

Obesity and Serum Uric Acid

Omar Khalid Alboqai, PhD* Asad Abu Odeh, MD**
Huda M. Al Hourani, PhD*** Faisal Al-Qudah, MD**

Objective: To study the serum level of uric acid among obese individuals and to identify the dominant risk factors for elevated serum uric acid.

Setting: International Academy Rehabilitation Sport, Irbid – Jordan.

Design: Cross-Sectional study.

Method: Three hundred healthy adult males aged 30-50 years were included in the study. The sample was divided into approximately equal three groups based on obesity categories. Plasma uric acid, total cholesterol, triglycerides, low density lipoprotein- cholesterol (LDL-C), high density lipoprotein-cholesterol (HDL-C), fasting blood glucose (FBG), blood pressure, height, weight and waist circumference were measured and a pre-tested. Structured questionnaire was administered by trained-interviewer.

Result: A graded increase of serum uric acid rates was observed with increased body weight and waist circumference. The serum uric acid among overweight and obese subjects compared with non-obese subjects were 5.6 and 10.8 times respectively.

Logistic regression analysis showed that the amount of body fat and distribution were the major risk factors for elevated serum uric acid; other factors such as obesity during adolescence, calories from dietary protein $\geq 16.5\%$ and creatinine play a minor role.

Conclusion: Elevated serum uric acid is more prevalent in obese individuals. Obesity is the dominant risk factor for elevated serum uric acid.

Bahrain Med Bull 2007; 29(3):

- * Department of Clinical Nutrition
College of Royal Medical Sciences for Allied Health Professions
- ** Royal Medical Services
- *** Department of Clinical Nutrition and Dietetics
Faculty of Allied Health Sciences
The Hashemite University
Jordan

Obesity may be defined as a disease of extensive fat accumulation to the extent that health and wellbeing are affected. However, the degree of excess fat, its distribution within the body, duration and the associated health consequences vary considerably between obese individuals¹. Obesity has long been recognized as an associated factor with a variety of adverse health consequences; chiefly among them diabetes, hypertension, dyslipidaemia, increased cardiovascular events, and elevated serum uric acid²⁻⁵. These patients are also more likely to present with silent disease and as a cluster of metabolic syndrome⁶. The most commonly recognized risk factors in the metabolic syndrome are highly correlated with each other and are pre-summed to reflect common metabolic pathway and they interact to increase risk in a synergistic fashion^{7,8}. Furthermore, several epidemiological studies showed a positive association between obesity and hyperuricemia^{9,10}. Increases in serum uric acid concentration showed positive association with body mass index (BMI), waist hip ratio (WHR), Waist/thigh girth, and sub-scapula triceps skin fold ratios¹¹. The risk of gout was increased among men who had been overweight in adolescence¹². It has been suggested that other factors, such as muscle mass, may also play a role in producing high serum uric acid²². Weight reduction has been associated with modest lowering of serum urate¹³.

Despite the growing body of evidence of these risks, the prevalence of obesity continues to increase worldwide including Jordan¹⁴.

Recent studies conducted in Jordan showed high prevalence of diabetes mellitus, hypertension and dyslipidemia^{3,15}. Cardiovascular disease is the leading cause of death in Jordan as reported by annual reports of Royal Medical Services, (RMS, 2001). No data exist in Jordan regarding elevated serum uric acid.

The aim of this study is to evaluate the serum level of uric acid among obese individuals and to identify the dominant risk factors for elevated serum uric acid.

METHOD

The subjects were selected by cross sectional study from Sareeh area in the Northern of Jordan. A total sample size was 350 out of 400 of eligible subjects responded. Inclusion criteria of the study were subjects who were apparently healthy, or had no clinical conditions known to affect carbohydrate, protein or lipid metabolism or body composition. The age was 30-50 years, and their body mass index (BMI) was within WHO categories. The remaining subjects (306: 103 BMI < 25 kg/m², 100 BMI ≥ 25 < 30 kg/m² and 103 BMI ≥ 30 kg/m²) were involved in the final study sample on which the statistical analysis would be carried out.

