Factors Affecting the Concentration of Triacylglycerols (Triglycerides) in Plasma: Reference Values for Adults

Josiane Steinmetz, Edwige Panek, Gérard Siest, and René Gueguen

We studied factors influencing concentrations of triglycerides in the blood of a presumably healthy population of about 9000 persons. Using multi-dimensional analysis, we show, in addition to variations related to sex and age, the relation between triglycerides and uric acid, overweight, arterial blood pressure, use of oral contraceptives (in women), consumption of alcohol and tobacco, and lack of physical exercise. These factors were classified as a function of their discriminative power by the statistical method of segmentation. We thus chose the following factors as criteria for exclusion from a reference population for the values of triglycerides in blood: in men 20 to 39 years old, overweight of more than 90%; in men 40 to 59 years old, overweight of more than 115%; consumption of more than half a liter of wine per day or of more than 11 cigarettes, the use of medicines, and a blood uric acid exceeding 420 μmol/L; in women 20 to 39 years old, contraceptives and overweight; in women 40 to 59 years old, overweight of more than 130% and the intake of medicines. At the 97.5th percentile of the reference population, as compared with a non-selected population, the values were 80% less for men 20 to 39 years old, 95% less for men 40 to 59 years old, and only 26 to 30% less for women 20 to 59 years old.

Additional Keyphrases: ranking of factors - sex- and age-related effects - hyperlipoproteinemia - epidemiological studies

Measurement of serum triacylglycerols (triglycerides) and other lipids has become important recently because of their relation to diseases associated with overweight, especially cardiovascular disease. The mortality from atherosclerosis continues to increase; in France alone, there are at least 150 000 new cases of myocardial infarction per year (1). According to WHO statistics (1), the main risk factors for cardiovascular disease are, in descending order of importance:

- high concentration of lipids, especially cholesterol and triglycerides, in the plasma
- hypertension
- smoking
- disorders of carbohydrate metabolism
- obesity
- lack of physical exercise
- stress

Each of these risk factors is associated with an increase in plasma triglycerides, over and above physiological variations. Some drugs such as oral contraceptives, particularly when taken over a long period, may also cause a large change. Individuals may be misclassified as being either at risk or not, if these factors are not taken into account. Thus it is important to establish reference values for triglycerides in a homogeneous population of healthy subjects.

The result of a biological test can be better interpreted if a set of values has been obtained previously for a representative group of individuals examined under the same conditions as was the subject (2).

Sources of variation are numerous. Only some of them will be considered here: those that are cause for excluding an individual from the reference population (these are linked with a pathological characteristic such as over-consumption of alcohol or the use of any drugs); and those factors that cause one or more stratifications in the reference population (these are related to physiological characteristics such as age, sex, and physical activity).

We have tried to delineate the factors of variation and to use some of them to establish reference values.

Materials and Methods

The biological variation of plasma triglycerides was studied in individuals who came to our Center in 1976-1977. About 25% of the subjects were volunteers and the remaining 75%, who did not have an overt medical complaint, were invited to the Center on the basis of their position in the files of the Caisse Primaire d'Assurance Maladie (the primary governmental health insurance fund) of Nancy.

We restricted our study to a group of 9300 persons—20- to 59-year-old persons who had fasted for 12-14 h. The health examination administered included some functional exploratory tests useful in the detection of cardiovascular disorders (blood pressure, electrocardiogram).

Ideal body weight was calculated according to the Lorenz formula:

\[
\text{Ideal weight} = (\text{height} - 100) - \left(\frac{\text{height} - 150}{4}\right)
\]

where height is in centimeters and weight in kilograms. The percentage deviation from ideal weight was then calculated: (ideal weight - actual weight/ideal weight) × 100.

