



THE RELATIONSHIP OF THE SERUM URIC ACID TO SERUM LIPIDS
A STUDY OF YOUNG NORMAL SUBJECTS IN TEHERAN

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Hypercholesterolemia is one of the major risk factors of atherosclerosis (1,2,3,4,5). Elevated triglyceride may also be a risk factor in coronary artery disease (4,5). However, there is controversy as to the association of serum uric acid levels with cardiovascular mortality and morbidity (6). Serum uric acid values have been reported to correlate with sex (7) and body weight(8). Uric acid has also been suggested to correlate with triglyceride, but there is conflicting evidence as to the association of uric acid and cholesterol levels (9,10,11,12).

The purpose of this study was to obtain baseline data relating to the serum uric acid, triglyceride and cholesterol values in a healthy population and to assess the correlation of these parameters.

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Methods and Materials

The data were obtained during the years 1973-1977 from employees undergoing complete physical examination. The ages ranged from 18 to 40. All the subjects were Iranians residing in Teheran. The studied group of 413 males and 438 females (total of 851) consisted of hospital personnel, nurses, student nurses, office worker and orderlies.

Complete medical history and physical examinations were obtained. Blood pressure was taken from both arms, several readings were recorded in the same session. Ideal weights were estimated by standard ideal weight tables and the percentage of deviation from ideal weight was calculated for each individual. Blood samples were drawn after 14 hours of fasting.

All subjects were on their usual diet for several days prior to the study. The serum cholesterol measurements were performed by the modified method of Liebermann-Burchard reaction(13). Uric acid was measured by the Caraway method adapted for autoanalyzer based on the reduction of phosphotungstate complex(14) triglyceride was determined by a modified Giegler procedure (15). Fasting serum glucose was measured by orthotoluidine method. Blood urea nitrogen (BUN), urinalysis, serum creatinine, sedimentation rate and complete blood counts were done by routine laboratory methods. All subjects had chest x-Rays and electrocardiograms. Subjects with overt medical problems were excluded. We considered this group as a representative sample of healthy, well nourished, middle and low income young Iranian population. The data was analyzed by computer.

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RESULTS:

In this group of healthy and active individuals, 65.8% were on their ideal weight, 6% deviated 1-5%, 8.8% deviated 5-10% from the ideal weight and 19.4% were more than 10% overweight. None of the subjects had overt hyperglycemia (1.5% had borderline elevation of serum glucose values), gout or known hypertension, but (1.2%) had blood pressures over 160mm of mercury systolic or 90 diastolic. It is evident that our data relates to the young healthy normotensive population. The mean, standard deviation and the normal range of cholesterol, triglyceride, uric acid and BUN are shown in tables I (subjects aging 18 to 29) and II (ages between 30 and 39). Males had slightly higher cholesterol values than females. The mean uric acid value in group II was 6.1 ± 1.2 S.D. mg per 100 ml for males and 5.1 ± 1.0 S.D. for females respectively. This indicates the lack of age difference in uric acid levels and the presence of higher values in males.

Figure 1 shows the distribution of various levels of uric acid in males and females. It is of interest that if the proposed upper limit of uric acid of 6mg/100ml for females and 7mg/100ml for males (16) are taken into account, 17% of females and 27% of males have values above these levels. Subjects who had higher uric acid values (Fig.2) deviated more from the ideal weight. In the 4-4.9mg uric acid group 54.4% of the group were on their ideal weight, where as in the 9-9.9mg /100ml category only 27% were on ideal weight. The interrelationship of different variables in respect to uric acid levels are shown in tables III, and IV. Pearson coefficient of correlation obtained by computer showed lack of correlation

Table I. Serum Cholesterol, Triglyceride, Uric Acid and BUN (mg/100) in healthy subjects of 18-29 years. Normal values represent 95% confidence limits (Mean \pm 2 SD).

