

## A study of serum uric acid levels in metabolic syndrome

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### Abstract

**Background and Objectives:** The aim of this study is the association between uric acid levels and metabolic syndrome in individuals undergoing general health screening. Serum uric acid levels have been reported to be associated with a variety of cardiovascular conditions. Previous epidemiological studies have suggested that hyperuricemia may be a risk factor for cardiovascular diseases. However, on the other hand, many studies argue that the observed association between uric acid and atherosclerosis is attributable to an indirect association of hyperuricemia with cardiovascular risk factor or clustering of these metabolic and hemodynamic risk factors, designated “metabolic syndrome”.

**Materials and Methods:** The study comprised of metabolic syndrome cases visiting the general medicine outpatient at Government General Hospital, Guntur. Age and sex matched healthy volunteers served as controls. Total 100 out of which 50 cases and 50 controls. Physical Parameters like Waist Circumference (WC), Blood Pressure, Systolic (SBP) & Diastolic (DBP) and Biochemical parameters like Fasting Plasma Glucose (FPG) and Lipid profile Total Triglycerides (TTG), Total Cholesterol (TCH), HDL Cholesterol (HDL-C). Metabolic syndrome is diagnosed using the diagnostic criteria provided by the International Diabetes Federation.

**Results:** The total numbers of study participants were 100. Out of them 50 cases of central obesity were selected with increased waist circumference and 50 age and sex matched controls were selected with normal waist circumference. Out of 50 obese individuals metabolic syndrome was detected in 23 (46%) of subjects, in 14 (60.86%) of men and in 9 (39.1%) of women and hyperuricemia was detected in 21 (42%) of individuals. The overall serum uric acid (SUA) analysis in the 50 obese group, 21 (Twenty one) are with increased SUA levels. The mean± standard deviation values of all physical (waist circumference, blood pressure) and biochemical parameters (FPG, lipid profile, SUA) of obese group when compared to controls were statistically highly significant.

**Discussion:** In the present study risk analysis was done among the obese group (waist circumference >90cms in men and >80cms in women) and control group who were non obese. The difference between all the variables (physical and biochemical) of both groups based on the standard error of difference was statistically significant and also the p value (<0.001) that was obtained from Student t test was statistically significant.

**Conclusion:** in the present study, an elevated serum uric acid concentration was found to be correlated with hypertension, insulin resistance and the risk factors of metabolic syndrome.

However, to fully determine the nature of the causal relationship between serum uric acid concentration and the risk of metabolic syndrome, future prospective studies are required.

**Key words:** Metabolic syndrome, Uric acid, Insulin resistance, obese, Hypertension.

### Introduction

Metabolic syndrome (MetS) is defined by a clustering of risk factors for cardiovascular disease the syndrome was first described in 1998 by a consultation group tasked with defining diabetes for the World Health Organization <sup>(3)</sup>. Since then, classification has changed repeatedly and currently three definitions are being used: the revised National Cholesterol Education Programme Adult Treatment Panel III (NCEP ATP III), the International Diabetes Federation (IDF), and the Harmonizing definition. It is important to diagnose this syndrome since it is closely associated with the future development of type 2 diabetes mellitus and cardiovascular complications. The aim of this study is the association between uric acid levels and metabolic syndrome in individuals undergoing general health screening. Serum uric acid levels have been reported to be associated with a variety of cardiovascular conditions. Previous epidemiological studies have suggested that hyperuricemia may be a risk factor for cardiovascular diseases. However, on the other hand, many studies argue that the observed association between uric acid and atherosclerosis is attributable to an indirect association of hyperuricemia with cardiovascular risk factor or clustering of these metabolic and hemodynamic risk factors, designated “metabolic syndrome”.

### Materials and Methods

Metabolic syndrome diagnosed using the diagnostic criteria provided by the International Diabetes Federation.

The study comprised of metabolic syndrome cases visiting the general medicine outpatient at Government General Hospital, Guntur. Age and sex matched healthy volunteers served as controls. Total 100 people out of which number of cases are 50 and number of controls are 50. 1. Physical Parameters like Waist Circumference (WC) and Blood Pressure, Systolic (SBP) & Diastolic (DBP). 2. Biochemical parameters: Blood samples were collected in 10-12 hours of fasting state from both control and test groups for the analysis of Fasting Plasma Glucose (FPG) and Lipid profile which include Total Triglycerides (TTG), Total Cholesterol (TCH) and HDL Cholesterol (HDL-C).

