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Association of hyperuricemia with Obesity and Metabolic Co-Morbidities among Post-Menopausal Egyptian Women

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Abstract: ***Background: Obesity is a global public health problem and is associated with cardio-metabolic diseases and hyperuricemia. Thus the aim of our study was to evaluate the role of serum uric acid as a marker of cardiovascular risk in screening of obesity-related metabolic comorbiditiesamong Egyptian women according to menopausal status. Methods: This a cross-sectional study included 72 pre-menopausal women and 128 post-menopausal women who were stratified according to BMI into three subgroup.Serum uric acid was measured. Fat mass (FM) were evaluated by Dual-energy X-ray absorptiometry (DEXA).Results: there were significantly higher values of serum uric acid in post-menopausal women compared to pre- menopausal women, in post-menopausal women, serum uric acidlevels were higher in obese compared to overweightas well as lean women, In post-menopausal women, there were significantly positive correlationsbetween serum uric acid and fasting plasma glucose, waist circumferenceas well as triglycerides .Also,stepwise linear regression analysis showed that serum uric acidlevels were independently correlated with systolic blood pressure ,triglycerides,HbA1c and FM.Conclusion: serum uric acid increased in post-menopausal women and associated with cardiovascular and metabolic diseases as well as obesity indices among Egyptian post-menopausal women.***

Keywords: post-menopausal; uric acid; obesity; metabolic

1. Introduction

The pandemic of obesity represents a major public health alarm, as obesity is associated with an increased risk of medical comorbidities contributing to a significant rise in mortality.The comorbiditiesof obesity including hypertension, dyslipidemia, type 2 diabetes mellitus (T2DM), coronary heart disease, osteoarthritis and hyperuricemia[1].

Serum uric acid level has been considered to be an atherosclerotic factor [2-5].Furthermore, many reports have suggested that females are at a higher risk for uric acid-induced atherosclerotic diseases than males, Moreover, many reports have suggested that serum uric acid level is positively correlated with the incidence of coronary heart disease [6], hypertension [7], as well as kidney dysfunction [8,9].

Interestingly, recent studies suggested that,serum uric acid levels vary between pre-menopause and post-menopause women, because blood estradiol level was changed rapidly during menopausal transition period, accordingly, serum uric acidlevels increase after menopause [10, 11].

In Egypt, obesity has increased at an alarming rate during the last three decades affecting 22% of adult males and 48% of adult females .Obesity is the main component of metabolic syndrome. hyperuricemia is a risk factor of cardiovascular disease which hasthe highest rate of morbidity and mortality. Early diagnosis through screening test and aggressive treatment should be done. Thus the aim of our study was to evaluate the role of serum uric acid as a marker of cardiovascular risk in screening of obesity-related metabolic comorbiditiesamong Egyptian women according to menopausal status.

2. Subject and Methods

A cross-sectional study included 200 unrelatedwomen. Seventy two pre-menopausalwomenand 128post-menopausal women who were stratified according to BMI intothreesubgroup;lean, BMI<25 (n=24), overweightBMI: 25-29 (n=40), and obese BMI >30(n=64). All subjects recruited from diabetesand endocrinology outpatient clinic of Internal Medicine Department of Zagazig University Hospitals.

Pregnant women or women with past history of cancer,liver, kidney, thyroid, or any active inflammatorydiseases were excluded from this study. None of the participantshad history of abdominal surgery that could have animpact on abdominal fat distribution, or receiving medications; hormone replacement therapy or medications for weight reduction or participatingin a dietary or exercise programs during the preceding6 months. The study protocol was approved by theEthical Committee of Faculty of Medicine, Zagazig University, and all participants assigned written informed consent.All women weresubjected to thorough history taking and full clinical assessment and anthropometricmeasures including body mass index (BMI) and waist circumference (WC).Women were defined postmenopausal at the absence of menses for 12 consecutive months.Women were regarded as postmenopausal if they had bilateral oophorectomy (either alone or in combination with hysterectomy) and had hysterectomy without bilateral oophorectomy and were above 50 years in case there was no onset of menopause before hysterectomy.Metabolic syndrome was determined according to the criteria of the National Cholesterol Education Program Adult Treatment Panel III which was defined as the presence of three or more of the following five criteria: 1) WC ≥80 cm in females, 2) triglycerides (TG) ≥150 mg/dl or under treatment for elevated triglycerides, 3) high-density lipoprotein (HDL)-

cholesterol < 50 mg/dL in females or under treatment for reduced HDL, 4) systolic blood pressure (SBP) ≥130 mmHg or diastolic blood pressure (DBP) ≥85 mmHg or under treatment for hypertension, and 5) fasting glucose ≥100 mg/dL or under treatment [12].