		Mean \pm S.D.	Normal range
Cholesterol (mg/100ml)	M	180.7 \pm 38.3	104.1 - 257.3
	F	182.5 \pm 40.4	102.1 - 262.9
Triglyceride (mg/100ml)	M	111.2 \pm 39.1	33.0 - 189.4
	F	97.0 \pm 27.5	42.0 - 152
Uric Acid (mg/100ml)	M	6.1 \pm 1.21	3.6 - 8.5
	F	5.1 \pm 1.02	3.0 - 7.1
BUN (mg/100ml)	M	13.9 \pm 3.5	6.9 - 20.9
	F	12.2 \pm 3.6	5.0 - 19.4

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Table II. Serum Cholesterol, Triglyceride, Uric Acid and BUN (mg/100) in healthy subjects of 30-39 years. Normal values represent 95% confidence limits (Mean \pm 2 SD).

		Mean \pm S.D.	Normal range
Cholesterol (mg/100ml)	M	197.8 \pm 40.8	116.2 - 279 .4
	F	189.7 \pm 38.5	112.2 - 268
Triglyceride (mg/100ml)	M	132.5 \pm 45.8	36.4 - 224.1
	F	93.2 \pm 27.3	43.6 - 152.8
Uric Acid (mg/100ml)	M	5.8 \pm 1.47	2.88- 8.74
	F	5.0 \pm 1.0	3.0 - 7.0
BUN (mg/100ml)	M	13.7 \pm 3.37	6.96 - 20.4
	F	12.8 \pm 3.60	5.6 - 20.0

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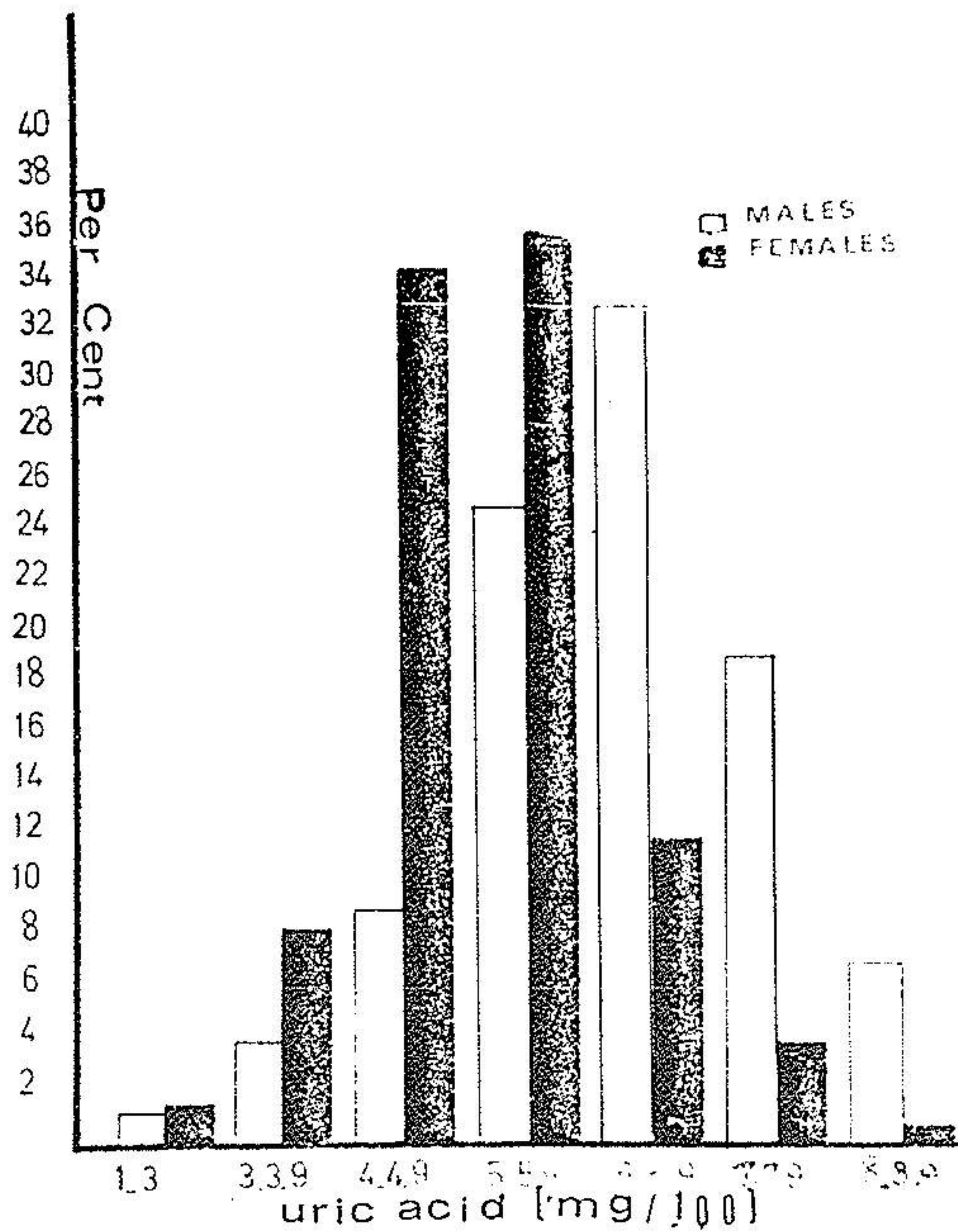