The health examination was supplemented with two questionnaires: one of general interest (socioprofessional category, life-style, physical activities, and leisure activities) and the other concerned with health (tobacco and alcohol consumption, personal and family history of cardiovascular diseases). A third questionnaire was filled in by the nurse or the clinical biologist at the time of the actual sampling procedure. This questionnaire indicated whether the subject was
Table I. Correlations between Triglycerides and Data from Biochemical, Physiological, and Morphological Examinations

<table>
<thead>
<tr>
<th></th>
<th>Men 40–59 years old</th>
<th>Women 20–39 years old</th>
<th>Women 40–59 years old</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r</td>
<td>r'</td>
<td>r</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>0.232</td>
<td>0.272</td>
<td>0.204</td>
</tr>
<tr>
<td>β-Lipoproteins</td>
<td>0.480</td>
<td>0.517</td>
<td>0.303</td>
</tr>
<tr>
<td>Glucose</td>
<td>0.113</td>
<td>0.160</td>
<td>0.001</td>
</tr>
<tr>
<td>Uric acid</td>
<td>0.312</td>
<td>0.390</td>
<td>0.173</td>
</tr>
<tr>
<td>Arterial blood pressure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>diastolic</td>
<td>0.100</td>
<td>0.110</td>
<td>0.024</td>
</tr>
<tr>
<td>systolic</td>
<td>0.096</td>
<td>0.120</td>
<td>0.015</td>
</tr>
<tr>
<td>Height</td>
<td>0.012</td>
<td>0.116</td>
<td>0.028</td>
</tr>
<tr>
<td>Weight</td>
<td>0.204</td>
<td>0.226</td>
<td>0.129</td>
</tr>
<tr>
<td>Degree of overweight</td>
<td>0.262</td>
<td>0.317</td>
<td>0.150</td>
</tr>
<tr>
<td>Subscapular skinfold</td>
<td>0.221</td>
<td>0.263</td>
<td>0.182</td>
</tr>
</tbody>
</table>

r: Correlation coefficient; r': Correlation ratio. Statistical significance is <5% for r or r' > 0.19.

taking any drugs; in the case of women, it indicated their menopausal status and whether they were using oral contraceptives.

Blood specimens were obtained from the antecubital fossa in supine patients, between 0800 and 0900 hours. The blood was collected without a syringe. Lithium heparin was used as anticoagulant. The blood tubes were centrifuged immediately after the collection, and the analyses were finished within 4 h.

The following assays were performed: triglycerides by an enzymatic method, manually (3) or automatically with a Greiner GSA II analyzer (4); uric acid by a phosphotungstic acid method, adapted to the Technicon SMA 12/60 (5); cholesterol by the Liebermann–Burchard method adapted to the Technicon SMA 12/60 (6); glucose by a neocuproin method adapted to the Technicon SMA 12/60 (7); and β-lipoproteins by Burstein’s turbidimetric method adapted to the Greiner GSA II (8).

Short- and long-term analytical variations were observed by means of rigorous quality control with simultaneous use of plasma pools, control sera, and the patient’s daily means (intra- and interlaboratory control).

Reproducibility of the triglyceride assay was determined by repeated analysis during the study of a serum stored lyophilized. Within-day variation (CV) was less than 4%, day-to-day variation less than 6%.

To study the various relationships, we used several statistical tools:

- The correlation coefficient and the correlation ratio. Although less widely used than the correlation coefficient, the correlation ratio (square root of the ratio of variance of the conditional mean value to the total variance) also gives an estimate of the functional relation between parameters. Its value is between 0 and 1 (9).
- The least-squares regression (10) of triglycerides on the morphologic factors.
- The correspondence analysis (10). For this, a histogram of the triglycerides for each sex and age group was divided into 10 classes. Class 1 corresponds to the lowest triglyceride concentration, class 10 to the highest. Correspondence analysis permits a comparison of the distribution of triglyceridemia with particular characteristics and responses to questionnaires.
- The partition analysis (11). This consists of performing successive dichotomies of the sample on the basis of the explanatory variables, in such a way that at each step the two subsamples obtained are as different as possible with regard to the variable in question (these differences were measured here by Welch’s test).

The population was divided according to sex. Three age classes were selected in women (20–39, 40–49, and 50–59 years) and two in men (20–39 and 40–59 years). In each subgroup, the analysis included 600 individuals (the maximum capacity of the statistical program used). The results were grouped into a tree-like pattern.

Plasma triglyceride values are presented according to 2.5, 5.0, 10.0, 50.0, 90.0, 95.0, and 97.5 quantiles of the distribution.

Results

Correlations between Plasma Triglyceride Concentration and Other Determinants

Triglycerides and other biochemical constituents. We calculated the correlation coefficients and the correlation ratios between triglycerides and certain biochemical factors: β-lipoproteins, cholesterol, glucose, and uric acid.

The most significant correlations were with β-lipoproteins (Table 1). The correlation coefficient varied from 0.30 to 0.48, depending on the subject’s age and sex.