3. Blood Sampling

Blood samples were drawn from all subjects after an overnight fast and divided into 3 portions: 1 ml of whole blood was collected into evacuated tubes containing EDTA, for hemoglobin A1c (HbA1c). The second ml of whole blood was collected into evacuated tubes containing potassium oxalate and sodium fluoride (2:1) for fasting plasma glucose. Sera were separated immediately from remaining part of the sample and stored at −20 °C

Biochemical and hormonal assays

We determined fasting plasma glucose by the glucose oxidase method (Spinreact, Girona, Spain). Total cholesterol (TC), TG and HDL cholesterol was measured. Low-density lipoprotein (LDL)-cholesterol was calculated using the Friedewald formula [13]. Hyperuricemia was defined as uric acid (UA) level6.0 mg/dl for women [14].

Dual-energy X-ray absorptiometry (DEXA)

The values of the body composition parameters were estimated from theDEXA scan of the total body, we measured fat mass (FM), additionally, we calculated the FM index (FMI; FM/height^2).

Statistical Analysis

Statistical analyses were performed using the Statistical Package for the Social Sciences for Windows (version 19; SPSS Inc., Chicago, IL, USA). Data were expressed using descriptive statistic (mean ± standard deviation) and were analyzed using t test. Pearson correlation coefficient was used to assess the association between serum uric acid, and parameters of metabolic syndrome in both Pre-menopausal and post-menopausal groups. Receiver operating characteristic (ROC) analysis was performed to assess sensitivities, specificities, area under the curve (AUC), and the cutoff values of serum uric acid for diagnosis of cardiovascular risks among studied women, linear regression analysis was done to detect the main predictors of serum uric acid in post-menopausal women P was significant if p < 0.05.

4. Results

Clinical and laboratory characteristics of studied women:

Post-menopausal group had significantly higher values of age,systolic blood pressure (SBP),waist circumference, body mass index (BMI), fat mass index (FMI), fasting plasma glucose (FPG),HbA1c, triglycerides (TG), total cholesterol (TC),LDL and serum uric acidthan pre-menopausal group (p <0.05).On the other hand, there were significant lower values of HDL in post-menopausal group compared to pre-menopausal group (p < 0.05) (Table 1).On the contrary, values there were non-significant difference regardingdiastolic blood pressure among studied groups.

Table 1: Clinical, anthropometric and laboratory characteristics of all studied subjects

	Post-menopausal group (mean ±SD) ,(n=128)	*Pre-menopausal group (mean ± SD,(n=72)*	*P*
Age (years)	41.01±8.710	32.3±6.73	<0.001*
Systolic blood pressure (mm Hg)	130.7±7.4	125.9±5.8	<0.001*
Diastolic blood pressure (mm Hg)	85.4±4.01	86.05±3.8	0.430
Waist circumference (cm)	1.4±0.27	00.88±0.07	<0.001*
Body mass index (kg/m^2)	30.5±5.89	21.6±1.77	<0.001*
fat mass index (kg/m2)	10.3±3.2	7.12±2.45	<0.001*
Total cholesterol (mg/dL)	181.6±26.3	168.8±19.3	<0.001*
Triglycerides (mg/dL)	202.4±59.7	178.02±10.45	<0.001*
LDL cholesterol (mg/dL)	153.4±19.6	139.7±5.8	<0.001*
HDL cholesterol (mg/dL)	47.89±5.2	53.6±3.2	<0.001*
Fasting plasma glucose (mg/dL)	88.01±7.76	83.8±8.2	<0.001*
HbA1c (%)	5.9±0.29	5.7±0.17	<0.001*
Serum uric acid (mg/dl)	8.36±1.6	4.9±1.13	<0.001*