Fig I:

The distribution of various, uric acid levels in 413 males and 438 females normal subject. The horizontal line shows various uric acid subgroups (mg per 100 ml).

The vertical line shows the percentage of male and female population.

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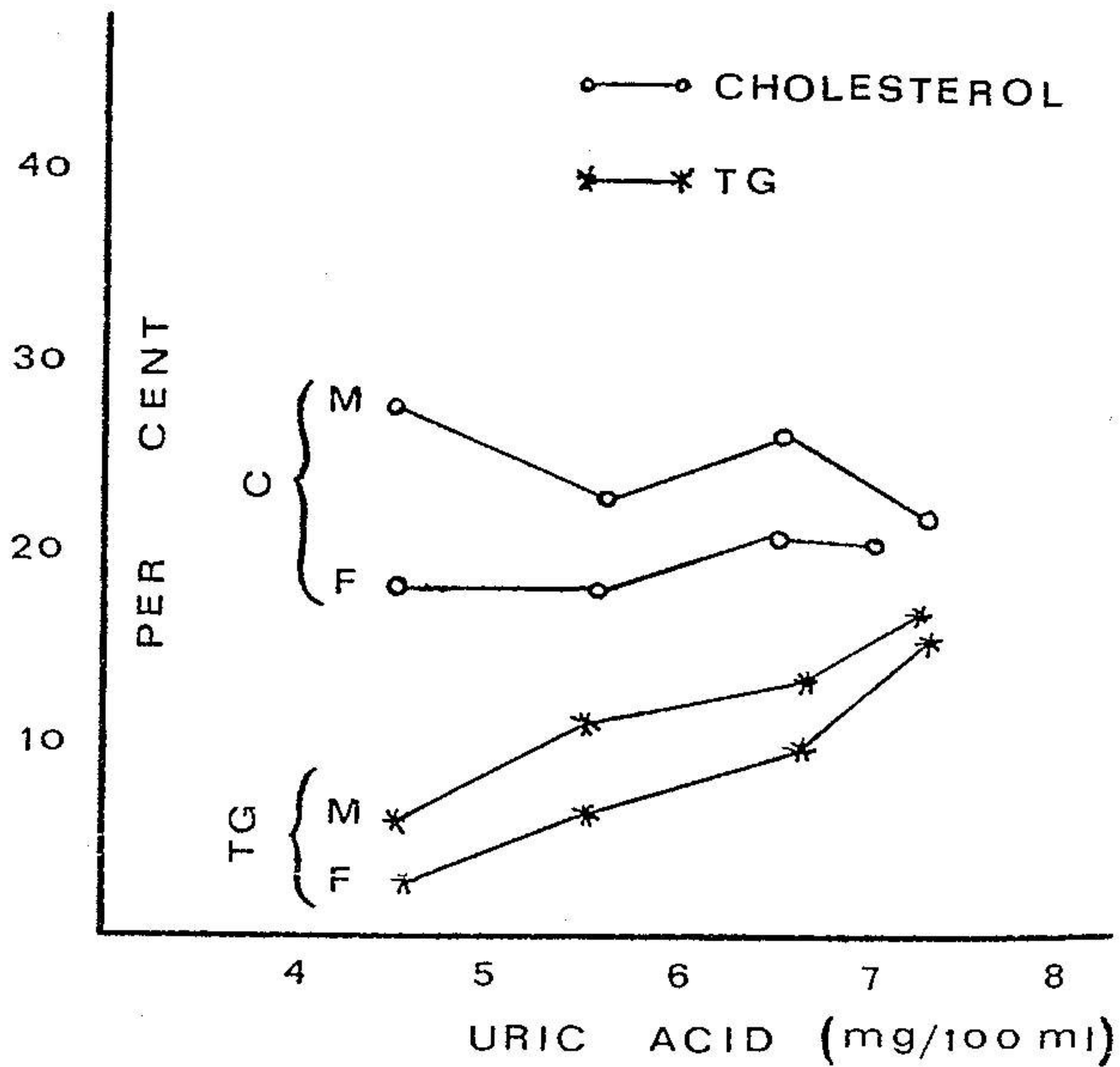