Similarly, the concentration of cholesterol and triglycerides increased together: the correlation coefficients and ratios exceeded 0.20 and were statistically significant. The correlation ratios and coefficients were not very different from each other, except in women 20 through 39 years old. Therefore the regression lines were nearly straight, but the residual variations were high.

Uric acid correlated significantly with triglycerides; the correlation ratio was above 0.30 and reached 0.39 in men (Table 1).

Finally, there was a nonsignificant correlation between triglycerides and glucose (Table 1).

Triglycerides in relation to functional and morphological examinations. Morphological factors, weight, and degree of overweight correlated with an increase in triglycerides, especially in subjects older than 40 years (Table 1). The correlation with the degree of overweight was more marked than with weight itself. This observation was confirmed by the correlation with another index of overweight, the subscapular skinfold (correlation coefficient, 0.27).

For instance, men more than 40 years old whose weight was 100% of the ideal weight had our average plasma triglyceride concentration of 1.20 mmol/L. When the weight exceeded 120% of ideal, triglyceride concentration exceeded 1.50 mmol/L (Figure 1).
In women, this percentage of ideal weight (120%) corresponds to 1.00 mmol of triglycerides per liter. The triglyceride concentration was above 1.50 mmol/L when the percent of ideal weight exceeded 170% (Figure 1).

Height did not correlate with plasma triglyceride concentration.

Of the functional examinations performed, only arterial blood pressure correlated with the triglyceride plasma concentration, and it only poorly ($r < 0.19$).

**Partial correlations of triglycerides with the preceding factors.** To study the paired correlations, we added a study of partial correlations (Table 2). We wished to analyze in more detail the strong triglycerides–uric acid correlation, taking into account morphological factors, especially overweight. In subjects older than 40, particularly men, the triglycerides–uric acid partial correlation was as high as 0.25 when morphological factors were taken into account. It was therefore partly independent of morphology. On the other hand, at a fixed concentration of uric acid the correlation between triglycerides and overweight decreased by half, from 0.26 to 0.13.

The relation between morphology and plasma triglyceride values was therefore not direct, but depended at least partly on uric acid concentration.

**Triglycerides in relation to answers to a general-interest questionnaire.** Having defined which biochemical, morphological, and functional examinations were related to variations in the plasma triglyceride concentration, we also assessed the correlations between triglycerides and some qualitative characteristics. To this end, we used the analysis of correspondences. Thus, in 20- to 39-year-old women, the use of oral contraceptives, alcohol consumption, and the use of tobacco were correlated with a tendency to a high triglyceride concentrations in plasma. Conversely, a low concentration of triglycerides in the plasma was associated with a certain amount of physical exercise (sports, gardening) during leisure time (Figure 2a). These tendencies were confirmed in the group of women 40 to 59 years old, especially with respect to the importance of the duration of smoking. Finally, an abnormal electrocardiogram was often associated with increased triglyceride concentration.

In 40- to 59-year-old men (Figure 2b), the individuals with increased triglyceride concentration were:

- those who drank more than 1 L of beer per day
- those who drank more than 1 L of wine per day
- impulsive subjects (i.e., people who act “on impulse”)
- hypertensive subjects
- those who had smoked for more than 10 years

Nonsmokers, those subjects who gardened every day, and farmers had the lowest triglyceride concentration.

The study of the correlations of plasma triglyceride concentration with biochemical, morphological, and functional parameters (Tables 1 and 2) together with the results of the analyses of correspondences (Figures 2a,b) enabled us to isolate a set of variables that correlated with plasma triglyceride concentration:

- drug intake (including the use of oral contraceptives in women)
- overweight
- the plasma uric acid concentration
- the electrocardiogram

---

**Table 2. Partial Matrix of Correlations between Triglycerides (T), Uric Acid (UA), and Degree of Overweight**

<table>
<thead>
<tr>
<th></th>
<th>Men 40–59 years old</th>
<th>Women 20–39 years old</th>
<th>Women 40–59 years old</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T</td>
<td>UA</td>
<td>T</td>
</tr>
<tr>
<td>Degree of overweight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.13</td>
<td>0.28</td>
<td></td>
<td>0.15</td>
</tr>
<tr>
<td>Uric acid</td>
<td>0.25</td>
<td>—</td>
<td>0.12</td>
</tr>
</tbody>
</table>