HDL-C, high-density lipoprotein-cholesterol; LDL-C, low-density lipoprotein cholesterol; HbA1c, hemoglobin A1c; *p1 <0.05

Clinical, anthropometric and laboratory characteristics of post-menopausal group stratified according to BMI (kg/m^2):In obese post-menopausal women, there were significantly higher values of SBP, DBP,WC, BMI, fat mass index (FMI), FPG, HbA1c, triglycerides, TC and LDL than lean group (p < 0.05). In overweight group, there were significant higher values of SBP,WC as well as BMI compared to lean group (p < 0.05), (Table 2). Regarding serum uric acid, there were significantly higher values in obese group (8.86±2.1) compared to overweight (7.86± 0.78) as well as lean women (7.54 ±1.1) (Figure 1).

Table 2: Clinical, anthropometric and laboratory characteristics of post-menopausal group

	Lean group (mean± SD) (n=24)	*Overweight group (mean± SD) (n=40)*	*Obese group (mean± SD) (n=64)*	*P1*	*P2*
Age (years)	41.1±9.8	40.9±9.7	41.06±7.5	0.975	0.983
Systolic blood pressure (mm Hg)	122.8±9.3	128.8±6.8	134.0±4.8	<0.001*	<0.001*
Diastolic blood pressure (mm Hg)	84.2±4.1	83.8±4.01	87.1±3.6	0.778	<0.001*
Waist circumference (cm)	0.9±.08	1.27±0.06	1.6±0.17	<0.001*	<0.001*
Body mass index (kg/m^2)	22.2±1.9	26.8±1.4	34.7±4.4	<0.001*	<0.001*
FMI (kg/m2)	7.48±0.8	8.1±0.82	12.39±3.1	0.463	<0.001*
Total cholesterol (mg/dL)	158.3±21.5	165.6±23.7	195.0±22.1	0.378	<0.001*
Triglycerides (mg/dL)	176.2±9.5	180.1±12.6	222.5±75.9	0.848	<0.001*
LDL cholesterol (mg/dL)	138.6±6.06	139.3±6.2	166.0±18.7	0.902	<0.001*
HDL cholesterol (mg/dL)	51.7±2.5	52.1±3.3	44.46±4.4	0.788	<0.001*
Fasting plasma glucose (mg/dL)	85.5±8.3	84.2±9.01	91.71±8.28	0.689	<0.001*
HbA1c (%)	5.7±0.15	5.7±0.13	6.02±0.34	0.574	<0.001*

HDL-C, high-density lipoprotein-cholesterol; LDL-C, low-density lipoprotein cholesterol; HbA1c, hemoglobin A1c; *p1 <0.001 when compared overweight group to lean group.* $P2 < 0.05$ when compared obese to lean.

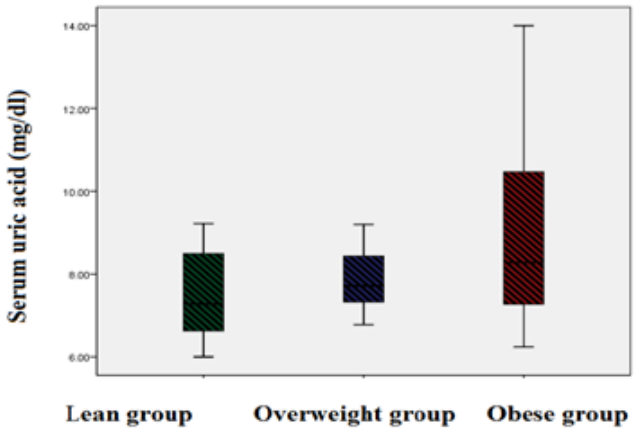

Figure 1: Comparison of serum uric acid levels (mg/dl) in post-menopausal women

Correlation of serum uric acid (mg/dl) levels with parameters of metabolic syndrome in pre and post-menopausal groups as shown in table 3:in post-menopausal women, there was significantlypositive correlation between serum uric acid and fasting plasma glucose,WCas well astriglycerides. On the other hand, there was significantlynegative correlation between serum uric acid and HDL (p< 0.001).While there were non-significantcorrelations between serum uric acid and other parameters in pre-menopausal women (p > 0.05).