All subjects fasted overnight before blood sampling, anthropometric measurements which include weight, height, waist and hip circumferences were performed. Blood pressure (BP), and serum uric acid, were measured in all subjects. BMI was calculated as body weight (kg) divided by height squared (m²). Central obesity was categorized into three groups as indicated by waist circumference: normal < 94 cm; moderate ≥ 94-102; high ≥ 102 cm based on waist circumference classifications¹. Elevated serum uric acid was defined as serum uric acid ≥ 7.0 mg/dl in men¹⁶. Hypertension was defined as systolic blood pressure (SBP) ≥ 140 mmHg, and/or diastolic blood pressure (DBP) ≥ 90 mmHg¹⁷.

Laboratory measurements were performed using standard automated procedures (Hitachi 911) with commercially available kits.

RESULT

The mean age of study subjects was 38.9 years, the range is 30 to 50 years as shown in table 1. The mean level of serum uric acid was 5.9 ± 1.6 .

Table 1: Characteristics of subjects

	Mean \pm SD
Age (years)	38.9 \pm 6.5
Height (cm)	171.8 \pm 5.7
Weight (kg)	83.2 \pm 14.6
Body mass index	28.2 \pm 4.8
Serum uric acid	5.9 \pm 1.6

Table 2: Subjects with elevated serum uric acid among obese

Indicators	Obesity index								Central obesity index							
	Body mass index categories (BMI-C)								Waist circumference (W-C)							
	Normal		Over weight		R1	Obese		R2	Normal		Moderate		R3	High		R4
	N.	%	N.	%		N.	%		N.	%	N.	%		N.	%	
	103	33.7	100	32.6		103	33.7		103	33.6	107	35.0		96	31.4	
Elevated serum uric acid	5	4.9	27	27.0	5.6*	54	52.4	10.8*	5	4.9	30	28.0	5.8*	51	53.1	10.9*

All (R): calculated with each category by dividing the proportions of biochemical abnormalities over weight or moderate or high or obese level / low-level proportion or non-obese proportion.

Table 2 shows that the serum uric acid among overweight and obese subjects was elevated 5.6, 10.8 times compared with normal weight subjects respectively. Whereas participants with moderate and high central obesity categories, their serum uric acid

was elevated 5.8, 10.9 times compared with participants with normal level of central obesity respectively.

Table 3 shows the adjusted level of serum uric acid for overweight and obese was 6.2, 19.17, 95% CI compared with normal subjects respectively, while for subjects with moderate and high central obesity were 6.63, 19.6, 95% CI compared with participants with normal level of central obesity respectively. Furthermore, dietary protein makes $\geq 16.5\%$ of energy and obesity during adolescence; elevated creatinine has significant relative risk for elevated serum uric acid.

Table 3: Adjusted relative risk of elevated serum uric acid of obesity

Variable	Exponential (B)	95% CI for Exponential (B)		<i>P value</i>
		Lower	Upper	
Body mass index(BMI-C)				
Parental hypertension	0.52	0.28	0.95	0.030
Dietary protein $\geq 16.5\%$ of energy	2.89	1.34	6.25	0.007
Creatinine	1.56	1.05	2.31	0.030
Overweight	6.20	2.23	17.22	0.005
Obese	19.17	7.04	52.15	0.000
Waist circumference (W-c)				
Adolescence obesity	2.22	1.10	4.48	0.020
Dietary protein $\geq 16.5\%$ of energy	2.93	1.36	6.33	0.006
Creatinine	1.56	1.05	2.31	0.020
Moderate central obesity	6.63	2.41	18.22	0.000
High central obesity	19.60	7.16	53.68	0.000

CI: Confident Intervals

Exp(B), estimated odds ratio in binary logistic regression models

DISCUSSION

The positive correlation between serum uric acid level and obesity has been recognized for a long time¹⁸. Several cross-sectional studies have indicated the relationship between elevated serum uric acid and obesity. In a cross sectional study of 640 apparently healthy Dutch men and women aged 65-79 years, serum uric acid level was found to be positively associated with body weight, BMI, body fatness, and lean body mass in men but not women¹⁰. The association of obesity with elevated serum uric acid is also supported by longitudinal studies¹⁹.

Overweight in adolescence was a more powerful predictor of this risk than overweight in adulthood¹⁹. This study emphasizes the association between elevated serum uric acid and obesity. Obese subjects had elevated serum uric acid approximately 10 times than non-obese subjects while overweight had elevated serum uric acid approximately 6 times than non-obese subjects as shown in table 2.