---

926 CLINICAL CHEMISTRY, Vol. 25, No. 6, 1979
smokers +10y .
weekly gardening .
weekly walk .

1 weekly sport

no oral contraceptives

daily gardening

no gardening

10 cigarettes / day

10 cig / day .
constantly exhausted .
1L beer / day .

axis 2

oral contraceptives .

axis 1

10 cig / day .
constantly exhausted .
1L beer / day .

axis 2

heart disease .

axis 1

daily gardening

no gardening

10 cigarettes / day

non smokers .

higher executives .
weekly gardening .

farmers

1L beer / day .
1L wine / day .

Fig. 2. Correspondence analysis
Class 1 corresponds to the lowest triglyceride concentration, class 10 to the highest. This analysis permits a comparison of the distribution of triglyceridaemia with particular characteristics and responses to questionnaires: top, women 20–39 years old; bottom, men 40–59 years old.
• wine or beer consumption
• tobacco consumption (no. cigarettes per day and duration of the habit)
• physical activity

After completing this qualitative study, we tried to rank these factors according to the size of the variations in plasma triglyceride concentration as a function of each factor.

Rank of Criteria of Selection for a Reference Population as a Function of Their Discriminative Power

In men 20 to 39 years old, overweight was the most discriminating variable (Figure 3a). Individuals who weighed less than 90% of their ideal weight had an average triglyceride concentration of 0.84 mmol/L. For those 15% overweight, this value was larger, 1.81 mmol/L—a 115% difference. The dispersion was very wide in this group (standard deviation, 1.28). The second most discriminating factor was tobacco consumption and the duration of the habit. For persons weighing less than 90% of their ideal weight, the triglyceride concentration was increased from 0.78 to 0.91 mmol/L, or 17%, depending on cigarette consumption, but this result was not statistically significant. For the group of persons who weighed 90 to 115% of their ideal weight, the value found for smokers was 1.29 mmol/L, and for nonsmokers, 0.96 mmol/L, a difference of 34%.

The consumption of alcohol in the form of wine also distinguished two subpopulations with statistically different mean triglyceride concentrations.

None of the other characteristics that we studied had any perceptible influence in this group of subjects.

In men 40 to 59 years old, overweight remained the most discriminating factor (Figure 3b). In the individuals that were not overweight, the triglyceride concentration increased with the number of cigarettes smoked and the amount of wine consumed per day, as in the sample of men 20 to 39 years old. On the other hand, when overweight was present, beer con-
sumption represented the second most discriminating factor in the ranking, but its influence was not significant in this case.

To sum up, in the male population sample, we found the main factor of variation for plasma triglyceride concentration to be the degree of overweight. The use of tobacco and the consumption of alcohol were the other discriminating factors, but their relative importance depended on age and overweight.

In women 20 to 39 years old, the use of oral contraceptives was the major discriminating factor. The average value for triglycerides was 0.71 mmol/L for women not on oral contraceptives, but 1.03 mmol/L (a 45% increase) for those taking oral contraceptives (Figure 3c). The results were widely dispersed (SD = 0.52 mmol/L).
Overweight was the second most discriminating factor in the group of women who were not taking oral contraceptives. Weight more than 15% above ideal was associated with an average increase in triglycerides of 0.20 mmol/L (33%). Furthermore, the average triglyceride value did not exceed 1.06 mmol/L for women not taking oral contraceptives, even in those who were 30% overweight. Among the other factors studied, alcohol and tobacco consumption had no significant influence.

In women 40 to 49 years old, overweight was the main dispersion factor (Figure 3d). The average triglyceride concentration was 0.86 mmol/L in the women who were less than 30% overweight, 1.25 mmol/L in those more than 30% overweight. The use of oral contraceptives was the second most discriminating factor in women who were less than 30% overweight, alcohol consumption for those 30% or more overweight.

In women more than 50 years old, the first selection criterion remained overweight; the use of drugs was second (Figure 3e).

Use of oral contraceptives thus appears to be more important than degree of overweight in considering a reference population of women between 20 and 39 years old. Because the use of oral contraceptives is limited after age 40, excess body weight then becomes the major characteristic to be taken into account, together with the use of drugs.

Reference Values for Triglycerides in Plasma

Based on this set of results, it is possible to define a preliminary list of criteria to be used in excluding individuals from a reference sample in a total population (Table 3).