Fig.II:

The solid line demonstrates the percentage of subjects on their ideal weight and the broken line shows the percentage of subjects more than 10% over weight.

The percentage of subjects on their ideal weight decreases with increasing uric acid values and the reverse is observed in subjects more than 10% overweight.

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between cholesterol and uric acid, ($r=0.08, p > 0.25$).
 the correlation between triglyceride and uric acid was
 $r=0.20, (P < 0.005)$. This correlation although not of a
 high degree, indicates the aggregation of higher uric
 acids with higher triglyceride. There was also a statis-
 tically significant but low degree of correlation betwe-
 en cholesterol levels and triglyceride ($r=0.23, p < 0.005$).
 The correlation between uric acid and BUN was not signi-
 ficant ($r=0.07, p > 0.1$).

When percentages of cholesterol levels above the arbitr-
 ary level of 200mg/100ml and triglyceride levels above

Table III. Correlation coefficient of
 various parameters

	Cholesterol	Significance
Uric Acid	$r=0.08$	NS
TG	$r=0.23$	$p < 0.005$
BUN	$r=0.05$	NS

TG: Triglyceride

r : Coefficient of correlation

BUN: Blood Urea Nitrogen

NS: Not significant

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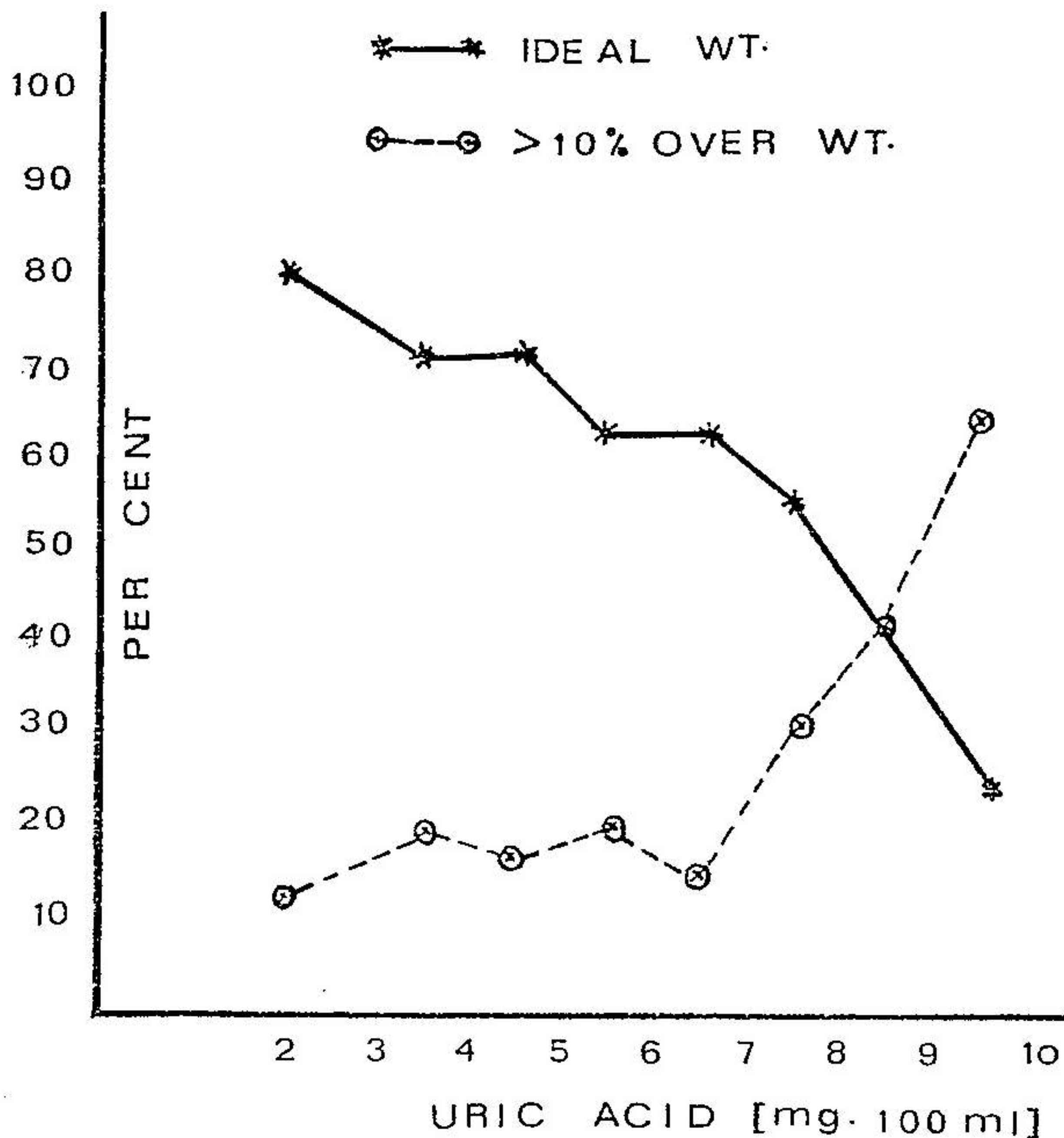


Fig.III:

The relationship of increasing serum uric acid values with percentages of cholesterol(C) levels above 200 mg per 100ml and triglycerides(TG) above 150 mg per 100 ml in males (M) and females(F).

Elevated uric acid values correlate with elevated triglycerides both in males and females.

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evaluate the effect of obesity, the same analysis was done with the exclusion of subjects who were more than 10% overweight (Fig. IV). The pattern of triglyceride, uric acid correlation did not change. But cholesterol levels above 200mg had appreciable correlation with higher uric acid levels in non-obese females, but no such correlation was observed in non-obese males. The data suggests that elevated triglyceride levels have a good correlation with elevated uric acid, independent of sex. Although obesity plays a major role in this relationship, non-obese healthy male and females with uric acid levels in the upper normal and abnormal range have a higher incidence of elevated triglycerides.

