

SERUM URIC ACID IN RELATION TO BODY WEIGHT

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Many studies have been concerned with the determination of the normal range of serum uric acid concentration and the deviations therefrom which should be considered pathological. Results obtained from various methods of analysis have been compared (Bywaters and Holloway, 1964; Crone and Lassen, 1956; Emmerson and Sandilands, 1963; Jacobson, 1938) and the geographical incidence of higher serum uric acid levels has been investigated (Horváth, Lavicka, and Koleková, 1964). In Czechoslovakia concentrations of 2.5 to 4.5 mg. per 100 ml. in men and 2.5 to 4.0 mg. per 100 ml. in women are regarded as normal. In a study of 500 healthy and non-obese blood donors, the average values in men were 3.50 and in women 2.94 mg. per 100 ml., and showed significant differences in various areas (Lavicka, Blahoš, Brabencová, Šifaj, Virt, Mikuš, and Kresánek, 1963).

The serum uric acid level may be raised by a diet with a higher purine content, but on the other hand also by starvation, physical strain, and by some drugs. Only a few studies have concentrated upon the relationship between constitution or body build and serum uric acid level (Grotel, 1927; Gertler, Garn, and Levine, 1951), and these studies have not been taken into consideration in the majority of rheumatological and metabolic investigations.

Material and Methods

We examined the serum uric acid level in 460 persons (220 men and 240 women) aged from 18 to 70 years. The examination was carried out on hospitalized patients at the Research Institute for Physical Medicine, Hydrology, and Climatology at Marienbad. Blood samples were taken in the mornings on an empty stomach, usually after one or two days of a standard diet of low purine content. The taking of blood samples was not preceded by any considerable muscle strain, nor by any intake of alcohol or drugs likely to increase the serum uric acid level. The persons investigated comprised mainly

individuals with various degrees of simple obesity, patients with spondylitic and spondylarthritic complaints, the lumbo-ischiadic syndrome, etc. The following diseases were excluded: carditis, gout, diseases of the blood, renal insufficiency, and other metabolic disorders, which are usually accompanied by increased uricaemia. Also excluded were patients taking uricosurics, diuretics, salicylates, and other antirheumatic drugs or analgesics, and patients with serum creatinine values above 1.4 mg. per cent.

The serum uric acid was determined by a modification of Folin's method (King, 1951). The variation coefficient by this method was 4.1 per cent. The bodyweight was recorded in the morning on an empty stomach to the nearest 50 g. The ideal or normal weight was calculated according to the equation of Broca:

Body height in cm. $- 100 = 100$ per cent.,

for both men and women without correction for age.

Statistical Evaluation.—Average serum uric acids level and standard deviations were determined for groups in certain weight ranges, the correlation coefficient r being determined in the usual manner.

Results

Examinations of serum uric acid in 460 persons with various bodyweights showed that a practically linear relation exists between the weight, starting from 80 kg., and the serum uric acid (Fig. 1, opposite). Average values for persons weighing up to 60 kg. were 3.92 mg. per cent. in men and 3.36 mg. per cent. in women. In individuals whose weight ranged from 120 to 140 kg., the average serum uric acid was 6.81 mg. per cent. in men and 4.82 mg. per cent. in women (standard deviations for this group were 1.2 and 1.1 mg. per cent.).

It may therefore be concluded that serum uric acid levels up to 8.8 mg. per cent. in men and 5.9 mg. per cent. in women in this obese group are still within the upper limit of the reliability interval $\pm SD$, that is in the range where 68 per cent. of normal values are to be found.

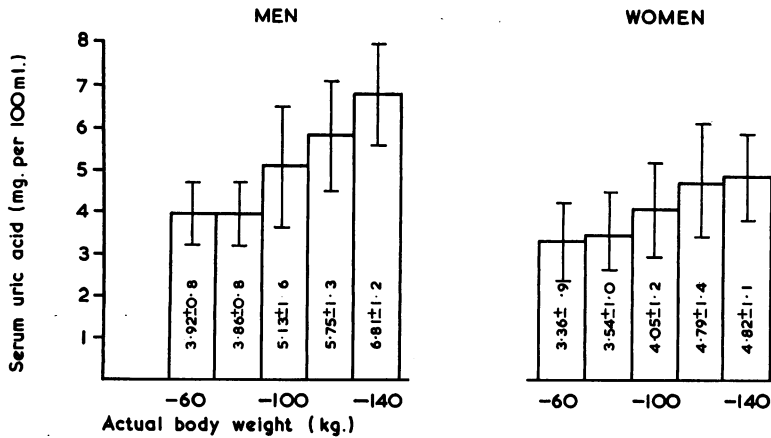


Fig. 1.—Average serum uric acid concentration ±SD and actual bodyweight.

Values in 32 per cent. of "normal persons" of this obese group still fall outside this zone of reliability. The zone ±2 SD, comprising 95.4 per cent. of observations, gives an upper limit for obese men of 9.2 mg. per cent. and for obese women of 7.0 mg. per cent. This gives a clear picture of the possible range of serum uric acid levels in otherwise healthy, but very obese, individuals without gout.

A highly significant positive correlation between bodyweight and serum uric acid levels was found in both men and women: $r = +0.60$ and $+0.42$ ($P < 0.001$). The relationship of obesity, expressed according to Broca's equation, and serum uric acid levels are shown in Fig. 2, which also makes clear the linear correlation between these two values. The correlation coefficient r is $+0.57$ for men and $+0.43$ for women (in both cases $P < 0.001$).