### Results

In the present study, the total numbers of study participants were 100. Out of them 50 cases of central obesity were selected with increased waist circumference and 50 age and sex matched controls were selected with normal waist circumference. The average age of study population was  $51.94 \pm 3.289$  yr, ranging from 40-60 years. Out of 50 obese individuals metabolic syndrome was detected in 23 (46%) of subjects, in 14 (60.86%) of men, and in 9 (39.1%) of women and hyperuricemia was detected in 21 (42%) of individuals.

The overall serum uric acid (SUA) analysis in the 50 obese group, 21 (Twenty one) are with increased SUA levels.

**Table 1:** Age distribution in study population

Study group (N=100)	Number	Mean±S.D. (age in years)
OBESE	50	51.94±3.289
CONTROL	50	78.46±6.37

**Table 2:** Anthropometric analysis (WC) in study population

Study group (N=100)	Number	Mean $\pm$ S.D. (waist circumference in cms)	t value	p value	
Obese	50	91.16 $\pm$ 5.08	11.0146	< 0.001	HS
Control	50	78.46 $\pm$ 6.37			

**Table 3:** Mean $\pm$ S.D. values of blood pressure in study population

Study group (N=100)	Obese (N=50)	Controls (N=50)	t value	p value	
Systolic blood pressure in mm of Hg	125.9 $\pm$ 10.08	113 $\pm$ 8.39	6.952	< 0.001	HS
Diastolic blood pressure in mm of Hg	80.1 $\pm$ 6.96	75.4 $\pm$ 6.13	3.582	< 0.001	HS

**Table 4:** Fasting plasma glucose (FPG) in study population

Study group (N=100)	Number	Mean $\pm$ S.D.	t value	p value	
Obese	50	94.1 $\pm$ 7.55	4.452	< 0.001	HS
Control	50	87.1 $\pm$ 8.05			

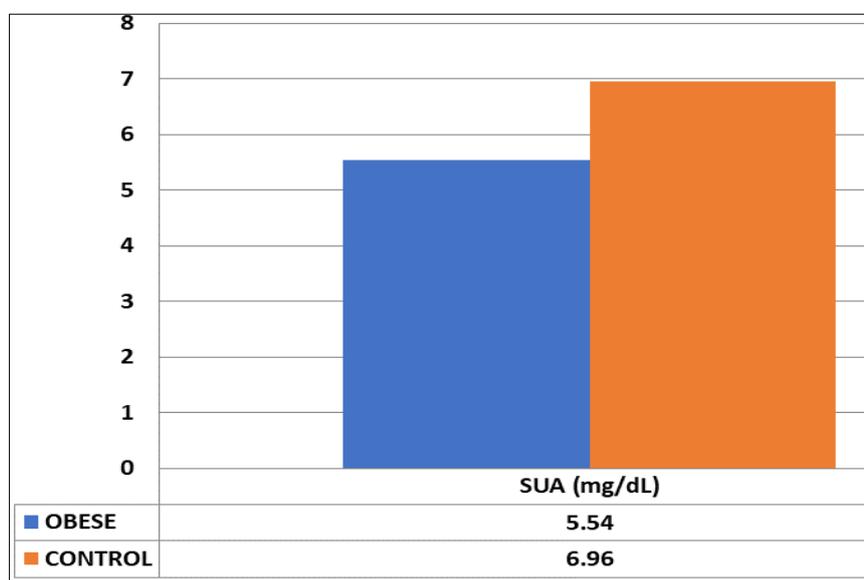
**Table 5:** Mean $\pm$ S.D. values of lipid profile in study population

Parameter	Obese (n=50)	Controls (n=50)	t value	p value	
Total cholesterol	165.66 $\pm$ 14.65	156.44 $\pm$ 12.16	3.424	< 0.001	HS
Total triglycerides	155.96 $\pm$ 23.17	140.96 $\pm$ 11.93	4.069	< 0.001	HS
HDL-C	41.64 $\pm$ 6.34	47.26 $\pm$ 5.54	4.717	< 0.001	HS
VLDL-C	31.2 $\pm$ 4.65	28.22 $\pm$ 2.37	4.037	< 0.001	HS
LDL-C	92.22 $\pm$ 12.29	80.96 $\pm$ 11.36	4.755	< 0.001	HS