Table 4 summarizes the limits for plasma triglyceride values of the reference distribution and for the total distribution according to the sex and age of the subjects.

The reference sample comprised 2850 individuals, i.e., about 13% of all the men and 46% of all the women. In this reference group, the plasma triglyceride concentrations were lower in women than in men, but increased in both sexes with age (Table 4). The average increase between the 20 to 39 group and the 40 to 59 group was 0.10 mmol/L for men and 0.16 mmol/L for women.

Furthermore, there was less dispersion of the results in the reference sample than in the total population. For instance, the triglyceride value for percentile 97.5 went from 3.24 mmol/L in the general population to 1.77 mmol/L in the reference population for men 20 to 39 years old, and from 3.53 mmol/L to 1.80 mmol/L for men 40 to 59 years old. In women, the value decreased from 1.89 mmol/L to 1.46 mmol/L in women 20 to 39 years old, and from 2.36 mmol/L to 1.88 mmol/L in women 40 to 59 years old.

Discussion

The definition of reference values for plasma triglycerides is a prerequisite step for any epidemiological investigation of the prevalence of hyperlipoproteinemias. Furthermore, such definition closely depends on the strict control of the quality of the analysis, especially with regard to accuracy and precision. Our reference values were established from a selected sample representative of a population called a “reference population.” Many studies have reported variations in physiological parameters, but few specify the rank of the parameters. In the context of preventive medicine, any factor likely to cause an increase in the plasma triglycerides must be considered a potential factor of risk to health.

In our study, we considered men and women separately, because triglyceride values are “normally” higher in men, as also observed by Aromaa et al. (12) in a Finnish population. Sex-related differences can be explained by the fact that triglycerides are present in high concentrations in very low-density lipoproteins, which themselves are present in higher concentrations in men than in women, while low-density lipoproteins are at a uniform concentration (13). Risks related to age are illustrated by the gradual increase in triglycerides and by the dispersion of results obtained for the total population, a dispersion lower in women than in men (Table 4).

Our study of correlations with biological and morphological factors, together with the analysis of correspondences between triglyceride values and life-style, enabled us to characterize qualitatively the factors chiefly affecting variations in triglyceride concentrations and the parallel metabolic changes. They were measured and classified by means of the partition method.
There was a very high correlation between triglycerides and \( \beta \)-lipoproteins; this can be explained by the fact that the lipoproteins contain both very-low-density lipoproteins and low-density lipoproteins, which are rich in triglycerides. These lipoproteins comprise 60% and 15%, respectively, of the total (14). The low-density lipoproteins fraction, which is rich in cholesterol (56%), accounts for the correlation between triglycerides and cholesterol. Many epidemiological investigations have demonstrated that hyperuricemia is correlated with hyperlipoproteinemia (15-18), especially type IV (19). Our results lead to the same conclusion, but with additional information: the correlation between triglycerides and uric acid is partly independent of overweight. This was particularly evident in men older than 40 years (Table 2). A correlation between the metabolism of lipids and purines was observed by Mielants et al. (20), but only in patients with gout. It could be due to a genetic linkage that causes a common enzyme deficiency, the nature of which is still unknown. In contrast, we found no significant correlation between triglyceride and glucose concentrations, but Gibson et al. (21) found one between triglycerides and insulin concentration in the plasma.

We measured three morphological variables that permit evaluation of the fat mass of the subjects: weight, overweight, and the thickness of the subcapsular skinfold. Overweight (taking both weight and height into consideration) and the subcapsular skinfold were closely related to plasma triglyceride values (Table 1). Because these morphological variables increase with age, changes in triglyceride values with age may merely reflect the gain in body weight during aging.

In men 20 to 59 years old and in women 40 to 59 years old, overweight appeared as the highest-ranking factor of variation in plasma triglycerides. It was the second-ranking factor in young women (20 to 39 years old), use of oral contraceptives being the major factor. The average serum triglyceride concentration in men 20 to 39 years old who were more than 15% overweight was twice as high as that of lean men (10% or more underweight).

Overweight represents a major risk factor that is amenable to reduction. The risk correlated with overweight is added to that for long-term smoking. For instance, in the same sample of men 20 to 39 years old, when the body weight was close to ideal (10% underweight to 15% overweight), the average serum triglyceride concentration was 0.96 mmol/L for nonsmokers, but 2.18 mmol/L in those who were more than 15% overweight and who had smoked for more than 11 years.