So far, at least, we have considered obesity as the primary symptom and the raised serum uric acid as

its effect, but the true mechanism of this relationship is not known. We tried to elucidate this question by investigating whether a change in weight (in our cases mainly a reduction in weight) would influence the level of serum uric acid. We assessed the uricaemia in 213 persons, who reduced their weight in the course of spa treatment by 1 to 16 kg. (average 6.6 kg.), in four thin persons who put on weight (from 1 to 3 kg.), and in one person whose weight was unchanged. Since the relationship of uricaemia to bodyweight was practically identical for men and women, we studied a mixed group of men and women together.

We found a positive correlation between change in weight and change in serum uric acid level, but it was not statistically significant ($r = +0.12$; $P < 0.1$). This indicates that the supposed relationship exists, but it may have been distorted by a number of other factors, mainly in connection with the reducing diet.

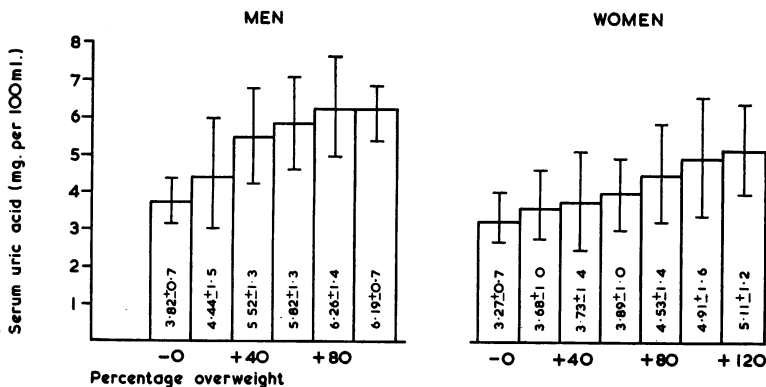


Fig. 2.—Average serum uric acid concentration ±SD and deviations from ideal bodyweight.

It is known that diet poor in calories, and starvation states connected with a negative nitrogen balance, may raise serum uric acid levels just as well as a high protein diet; also increased physical strain from therapeutic physical exercise may often raise serum uric acid levels.

Discussion

The finding of a general relationship between serum uric acid levels and bodyweight in obese persons without gout is certainly somewhat confusing in the light of some of our hitherto accepted ideas. It also makes it difficult to determine the limits of normal uricaemia and hyperuricaemia.

(1) In assessing so called "normal" values, it is necessary to differentiate between the "norm" for men and for women, as it is usually done, and also to consider bodyweight.

(2) Terms like primary, idiopathic, or asymptomatic hyperuricaemia will probably be easier to explain in relation with bodyweight; a relationship which Talbott (1963) found in 5 to 10 per cent. of a series of men without gout. Stecher (1957) considered the idiopathic hyperuricaemia discovered in about 20 per cent. of healthy relatives of gouty patients to be a proof of the heredity of gout and hyperuricaemia.

(3) The finding of hyperuricaemia in patients with degenerative joint disease has led to an overemphasis on laboratory findings, and to a tendency to talk of "arthrosis with gouty component", "gouty arthrosis", "latent gout", "atypical gout without attacks", arthritism, and so on (Stoia, 1959). It may be concluded that many of the patients concerned were often obese, but this fact is not mentioned in these studies. The differences observed in uricaemic levels between various series of patients with rheumatoid arthritis and degenerative joint disease (Weaver and Smyth, 1963) may be due to differences in bodyweight.

(4) It will be necessary to demand stricter criteria for the definite diagnosis of gout without tophi. Differential diagnosis will have to take into account the fact that serum uric acid levels tend to be higher in obese but otherwise normal patients.

(5) In a number of extra-articular complaints ascribed to the "hyperuricaemic syndrome" without manifest gout, it will be necessary to assess the hyperuricaemia in connection with the bodyweight.

Summary

It was found that a certain degree of hyperuricaemia existed in normal but obese persons without gout,

and that when they lost weight in the course of spa therapy the serum uric acid levels also declined. It is therefore necessary to take the question of obesity into account when the serum uric acid level is estimated in the diagnosis of gout and other "hyperuricaemic" conditions.

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L'acide urique sanguin par rapport au poids corporel

RÉSUMÉ

On a trouvé qu'un certain degré d'hyperuricémie existait chez des personnes obèses, mais non-goutteuses et normales de tout autre point de vue. Lorsque ces sujets perdaient du poids au cours du traitement à une station thermale, leur uricémie diminuait. Il est donc nécessaire de tenir compte de l'obésité lorsqu'on détermine le taux de l'acide urique sanguin dans le but diagnostique de la goutte ou des autres conditions "hyperuricémiques".

El ácido úrico en el suero en relación con el peso del cuerpo

SUMARIO

Se halló que un cierto grado de hiperuricemia existe en personas obesas pero normales y non-gotosas. Al perder peso durante el tratamiento en un balneario, el ácido úrico en el suero de tales personas tiende a bajar. Es pues necesario tomar en cuenta la obesidad cuando se determina la tasa del ácido úrico en el suero para el diagnóstico de la gota y de otras condiciones "hiperuricémicas".