**Table 6:** Mean $\pm$ S.D. values of serum uric acid (SUA) in study population

Study group (n=100)	Number	Mean $\pm$ S.D. (SUA in mg %)	t value	p value	
Obese	50	6.96 $\pm$ 1.68	4.566	< 0.001	HS
Control	50	5.54 $\pm$ 1.42			

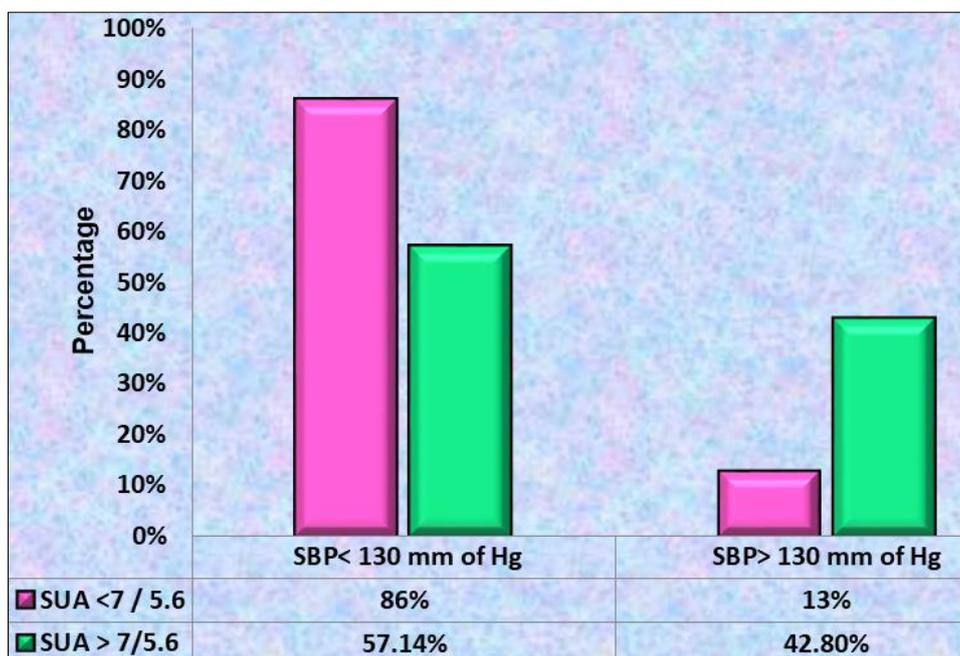
The mean $\pm$  standard deviation values of all physical (waist circumference, blood pressure) and biochemical parameters (FPG, lipid profile, SUA) of obese group when compared to controls were statistically highly significant.

**Fig 1**

**Table 7:** Cross tabulation between serum uric acid and SBP

SBP (mmHg)	Serum Uric Acid Levels (mg/dl) (N=50 Obese Group)		
	< 7/ 5.6 (N=29)	> 7/ 5.6 (N=21)	Total
< 130	25 (86%)	12 (57.14%)	37
> 130	4 (13%)	9 (42.85%)	13
Total	29	21	50

A chi-square of independence was performed to examine the relation between serum uric acid level and systolic BP. The association between these variables was statistically significant.  $X^2$  (df- 1) = 5.347, p= 0.0207 ( $p < 0.05$ ).