Multiple stepwise linear regression analyses in post-menopausal women

Stepwise linear regression analysis test was done to assess the main independent parameters associated with serum uric acid .Our results showed that, serum uric acid were independently correlated with SBP ,triglycerides,HbA1c and FMI (p< 0.001) (Table 4).

Table 4: Multiple stepwise linear regression analyses in post-menopausal women to test the influence of the main independent variables against serum uric acid (mg/dl)

Model		*Unstandardized Coefficients*		*Standardized Coefficients*			*95% C.I.*	
		B	***SE***	***B***	*t*	*p*	*Lower Bound*	*Upper Bound*
	Constant	1.687	3.998		0.422	0.0675	-9.687-	6.313
	Triglycerides	0.007	0.004	0.250	1.890	0.064	0.000	0.015
	HbA1c	2.167	0.723	0.378	2.998	<0.001*	0.721	3.614
	FMI (kg/m2)	0.158	0.057	0.307	2.762	<0.01*	0.044	0.273
	Systolic blood pressure	0.045	0.021	0.207	2.134	<0.05*	0.086-	0.003-

Accuracy of serum uric acidfor discriminating cardiovascular risk among post-menopausal women by ROC analysis:

We further investigated the potential diagnostic value of serum uric acid by receiver operating characteristic curve (ROC) curves and the area under the curve (AUC) values. (Fig.2). In post-menopausal women, the cutoff values of serum uric acidwas6.1and the AUC was 0.955 (95% CI = 0.911-0.999). Additionally, the sensitivity and the specificity were (98.4% and 98.33%), thusserum uric acidcould be useful diagnostic test discriminate cardiovascular risk of pre-menopausal women from post-menopausal women.

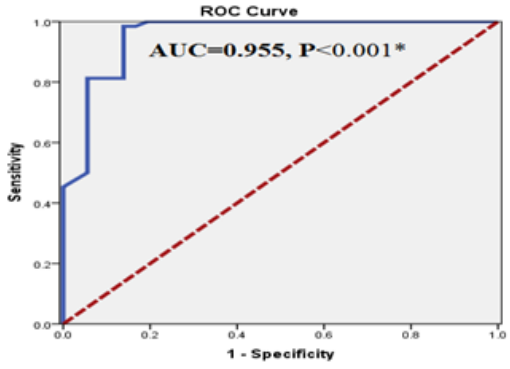

Figure 2: ROC assess the diagnostic performance of cardiovascular risk among post-menopausal women

5. Discussion

Obesity is a risk factor of cardiovascular diseases [15-17].Serum uric acid levels were associated with hypertension [18, 19], diabetes [20,21], obesity [22,23], insulin resistance [24] dyslipidemia [25], cardiovascular diseases [26,27] peripheral arterial disease[28] markers of inflammation[29] and oxidative stress[30,31].

There was great evidence that, visceral obesity is independently associated with higher serum uric acid in post-menopausal women [32].

Obesity is a global public health problem .Moreover; obesity is strongly associated with metabolic diseases and hyperuricemia [1]. With the rapid socio-economic growth, the prevalence of obesity has increased rapidly .In Egypt, obesity has increased at an alarming rate during the last three decades. Thus the aim of our study was to estimate the role of serum uric acid as a marker of cardiovascular risk in screeningof obesity-related metabolic comorbidities among Egyptian women according to menopausal status.

Our study revealed clear evidence that, Post-menopausal group had significantly higher values of age, SBP, waist circumference, BMI, FMI, fasting plasma glucose, HbA1c, TG, TC , LDL and serum uric acid than pre-menopausal group.
This was in agreement with the findings detected byJoo et al., they found that serum uric acid was higher in menopause women [33].

Hak et al. results indicated that menopause increases the risk of hyperuricemia among postmenopausal women [31].