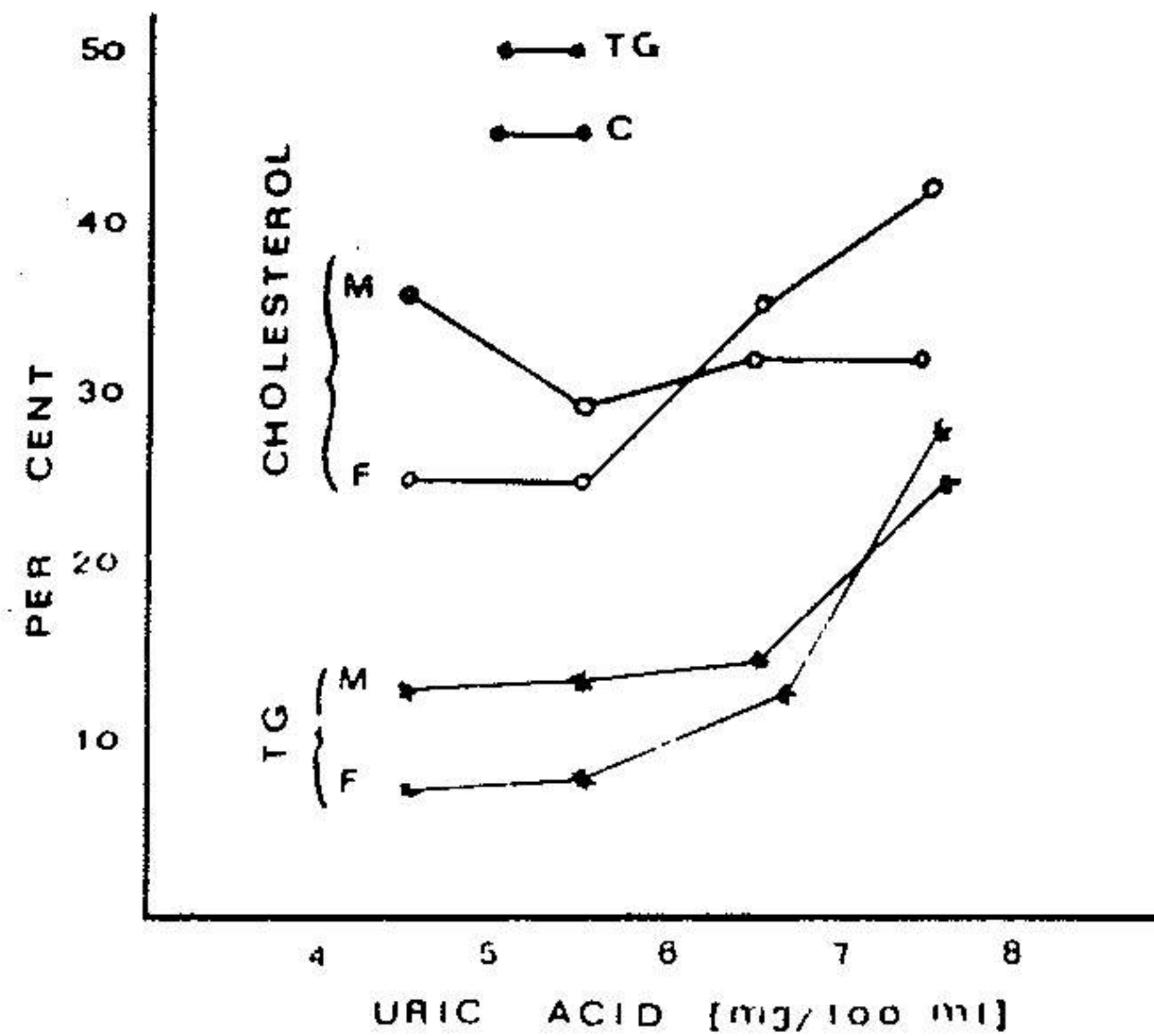


Fig. IV.

The relationship of increasing serum uric acid values with cholesterol values above 200 mg. per 100 ml and triglycerides (TG) above 150 mg. per 100ml. males (M) and females (F).

Subjects more than 10% overweight have been excluded.

