

HYPERURICAEMIA IN OBESE TYPE 2 DIABETICS IN JOS, NORTH CENTRAL NIGERIA

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ABSTRACT

Introduction: Uric acid is a metabolite from the breakdown of purines. Elevated serum levels (hyperuricaemia) is known to have an association with cardiovascular risk factors that are often seen in obesity, such as hypertension, dyslipidaemia and glucose intolerance. This study will attempt to give an insight into this association among individuals with Type 2 Diabetes mellitus.

Methodology: 100 patients with Type 2 diabetes visiting a private health facility in Jos, North Central Nigeria participated in this study. The data obtained for analysis from each participant were anthropometric indices (body mass index, waist circumference) and laboratory parameters (serum lipids and uric acid).

Results: 64% of participants were males. 79% of the population were obese and 45% had hyperuricaemia. The proportion of females with obesity (94.4%) was significantly greater than that for males (70.3%) but there was no significant difference between the proportion of males and females with hyperuricaemia. Serum uric acid showed significant positive correlation with waist circumference ($p=0.04$) and age ($p=0.03$) and had no significant relationship with other variables.

Conclusion: Early detection and treatment of hyperuricaemia in obese patients will help reduce their overall risk of cardiovascular events. This is achieved by both non pharmacological and pharmacological means.

Key words: Diabetes, Hyperuricaemia, Obesity

INTRODUCTION

Uric acid is a diprotic acid synthesized following the catabolism of purines. It was first isolated from kidney stones by Scheele¹. The breakdown of purines produces xanthine which is metabolized to uric acid by xanthine oxidase in mammals. In lower animals, the enzyme uricase converts uric acid to allantoin². Uric acid is excreted as a waste product in urine and faeces.

However, it does serve certain functions in the body such as exercising the role of a free radical scavenger due to its reducing ability³. Elevation in serum uric acid levels may be due to increased production or decreased excretion. Increased production of uric acid could be due to ingestion of purine rich diet or excessive breakdown of cells such as skeletal muscle cells (rhabdomyolysis) or tumour cells. Reduced excretion is commonly as a result of impairment in renal function. Serum uric acid levels above 416 $\mu\text{mol/l}$ results in the supersaturation of plasma by uric acid⁴. The upper

limit of the reference range for serum uric acid however depends on individual laboratories.

Obesity is a medical condition in which excess body fat has accumulated to the extent that it may have adverse effects on the health of the individual, leading to reduced life expectancy and/or increased health problems⁵. The storage of fat in adipose tissue serves some physiologic functions such as the provision of an energy source and maintenance of body temperature. In obesity however, the adverse effects of its accumulation outweighs its benefits. Obesity is one of the leading causes of preventable deaths worldwide⁶. In the United States it is estimated that about 365000 deaths annually are obesity related⁷. As at 2005, about 396 million persons worldwide were obese, and that number is expected to rise to 573 million by the year 2030⁸. In Nigeria, the prevalence of obesity ranges from between 8.1% to 22.2% depending on the part of the

country being studied⁹. Obesity is known to have an association with certain cardiovascular risk factors, viz: hypertension, diabetes mellitus and dyslipidaemia. This association was first described by Reaven, and has since been referred to as the Syndrome X or metabolic syndrome¹⁰.

The Aims of this study are:

1. To determine the prevalence of hyperuricaemia and obesity among Type 2 Diabetics
2. To assess the association between hyperuricaemia and obesity
3. To determine the correlates of serum uric acid among persons with Type 2 Diabetes mellitus

STATISTICAL ANALYSIS

This was done with the Epi Info statistical software (version 7.0). Chi square was used to test the significance of association between categorical variables (hyperuricaemia, obesity). The Pearson correlation coefficient was used to determine the relationship between serum uric acid and other variables such as age, waist circumference, body mass index and serum triglycerides. In all instances, $p < 0.05$ was considered statistically significant.

MATERIALS AND METHODS

100 adult Type 2 Diabetics accessing care at a private diabetes clinic in Jos, North Central Nigeria were enrolled to participate in this study. The following anthropometric indices were measured in each participant:

Weight: this was measured to the nearest kilogramme using a metric weighing scale.

Height: this was measured to the nearest centimeter using a stadiometer.

Waist circumference: this was measured at the midpoint between the iliac crest and the inferior costal margin at expiration using a measuring tape.

The values of weight and height were used to calculate the body mass index of each participant in Kg/m^2 .

Blood samples were collected for triglyceride, cholesterol and uric acid assays after an overnight fast. Triglyceride and cholesterol were assayed using the glycerol phosphate oxidase and cholesterol oxidase methods respectively. Uric acid was assayed using the uricase EMST method.