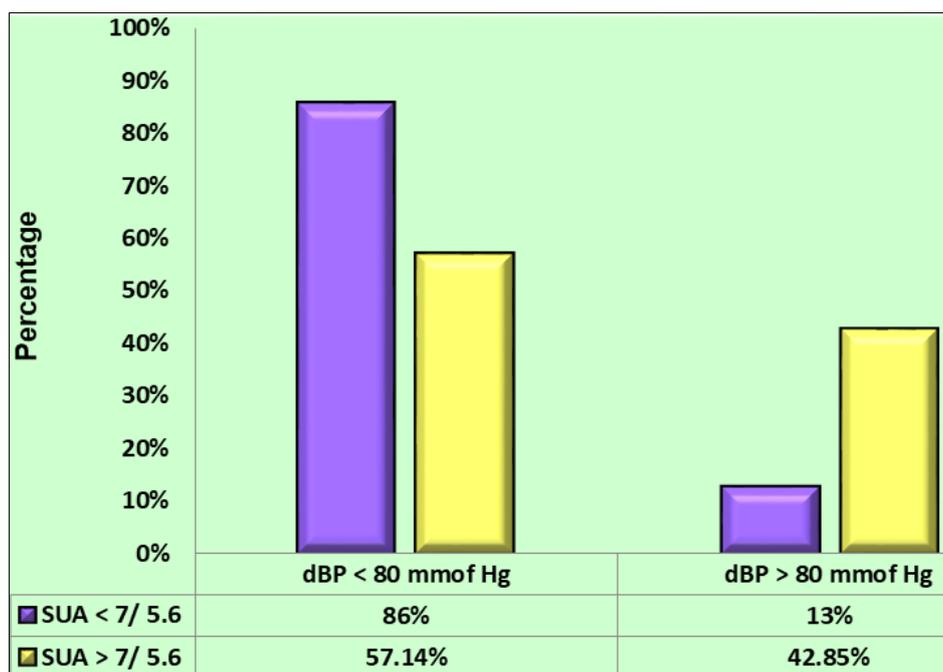


**Chart 1:** Relationship between serum uric acid and systolic BP

**Table 8:** Cross tabulation between serum uric acid and diastolic blood pressure

DBP (mmHg)	Serum Uric Acid Levels (mg/dl) (N=50 Obese Group)		
	< 7/ 5.6 (N=29)	> 7/ 5.6 (N=21)	Total
< 80	25 (86%)	12(57.14%)	37
> 80	4(13%)	9(42.85%)	13
Total	29	21	50

A chi-square of independence was performed to examine the relation between serum uric acid level and diastolic BP. The association between these variables was statistically significant.  $X^2$  (df- 1) = 5.347, p= 0.0207 ( $p < 0.05$ )



**Chart 2:** Relationship between serum uric acid and diastolic BP

### Discussion

Metabolic syndrome, representing a cluster of visceral obesity, hypertension, dyslipidemia and glucose intolerance induced by insulin resistance, is a common basis for the development of atherosclerosis, especially coronary heart disease and atherosclerotic brain infarction. A need for the early diagnosis of metabolic syndrome is essential to prevent and decrease morbidity and mortality due to cardiovascular disease. The present study was done to assess the presence of metabolic syndrome according to IDF criteria in obese individuals and more specifically the relation between the 23 metabolic syndrome individuals attending Government General Hospital, Guntur. In the present study risk analysis was done among the obese group (waist circumference >90cms in men and >80cms in women) and control group who were non obese. The difference between all the variables (physical and biochemical) of both groups based on the standard error of difference was statistically significant and also the p value (<0.001) that was obtained from Student t test was statistically significant. In our study, the prevalence of MetS in Obese population was 46% using the IDF criteria. This is lower than the prevalence found in other countries. For example, in a recent survey from the USA using the relation between components of MetS and uric acid levels, in harmonizing definition, the prevalence of MetS was 34.3%.

### Uric acid and metabolic syndrome

In the present study, it was observed that 47.8% of metabolic syndrome individuals had elevated serum uric acid levels above the normal range and only 17% of control group had elevated serum uric acid levels.

### Conclusion

In conclusion, in the present study, an elevated serum uric acid concentration was found to be correlated with hypertension, insulin resistance and the risk factors of metabolic syndrome. However, to fully determine the nature of the causal relationship between serum uric acid concentration and the risk of metabolic syndrome, future prospective studies are required.