In addition, this study showed that central obesity had a potential risk on elevated serum uric acid more than overall obesity. Also high protein intake and creatinine were significantly associated with elevated uric acid, as have been found by Vague, et al and Cigolini et al¹¹. Furthermore, serum uric acid was also positively correlated with serum triglyceride, LDL-C and negatively with HDL as have been found by Facchini et al²⁰. The association of obesity with overweight has a number of effects on urate metabolism, which include decreasing urate clearance and increasing urate production²⁰.

CONCLUSION

This study reveals that obesity particularly central one is the dominant risk factor for elevated serum uric acid. Therefore it is important to establish preventive measures towards reducing obesity and overweight rather than treating health consequences such as elevated serum uric acid.

REFERENCES

1. World Health Organization (1997). Report of a WHO consultation on obesity. Preventing and managing the Global Epidemic, Geneva: WHO.
2. Carey DG, Jenkins AB, Campbell LV, et al. Abdominal fat and insulin in normal and overweight men. *Diabetes*; 1996; 45:633-8.
3. Jaddou H, Batieha A, Ajlouni K. Prevalence and associated factors of hypertension results from a three community based survey, Jordan. *J Hum Hypertensions* 1996; 10: 815-21.
4. Anderson AJ, Sobocinsk KA, Freedom DS, et al. Body fat distribution, plasma lipids and lipoprotein. *Arteriosclerosis* 1988; 8: 88-94.
5. Tuomilehto J, Zimmet, P, Wolf E, et al. Plasma uric acid level and its association with diabetes mellitus and some biologic parameters in a biracial population of Fiji. *Am J Epidemiol* 1988; 127: 321-36.
6. Linbald U, Langer RD, Wingard DL, et al. Metabolic syndrome and ischemic heart disease in elderly men and women. *Am J Epidemiol* 2001; 153: 481-7.

7. Ferrannini E, Haffner SM, Stern M et al. High blood pressure and insulin resistance: influence of ethnic background. *Eur J Clin Invest* 1991; 21:280-7.
8. Stern M. Disease risk: evidence for a role of uric acid in the obesity-insulin resistance syndrome. *Am J Epidemiol* 1995; 142: 288-94.
9. Acheson RM, Collart AB. New Haven Survey of joint disease: relationship between some systemic characteristics and osteoarthritis in a general population. *Ann Rheum Dis* 1975; 34:379-87.
10. Loenen HM, Eshius H, Lowik MR, et al. Serum uric acid correlates in elderly men and women with special reference to body composition and dietary intake (Dutch Nutrition Surveillance system). *J Clin Epidemiol* 1990; 43:1297-303.
11. Cigolini M, Targher G, Tonoli M, et al. Elevated serum uric acid: relationships to body fat distribution and other components of the insulin resistance syndrome in 38-year-old healthy men and women. *International J Obes Relat Metab Disord* 1995; 19:92-6.
12. Must A. Morbidity and mortality associated with elevated body weight in children and adolescents. *Am J Clin Nutr* 1996; 63: 445-7.
13. Scott JT. Obesity and uricaemia. *Clin Rheum Dis* 1977; 3: 25-35.
14. Ajlouni K, Jaddou H, Batiha A. Obesity in Jordan. *Int J of Obes Relat Metab Disor* 1998; 22: 624-8.
15. Ajlouni K, Jaddou H., Batiha A. Diabetes and impaired glucose tolerance in Jordan: prevalence and associated risk factors. *J Intern Med* 1998; 244: 317-23.
16. Roubenoff R. Gout and hyperuricemia. *Rheum Dis Clin North Am* 1990; 16: 539-50.
17. Chobanian AV, Bakris GL, Black HR et al. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: The JNC 7 Report. *JAMA* 2003; 389: 2560-71.
18. Gertler MM, Garn SM, Levine SA: Serum uric acid in relation to age and physique in health and in coronary heart disease. *Ann Intern Med* 1951; 34: 1421-31.
19. Roubenoff R, Klag MJ, Mead LA, et al. Incidence and risk factors for gout in white men. *JAMA* 1991; 266: 3004-7.
20. Facchini F, Chen YD, Hollenbeck CB, et al. Relationship between resistance to insulin-mediated glucose uptake, urinary uric acid clearance, and plasma uric acid concentration. *JAMA* 1991; 66: 3008-11.