Lellouch et al. (22) established a linear relation between triglyceride concentration and fat mass in men 46 to 52 years old. This was also true for our population of men, while in the women the relation remained significant but nonlinear \((r < 0.23)\). However, it is the weight gain more than the fat mass itself that is mainly associated with increase in triglycerides. According to Albrinks et al. (23), those subjects who gained weight during adulthood had triglyceride values twice as high as those who did not gain weight, even for the same degree of obesity. A comparison of health examinations made at five-year intervals should enable us to confirm these results in the future.

Oral contraceptives had a major influence on plasma triglyceride values. Women who took these drugs revealed indirectly an overall tendency to latent hypertriglyceridemia, aggravated by overweight. Our results therefore are in agreement with those of Schenker et al. (24), who concluded that triglyceride values were increased by the “pill” regardless of its composition. According to other authors, progestational hormones cause a decrease in triglycerides, while estrogens increase them (25-29). The mechanism of this triglyceride increase remains obscure. Kekki and Nikkila (30) showed that in women taking oral contraceptives, the rate of triglyceride production was twice that of a control group, while the rate of triglyceride disappearance was only slightly increased; this pattern leads to a large increase in triglycerides in plasma.

The number of cigarettes smoked per day and the duration of the habitual use of tobacco correlated with an increase in triglycerides in men. The number of cigarettes smoked per day was the second-ranking selection factor for the reference sample of lean subjects, while the duration of addiction to tobacco correlated with overweight. The latter factor, as we have already emphasized, increased the risk due to tobacco consumption. The 20% increase in triglycerides observed by Ringsdorf et al. (31) in subjects who smoked more than 10 cigarettes per day was also observed in our sample of men 20 to 39 years old. This increase was reduced to 15% in the group 40 to 59 years old, a finding that confirms that of Schwartz et al. (32) that the correlation between smoking and high plasma triglyceride values is more significant in the young adult. When tobacco consumption exceeds 20 cigarettes per day, the increase in plasma triglycerides reaches 60% (33).

Finally, in our population sample, alcohol was a discriminating factor that applied only to men whose weight was at least 90% of their ideal weight. High plasma triglyceride concentrations induced by alcohol have often been reported (34-36). Alcohol causes increased triglyceride synthesis in the liver via two pathways: ingested alcohol is catabolized into acetyl CoA, leading to triglycerides, and the formation of acetyl CoA, which generates H\(^+\) (NADH + H\(^+\)), greatly favors the reduction of dihydroxyacetone phosphate (arising from hepatic glycolysis) into 3-phosphoglycerol, and thus the synthesis of triglycerides.

These results concerning plasma triglyceride values are comparable with those of Guize et al. (15) on uricacidemia. Indeed, using correspondences analysis, these authors found, in a sample of men 50 to 59 years old, a correlation of hyperuricacidemia with a history of obesity and also with regular consumption of alcohol. In contrast, a low uricacidemia was related to an absence of any history of tobacco consumption and to the regular practice of sports. All these observations could explain the statistically significant correlation between triglycerides and uric acid, which could arise from an unbalanced diet, regular smoking, or a lack of physical exercise.

We estimated the reference distribution of triglycerides after our observations concerning the factors affecting variation of plasma triglyceride concentrations. We thus eliminated 70% of the total population from our reference sample and lowered the 97.5th percentile by 30% in women and by 80 to 95% in men. The limits found for our reference sample correspond to those established by Kattermann (37) after selection.

After qualitative evaluation of the factors producing variations in plasma triglyceride concentrations, these factors were quantified and classified in order of decreasing importance. Our conclusions were as follows:

- in men, degree of overweight is most important, followed by the regular use of tobacco and the consumption of wine
- in women, the use of oral contraceptives is most important, followed by overweight (young women) or overweight followed by the use of drugs (in women more than 40 years old).

Overweight was, therefore, the common factor in the ranking. Indeed, this feature, together with an increase in uricacidemia resulting from a rich diet, as well as a lack of physical activity, reflects a certain way of life. Variations in
plasma triglyceride concentrations associated with weight gain were the greatest when this gain was greatest and when associated with other risk factors such as consumption of alcohol, use of tobacco, and the use of drugs.

**References**