Regarding the influence of BMI on clinical and biochemical parameters, our results revealed that, in obese post-menopausal women, there were significantly higher values of SBP, DBP, WC, BMI, fat mass index (FMI), fasting plasma glucose, HbA1c, triglycerides, TC and LDL than lean group,moreover in overweight group, there were significant higher values of SBP, waist circumference as well as BMI compared to lean group.

In agreement with our findings,Wei et al. reported that patients with metabolic syndrome have a significantly higher ratio of abnormal BP, FPG, TG, WC, and HDL-C than those without metabolic syndrome [34].

The main finding of our study, there were significantly higher values in obese post-menopausal women compared to overweight post-menopausal women as well as lean post-menopausal women.

Marotta et al. agreed with our results that serum uric acid increased in obesity [35].

These findings are in a close agreement with results reported byOzbey et al. they explored that the change of fat distribution during menopausal transition is one of the reasons for increasing serum uric acid [36].

Our study demonstrated that, in post-menopausal women, there was significantly positive correlation between serum uric acid and fasting plasma glucose, WCas well as triglycerides. On the other hand, there was significantlynegative correlation between serum uric acid and HDL.

Similar to our results, Cremonini et al. reported that visceral adiposity accumulation is independently associated with higher serum uric acid, and this association is confined to women in menopause [32].

Previous studies reached similar conclusions that serum uric acid is significantly associated with cardiovascular risk factors such as hypertension [37],metabolic syndrome (MetS) [38], and insulin resistance [39]. Other studies also found that high SUA concentrations are associated with an increased risk of MetS[40].

On the contrary, study by joo et al. revealed that in Korean population, there were non-significant correlations between serum uric acid and MetSwith menopause [33].

Our study explored that, in post-menopausal women, stepwise linear regression analysis showed that serum uric acid were independently correlated with SBP ,triglycerides,HbA1c and FMI

Similar to our results, Joo et al. found that, in the logistic regression analysis, metabolic syndrome independently correlated with age and serum uric acid [33].

Prasad et al. detected that; serum uric acid was strongly correlated to early coronary atherosclerosis in postmenopausal women [41].

Interestingly, ROC analyses revealed that serum uric acid level was useful biomarker discriminating cardiovascular riskof pre- menopausal womenfrom post-menopausal women.

Similar to our results Lee et al. explored that, higher serum uric acid levels are positively associated with the presence of metabolic syndrome in Korean patients [42].

In conclusion, We demonstrate that serum uric acid increased in obese post-menopausal women and associated with cardiovascular and metabolic diseases as well as obesity indices among Egyptian post-menopausal women thus, serum uric found to be good diagnostic marker of cardiovascular and metabolic diseases especially in obese post-menopausal women. We recommend further studies on a population to support these findings.

References

[1] Kelly T, Yang W, Chen CS, et al.(2008) Global burden of obesity in 2005 and projections to 2030. Int J Obes;32:1431–7.
[2] Gustafsson D, Unwin R (2013) The pathophysiology of hyperuricaemia and its possible relationship to cardiovascular disease, morbidity and mortality. BMC Nephrol 14: 164