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COMMENTS:

The present investigation was undertaken to evaluate the status of serum uric acid, cholesterol, triglyceride and BUN concentrations in a sample of normal population who were carefully screened to exclude subjects with medical problems. There have been conflicting reports as to the correlation of these variables(7,10,11). In a study of 345 apparently normal subjects in Pittsburg Pennsylvania no correlation between uric acid and triglyceride was found(6). The subjects in the latter study were not fasting and screening for medical problems was not done. In another study in Evans County Georgia U.S.A., a small but non-significant correlation between serum cholesterol and uric acid levels were demonstrated(16). Similar findings were noted in the Tecumseh county study (9). In another study higher cholesterol values were noted in hyperuricemic patients (12) but no data concerning triglycerides were presented. In a study of 282 patients with peripheral vascular disease in Glassgow, Scotland no statistically significant relationship between uric acid triglyceride, was found(11). It should be noted that the two populations were quite different (patients with peripheral vascular disease with a mean age of 52, contrasting our healthy group). Our study shows that the overall values of uric acid have a significant but low degree of correlation with triglyceride and also the degree of obesity, but not with cholesterol or BUN. High percentage of elevated triglycerides in subjects with higher uric acid levels confirms this correlation, but higher cholesterol values have no apparent association with increased uric acid values. It is possible that in healthy subjects el-

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evated uric acid, triglyceride and obesity are interrelated obesity having the best correlation with uric acid levels. Exclusion of overweight subjects and analysis of male and female uric acid levels did not change the pattern of aggregation of higher triglyceride levels with higher uric acid values. Some authors have suggested that correction for obesity may not be necessary since hyperuricemia and hypertriglyceridemia form a constellation and correction on the basis of obesity or any other single component would be incorrect (21).

The present data also indicates that uric acid levels in presently studied population may be higher than those reported in North American and European populations (16, 17, 18). In a hospital population in California only 13.5% of males had uric acid values above 7mg/100ml. In white general population of Evans county Georgia 14% of males and females had serum uric acid values above 6mg per/100 ml (for females) and 7mg per/100ml (for Males) (16). Our corresponding figures are 27% for males and 17% for females. In Evans county and our own study the same method for measurement of uric acid was employed. Other studies in western countries have even shown lower uric acid values than those of Evans county Georgia (21).

Higher uric acid levels in Iranian population has been known to clinicians in Iran for several years and our data provides evidence in favor of this clinical impression. The difference between uric acid levels in our studied population and that of European and North American reports can not be readily explained by diet variations. Iranians in comparison to North Americans, consume a relatively low purine, low protien, high carbohydrate diet,

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Increased red cell mass and hemoglobin in people residing in high altitudes has been reported to cause relative hyperuricemia(20). Teheran has an altitude of 1560 meters above sea level and this factor may play a role. Further studies are needed to clarify this assumption.

SAMMARY:

Serum uric acid, triglyceride and cholesterol levels were measured in 851 healthy adults in Teheran, Iran. Careful laboratory and clinical evaluation was undertaken to exclude any medical problems. Only 65% were on ideal weight. The mean uric acid values were 6.1 for males and 5.1 for females under 30 years of age. Uric acid levels above 6mg in females and 7mg in males were observed in 17% and 27% of subjects, respectively. Uric acid values were higher in the studied population compared to the North American and European studies. Increased body weight had the best correlation with elevated uric acid levels. There was statistically significant small positive correlation between uric acid and triglyceride, cholesterol and triglyceride, but there was no such correlation between uric acid and cholesterol. Exclusion of overweight subjects did not abolish the association of high uric acid with higher triglyceride levels. This study also provided some criteria for normal values of serum uric acid, cholesterol, and triglyceride of healthy subjects in our country.

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Table IV. Correlation of various parameters

	Uric Acid	Significance
Cholesterol	r=0.08	NS
TG	r=0.2	p < 0.005
BUN	r=0.07	NS

TG: Triglyceride

r : Coefficient of correlation

BUN: Blood Urea Nitrogen

NS: Not significant

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