty acid synthesis in adipose tissue enhances de novo purine synthesis through activation of the hexose monophosphate (HMP) shunt pathway, resulting in increased uric acid production. These mechanisms may collectively contribute to the higher serum uric acid concentrations observed in obese individuals in the present study [10-16].

Overall, the findings of the present study indicate that obesity indices, including BMI, waist circumference, hip circumference, and waist-hip ratio, are positively associated with serum uric acid levels. The results reinforce the growing evidence that obesity and hyperuricemia are closely interrelated metabolic conditions. Early identification of elevated serum uric acid among obese individuals may therefore facilitate timely intervention and reduce the risk of metabolic and cardiovascular complications associated with hyperuricemia [15-17].

The present study has certain limitations. First, the sample size was relatively small, which may limit the generalizability of the findings. Second, the study employed a cross-sectional case-control design; therefore, a causal relationship between obesity and hyperuricemia cannot be established. Third, the study was conducted at a single tertiary care center, and the findings may not represent the general population. Large-scale, multicenter longitudinal studies are required to further clarify the temporal relationship and underlying mechanisms linking obesity with elevated serum uric acid levels.

CONCLUSIONS

The present study demonstrated that obese individuals had significantly higher serum uric acid levels than non-obese healthy controls, indicating a strong positive association between obesity and hyperuricemia. Increased body mass index, waist circumference, hip circumference, and waist-hip ratio were associated with elevated serum uric acid concentrations, suggesting that both general and central obesity contribute to altered uric acid metabolism. The underlying mechanisms may involve insulin resistance, hyperinsulinemia, reduced renal uric acid excretion, and increased purine synthesis associated with excess visceral adiposity. These findings highlight the potential role of serum uric acid as a useful biochemical marker in the assessment of obesity-related metabolic risk. Early identification and monitoring of serum uric acid in obese individuals may facilitate timely interventions to reduce the risk of hyperuricemia and its associated complications. However, larger multicenter longitudinal studies are required to confirm these findings and further elucidate the causal relationship between obesity and elevated serum uric acid levels.

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CONTRIBUTION OF AUTHORS

Research concept- Arati Ganiger, K Mallikarjuna Swamy
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Final approval- K Mallikarjuna Swamy

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