[3] Li M, Hou W, Zhang X, Hu L, Tang Z (2014) Hyperuricemia and risk of stroke: a systematic review and meta-analysis of prospective studies. Atherosclerosis 232: 265–270.
[4] Wang J, Qin T, Chen J, Li Y, Wang L, Huang H, et al. (2014) Hyperuricemia and risk of incident hypertension: a systematic review and meta-analysis of observational studies. PLoS One 9: e114259
[5] Feig DI (2014) Serum uric acid and the risk of hypertension and chronic kidney disease. CurrOpinRheumatol 26: 176–185.
[6] Kim SY, Guevara JP, Kim KM, Choi HK, Heitjan DF, Albert DA (2010) Hyperuricemia and coronary heart disease: a systematic review and meta-analysis. Arthritis Care Res (Hoboken) 62: 170–180
[7] Akasaka H, Yoshida H, Takizawa H, Hanawa N, Tobisawa T, Tanaka M, et al. (2014) The impact of elevation of serum uric acid level on the natural history of glomerular filtration rate (GFR) and its sex difference. Nephrol Dial Transplant 29: 1932–1939.
[8] Iseki K, Iseki C, Kinjo K (2013) Changes in serum uric acid have a reciprocal effect on eGFR change: a 10-year follow-up study of community-based screening in Okinawa, Japan. Hypertens Res 36: 650–654.
[9] Connors AF Jr., Speroff T, Dawson NV, Thomas C, Harrell FE Jr., Wagner D, et al. (1996) The effectiveness of right heart catheterization in the initial care of critically ill patients. SUPPORT Investigators. JAMA 276: 889–897.
[10] Wingrove CS, Walton C, Stevenson JC(1998). The effect of menopause on serum uric acid levels in non-obese healthy women. Metabolism. 47:435–438.
[11] Rho YH, Woo JH, Choi SJ, Lee YH, Ji JD, Song GG(2008). Association between serum uric acid and the Adult Treatment Panel III-defined metabolic syndrome: results from a single hospital database. Metabolism. 57:71–76.
[12] Grundy SM, Cleeman JI, Daniels SR, Donato KA, Eckel RH, Franklin BA, et al(2005). Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung, and Blood Institute Scientific Statement. Circulation. 112(17):2735–2752.
[13] Frieldewald WT, Levy RI, Fredrickson DS (1972) Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. ClinChem 18:499–502.
[14] Roubenoff R. Gout and hyperuricemia. Rheum Dis Clin North Am 1990;16:539-50.
[15] Grundy SM, Brewer HB, Jr, Cleeman JI, Smith SC, Jr, Lenfant C.(2004) Definition of metabolic syndrome: Report of the National Heart, Lung, and Blood Institute/American Heart Association conference on scientific issues related to definition. Circulation.109:433–438.
[16] Grundy SM, Cleeman JI, Daniels SR, Donato KA, Eckel RH, Franklin BA, et al.(2005) Diagnosis and management of the metabolic syndrome An American Heart Association/National Heart, Lung, and Blood Institute Scientific Statement Executive summary. Cardiol Rev. 13:322–327.
[17] Wilson PW, D'Agostino RB, Parise H, Sullivan L, Meigs JB.(2005) Metabolic syndrome as a precursor of cardiovascular disease and type 2 diabetes mellitus. Circulation112:3066–3072.
[18] Chen JH, Yeh WT, Chuang SY, Wu YY, Pan WH (2012). Gender-specific risk factors for incident gout: a prospective cohort study. Clin Rheumatol.31:239–245.
[19] Lee HJ, Park HT, Cho GJ, Yi KW, Ahn KH, et al.(2011) Relationship between uric acid and metabolic syndrome according to menopausal status. Gynecol Endocrinol.27:406–411.
[20] Li Q, Yang Z, Lu B, Wen J, Ye Z, et al.(2011) Serum uric acid level and its association with metabolic syndrome and carotid atherosclerosis in patients with type 2 diabetes. Cardiovasc Diabetol,10:72
[21] Lin KC, Tsai ST, Lin HY, Chou P (2004). Different progressions of hyperglycemia and diabetes among hyperuricemic men and women in the kinmen study. J Rheumatol.31:1159–1165.
[22] Gaffo AL, Edwards NL, Saag KG.(2009) Gout. Hyperuricemia and cardiovascular disease: how strong is the evidence for a causal link? Arthritis Res Ther. 11:240.
[23] Meisinger C, Koenig W, Baumert J, Döring A.(2008) Uric acid levels are associated with all-cause and cardiovascular disease mortality independent of systemic inflammation in men from the general population: the MONICA/KORA cohort study. ArterioscIerThrombVasc Biol. 28:1186–1192.
[24] Meisinger C, Thorand B, Schneider A, Stieber J, Döring A, et al.(2002) Sex differences in risk factors for incident type 2 diabetes mellitus: the MONICA Augsburg cohort study. Arch Intern Med. 162:82–89.
[25] Döring A, Gieger C, Mehta D, Gohlke H, Prokisch H, et al.(2008) SLC2A9 influences uric acid concentrations with pronounced sex-specific effects. Nat Genet. 40:430–436.
[26] Hak AE, Choi HK.(2008) Menopause, postmenopausal hormone use and serum uric acid levels in US women–the Third National Health and Nutrition Examination Survey. Arthritis Res Ther. 10:R116.
[27] Wingrove CS, Walton C, Stevenson JC. The effect of menopause on serum uric acid levels in non-obese healthy women. Metabolism. 1998;47:435–438.
[28] Lind T, Godfrey KA, Otun H, Philips PR.(1984) Changes in serum uric acid concentrations during normal pregnancy. Br J ObstetGynaecol. 91:128–132
[29] Elks CE, Perry JR, Sulem P, Chasman DI, Franceschini N, et al.(2010) Thirty new loci for age at menarche identified by a meta-analysis of genome-wide association studies. Nat Genet. 42:1077–1085.
[30] Singh JA, Reddy SG, Kundukulam J. Risk factors for gout and prevention: a systematic review of the literature. CurrOpinRheumatol. 2011;23:192–202.
[31] Hak AE, Curhan GC, Grodstein F, Choi HK.(2010) Menopause, postmenopausal hormone use and risk of incident gout. Ann Rheum Dis. 69:1305–1309.
[32] Cremonini E, Bonaccorsi G, Bergamini CM, Castaldini C, Ferrazzini S, Capatti A, et al.(2013) Metabolic transitions at menopause: in post-menopausal women the increase in serum uric acid correlates with abdominal adiposity as assessed by DXA. Maturitas. 75:62–66.
[33] Jong KilJoo, Gil Pyo Hong, Si Eun Han, et al., (2014)The Association between Serum Uric Acid Level