Definition of terms

1. Hyperuricaemia was defined as serum uric acid levels greater than $416\mu\text{Mol/l}^4$.
2. Obesity was defined as a waist circumference $>94\text{cm}$ in men and $>80\text{cm}$ in women¹⁹.

RESULTS

Of the 100 participants in the study, 64% were males and 36% were females. The mean ages for males and females were 55.1 ± 7.9 and 55.7 ± 10 years respectively with no statistically significant difference ($p=0.77$). Hyperuricaemia was present in 45% of participants while 79% of them were obese.

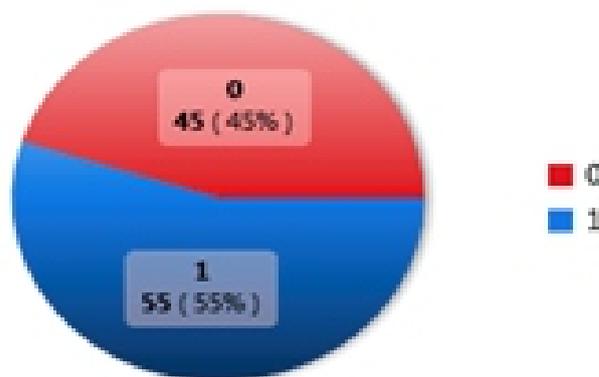


Figure 1: Distribution of hyperuricaemia among participants (0=present, 1=absent)

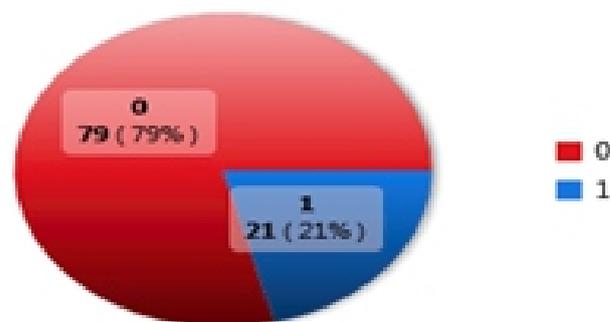


Figure 2: Distribution of obesity among participants (0=present 1=absent)

70.3% of males were obese as opposed to 94.4% of females. This difference was statistically significant ($X^2 = 8.08$; $df=1$; $p = 0.004$). No statistically significant difference was observed between the 39.1% of males with hyperuricaemia compared to the 55.6% of females with the condition ($X^2 = 2.53$; $df=1$; $p = 0.111$). Obesity showed significant association with hyperuricaemia among males ($X^2 = 3.48$; $df=1$; $p = 0.04$) but not among females ($X^2 = 0.03$; $df=1$; $p = 0.87$). Serum uric acid showed significant correlation with waist circumference ($p = 0.04$) but not with age ($p=0.07$), body mass index ($p=0.76$), serum triglyceride ($p=0.22$), or cholesterol ($p=0.65$) (Table 1). However, after

adjusting for confounding variables (waist circumference, body mass index, triglyceride, cholesterol) age showed significant correlation with serum uric acid ($p= 0.03$) but the other variables did not.