## References

1. Kim HC, Kang DR, Choi KS, Nam CM, Thomas GN, Suh I. Spousal concordance of metabolic syndrome in 3141 Korean couples: a nationwide survey. *Ann Epidemiol.* 2006;16(4):292-298.
2. Oh HJ, Moon SH, Lee JW, Hyun HY, Lee DC, Lee HR. Relationship between serum uric acid and metabolic syndrome. *J Korean Acad Fam Med.* 2006;27(9):699-705.
3. Alberti KG, Zimmer PZ. Definition, diagnosis and classification of diabetes mellitus and its complications. Part I: Diagnosis and classification of diabetes mellitus provisional report of a WHO consultation. *Diabet Med.* 1998;15:539-53.
4. Balkau B, Charles MA. Comment on the provisional report from the WHO consultation. European Group for the Study of Insulin Resistance (EGIR). *Diabet Med.* 1999;16:442-3.
5. Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. Executive Summary of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). *JAMA.* 2001;285:2486-97.
6. Grundy SM, Cleeman JI, Daniels SR, *et al.* American Heart Association; National Heart, Lung, and Blood Institute. Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung and Blood Institute scientific. *Circulation.* 2005;112:2735-52.
7. Wilson PW, D'Agostino RB, Parise H, Sullivan L, Meigs JB. Metabolic Syndrome as a precursor of cardiovascular disease and type 2 diabetes mellitus. *Circulation* 2005;112:3066-72.
8. Hildrum B, Mykletun A, Hole T, Midthjell K, Dahl AA. Age-specific prevalence of the MS defined by the IDF and national cholesterol education program: the Norwegian HUNT 2 study. *BMC Publ Health.* 2007;7:220.
9. Magat C, Goel NK, Walia DK, Agawal N, Sharma MK, Kaur J, *et al.* Metabolic syndrome: a challenging health issue in highly urbanized union territory of north India. *Diabetol Metab Syndr.* 2010;2:19.
10. National Cardiovascular Disease. Available from: [http:// whoindia.org/LinkFiles/ NMH-Resources-National-CVD-diabetes-Final-Report.pdf](http://whoindia.org/LinkFiles/NMH-Resources-National-CVD-diabetes-Final-Report.pdf).(Last accessed on 2012 Feb 05).
11. Ford SE, Giles HW, Dietz HW. Prevalence of the metabolic syndrome among US adults. *JAMA.* 2002;287:356-9.
12. Association conference on scientific issues related to definition. *Circulation.* 2004;109(3):433-438.  
DOI:10.1161/01.CIR.0000111245.75752.C6.Jan27. [PubMed] [Cross Ref]
13. Kang YH, Min HG, Kim IJ, Kim YK, Son SM. Comparison of alanine aminotransferase, white blood cell count, and uric acid in their association with metabolic syndrome: a study of Korean adults. *Endocr J.* 2008;55(6):1093-1102.
14. Koulouridis E, Georgalidis K, Kostimpa I, Koulouridis I, Krokida A, Houliara D. Metabolic syndrome risk factors and estimated glomerular filtration rate among children and adolescents. *Pediatr Nephrol.* 2010;25(3):491-498. DOI:10.1007/s00467-009-1364-x. [PubMed] [Cross Ref]
15. Hi N, Okamoto M, Yoshida H, Matsuo Y, Suzuki K, Tatara K. Serum uric acid and risk for development of hypertension and impaired fasting glucose or type II diabetes in Japanese male office workers. *Eur J Epidemiol.* 2003;18(6):523-530. DOI: 10.1023/A:1024600905574. [PubMed] [Cross Ref]
16. Sung KC, Shin HS, Kim BJ, Kim BS, Kang JH, Lee MH, *et al.* Relationship between serum uric acid concentration and insulin resistance and metabolic syndrome. *Circ J.* 2005;69(8):928-933. DOI: 10.1253/circj.69.928. [PubMed] [Cross Ref]
17. Wietlisbach V, Bovet P, Shamlaye C, Riesen W, Paccaud F, Burnier M. Prevalence of hyperuricemia and relation of serum uric acid with cardiovascular risk factors in a

- developing country. *BMC Public Health*. 2004;4(1):9. DOI:10.1186/1471-2458-4-9. [PMC free article] [PubMed] [Cross Ref]
18. Schachter M. Uric acid and hypertension. *Curr Pharm Des*. 2005;11(32):4139-4143. DOI: 10.2174/138161205774913246. [PubMed] [Cross Ref]
  19. Tai ES, Emmanuel SC, Chew SK, Tan BY, Tan CE. Isolated low HDL cholesterol: an insulin-resistant state only in the presence of fasting hypertriglyceridemia. *Diabetes*. 1999;48(5):1088-1092. DOI:10.2337/diabetes.48.5.1088. [PubMed] [Cross Ref]
  20. Allo-Perin P, Gentile L, Repetti E, Pagano G. Low HDL cholesterol: a component of the metabolic syndrome only in the presence of fasting hypertriglyceridemia in type 2 diabetic patients. *Diabetes Metab*. 2001;27(1):31-35.
  21. Bosello O, Zamboni M. Visceral obesity and metabolic syndrome. *Obes Rev*. 2000;1(1):47-56. DOI: 10.1046/j.1467-789x.2000.00008.x. [PubMed] [Cross Ref]