and Incidence of Metabolic Syndrome according to Menopausal Status in Korean Women.J Menopausal Med. 20(3): 126–132.
[34] Cheng-Yu Wei, Chia-Cheng Sun, James Cheng-Chung Wei, et al.(2015) Association between Hyperuricemia and Metabolic Syndrome: An Epidemiological Study of a Labor Force Population in TaiwanBiomed Res Int.: 369179.
[35] Teodoro Marotta, Maria Liccardo, Federico Schettini, Francesco Verde, Aldo L. Ferrara(2015) Association of Hyperuricemia With Conventional Cardiovascular Risk Factors in Elderly PatientsJClinHypertens (Greenwich). 17:27–32.
[36] Ozbey N, Sencer E, Molvalilar S, Orhan Y.(2002) Body fat distribution and cardiovascular disease risk factors in pre- and postmenopausal obese women with similar BMI. Endocr J.49:503–509.
[37] Mellen P. B., Bleyer A. J., Erlinger T. P., et al. (2006) Serum uric acid predicts incident hypertension in a biethnic cohort: the Atherosclerosis Risk in Communities study. *Hypertension*. 48(6):1037–1042.
[38] Ford E. S., Li C., Cook S., Choi H. K. (2007) Serum concentrations of uric acid and the metabolic syndrome among US children and adolescents. *Circulation*. 115(19):2526–2532.
[39] Chen L.-K., Lin M.-H., Lai H.-Y., Hwang S.-J., Chiou S.-T. (2008)Uric acid: a surrogate of insulin resistance in older women. *Maturitas*. 59(1):55–61
[40] Lee M. S., Lin S. C., Chang H. Y., Lyu L. C., Tsai K. S., Pan W. H.(2005) High prevalence of hyperuricemia in elderly Taiwanese. *Asia Pacific Journal of Clinical Nutrition*. 14(3):285–29.
[41] Prasad M, Matteson EL, Herrmann J, Gulati R, Rihal CS, Lerman LO, Lerman A(2017).Uric Acid Is Associated With Inflammation, Coronary Microvascular Dysfunction, and Adverse Outcomes in Postmenopausal Women.Hypertension. 69(2):236-242.
[42] Ju-Mi Lee, Hyeon Chang Kim, Hye Min Cho, Sun Min Oh, Dong Phil Choi, and Il Suh.(2012) Association Between Serum Uric Acid Level and Metabolic Syndrome.JPrev Med Public Health. 45(3): 181–187.

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