$$\text{Equation: } Y = [2.2048]X + 269.8001$$

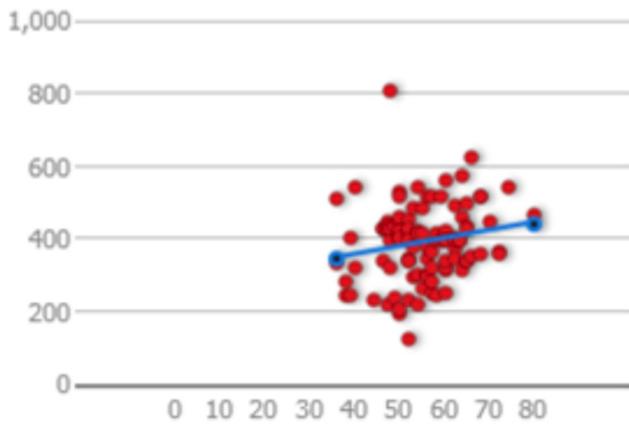


Figure 3: Scatterplot of uric acid versus age of participants

$$\text{Equation: } Y = [0.0647]X + 373.5227$$

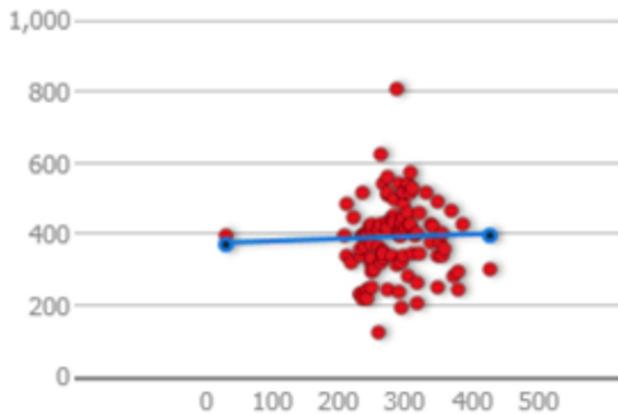


Figure 4: Scatterplot of uric acid versus BMI of participants

$$\text{Equation: } Y = [2.0722]X + 184.0535$$

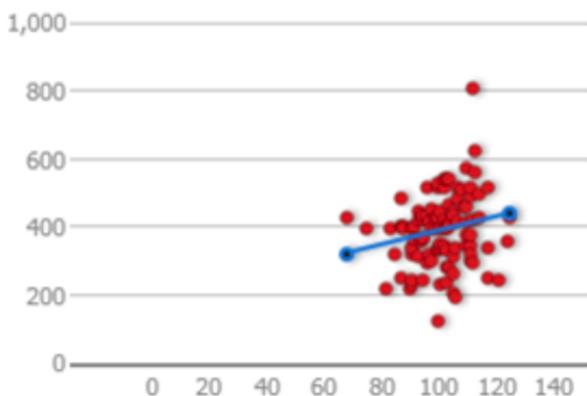


Figure 4: Scatterplot of uric acid versus waist circumference of participants

Table 1. The different correlates of uric acid

Correlate	Correlation coefficient	F - test	P value
Age	0.18	3.33	0.07
Waist circumference	0.20	3.90	0.04
Body mass index	0.03	0.10	0.76
triglyceride	0.12	1.55	0.22
Total cholesterol	0.05	0.21	0.65

DISCUSSION

Assessment of serum uric acid levels in obese individuals is important because both hyperuricaemia and obesity are risk factors for cardiovascular events such as cerebrovascular disease, myocardial infarction and peripheral vascular disease¹¹. In our study population the proportion of females who were obese (94.4%) was greater than that of obese males (70.3%) with a difference that was statistically significant. These results are similar to those of other studies on related topics from other parts of the world^{12,13}. Here in Nigeria, Adedoyin et al¹⁴ found out that obesity had the highest prevalence among elderly females in a population based study. In some other populations however, no significant difference between the prevalence of obesity among males and females was observed¹⁵. The comparatively greater physical activity level in males may explain the lower prevalence rate in them. Also , repeated pregnancies in females contributes to a progressive accumulation of adipose tissue¹⁶.

Hyperuricaemia was more prevalent among the females in our study population compared with males, although the difference was not statistically significant. Some other studies also found no significant difference between the prevalence of hyperuricaemia in men and women¹⁷ while others showed that the condition was more prevalent in men^{18,19}.

We demonstrated the presence of a significant association between hyperuricaemia and obesity among the male population but not the females. Serum uric acid levels tend to be higher in obese individuals compared with normal weight controls²⁰. Several studies support this association between hyperuricaemia and obesity^{21,22,23}. Others do not²⁴. This is probably as a result of the fact that the cut-off value used to define hyperuricaemia was not

the same in all studies. For instance, Remedios et al²⁴ used 357umol/l as upper limit to define hyperuricaemia in their work while we used 416umol/l. Age correlated positively with serum uric acid in our study. Other workers agree with this finding^{25,26}. Uric acid however did not correlate with serum triglyceride or total cholesterol. Research findings on this matter appear to differ for reasons still unclear. Some workers demonstrated a positive correlation between uric acid and serum triglycerides alone^{27,28}. Others showed a correlation with both triglycerides and total cholesterol²⁹. Still others found no correlation between uric acid and either lipid fraction²⁴.

CONCLUSION

Approach to the management of obesity should be holistic. It should involve looking for and managing the different associated conditions such as hypertension, Diabetes, dyslipidaemia and especially hyperuricaemia. Correction of hyperuricaemia involves non pharmacological and pharmacological measures and will significantly reduce the overall risk of cardiovascular events.

REFERENCES

- 1 Scheele V.Q., Examen Chemicum Calculi Urinari Opuscula 1776;2:73
- 2 Angstadt C.N., Purine and Pyrimidine metabolism. Purine catabolism *NetBiochem* 1997;3:45
- 3 Maxwell S.R.J., Thompson H., Sandler D., Leugen C., Baxter M.A., Antioxidant status in patients with uncomplicated insulin dependent and non insulin dependent diabetes *Eur J Clin Invest* 1997;27:484-490
- 4 Loeb J.N., The influence of temperature on the solubility of monosodium urate *Arthritis Rheum* 1972;15:189-192
- 5 Haslam D.W., James W.P., Obesity *Obesity* 2005;366:1197-1209
- 6 Makdad A.H., Marks J.S., Stroup D.F., Gerbending J.L., Actual causes of death in the U.S. *JAMA* 2000;291:1238-145
- 7 Allison D.B., Fontaine K.R., Mason J.E., Stevens J., Vantallie T.B., Annual deaths attributable to obesity in the U.S. *JAMA* 1999;282:1530-1558
- 8 Kelly T., Wang Y., Chen S., Reynolds K., He J., Global burden of Obesity in 2005 and projections to 2030 *International Journal of Obesity* 2008;32:1431-1437
- 9 Chukwuonye L.L., Chuka A., John C., Ohagwu K., Imoh M., Isa S., Prevalence of overweight and obesity in adult Nigerians *Dovepress Journal* 2013;6:43-47.
- 10 Reaven G.M., Role of insulin resistance in human diabetes *Diabetes* 1988;37:1595-1607.
- 11 Tsouli S.G., Liberopolous E.N., Mikhaliadis D.P., Anthyros V.G., Elisaf M.S., Elevated serum uric acid levels in metabolic syndrome: an active component or an innocent bystander? *Metabolism* 2006;55:1203-1301
- 12 Njekekela M., Kuga S., Nara Y., Ntogwisangu J., Masesa Z., Mashalla Y., Prevalence of obesity and dyslipidaemia in middle aged men and women in Tanzania Africa- relationship with resting energy expenditure and dietary factors *J Nutri Sci Vitaminol* 2002;48:352-358.
- 13 Hajian Tilaki K.O., Heidari B., Prevalence of obesity, central obesity and associated factors in urban population aged 20 to 70 years in North of Iran –a population based study and regression approach *Obes Rev* 2007;8:3-10
- 14 Adedoyin R.A., Mbada C.F., Balogun M.O., Adebato R.A., Martins T., Ismail T., Obesity prevalence in adult residents of Ile-ife Nigeria *Nig Q J Hosp Med* 2009;19:63-68
- 15 Ogden C.L., Carroll M.D., Kit B.K., Flegal K.M., Prevalence of obesity in the United States 2009 to 2010 *NCHS Data Brief* 2012;No 82
- 16 Luoto R., Mannisto S., Raitanen J., Ten year change in the association between obesity and parity: results from the National FINRISK Population Study *Gen Med* 2011;8:399-406
- 17 Zhu Y., Pandra B.J., Choi H.K., Prevalence of gout and hyperuricaemia in the U.S. general population: the National Health and Nutrition Examination Survey 2007 -2008 *Arthritis Rheum* 2011;63:3136-3141
- 18 Liu B., Wang T., Zhao H.N., Yue W.W., Yu H.P., Liu C.K., Prevalence of hyperuricaemia in China: a meta analysis *BMC Public Health* 2011;11:832
- 19 Alikor C.A., Enem Chioma P.C., Odia O.J., Prevalence of hyperuricaemia in a rural population of Nigerian Niger Delta Region *Niger J Med* 2013;22:1-192
- 20 Albogai O.A., Odeh A.A., Al Hourani H.M., Al Qudah F., Obesity and serum uric acid *Bahrain Med Bull* 2007;12:34
- 21 Bellinger T.M., Russell D.L., Risk factors for gout .A hospital based study in Urban Black South Africa *Rev Rhum Engl Ed* 1998;65:225-231

22. Emmerson B., Hyperlipidaemia in hyperuricaemia and gout *Ann Rheum Dis* 1998;57:509-510
23. Yoo T.W., Sung K.C., Shin H.S., Kim B.J., Kim B.S., Kang J.H., Relationship between serum uric acid concentration and insulin resistance and metabolic syndrome *Circ J* 2005;8:928-933
24. Remedios C., Shah M., Bhasker A.C., Lakdawala M., Hyperuricaemia: a reality in Indian obese *Obes Surg* 2012;22:945-948
25. Krishnan E., Benneth M., Chen L., Aging, not menopause, is associated with higher prevalence of hyperuricaemia among older women *Menopause* 2014; e publication
26. Qui L., Cheng X., Wu J., Liu J., Xu T., Ding H., Prevalence of hyperuricaemia and its related risk factors in healthy adults from Northern and North Eastern Chinese Population *BMC Health* 2013; 13:664
27. Mielants H., Veys E.M., de Weerd A., Gout and its relationship with lipid metabolism: correlations between uric acid, lipids and lipoprotein levels in gout *Ann Rheum Dis* 1973;32:506-509
28. Bansal B.C., Gupta R.R., Bansal M.R., Prakash C., Serum lipids and uric acid relationships in ischaemic thrombotic cerebrovascular disease *Stroke* 1975;6:304-307
29. Sarmah D., Sharma B., A correlative study of uric acid with lipid profile *Asian J med Sci* 2013;4:8-14