

THE METABOLISM OF LIPIDS – VALUE AND IMPACT ON THE POPULATION'S HEALTH

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ABSTRACT

The abuse of lipids from the people's food associated with the sedentary lifestyle has led to the increase of the appearance of diabetes, cardio-vascular diseases, obesity and colon cancer. The achievement of this research emphasized the relationship between the variability of these lipid parameters according to the age, gender, types of diseases and the degree of affectation among people. There have been used two groups : one as a control group and the other as a study group, composed of individuals from both genders, with the age between 18 and 80 years and who have been chosen from the patients with different cardio-vascular diseases, nutrition diseases and diabetes. The increased level of cholesterol and total lipids from the human body is due first of all because of the metabolism and it affects in the same time the both genders and it appears also on the very young persons.

Key words: the metabolism of lipids, cholesterol, total lipids.

Introduction

In our days there are a lot of great progresses made in the fields of biology, medicine and technology. Nevertheless, the human society can't face the aggressors of its own health: smoking, consumption of alcoholic drink and drugs, sedentary lifestyle, consumption of food rich in cholesterol, animal fatness and additives, stress, negative emotions and the lack of information or indifference regarding the effect of all these factors towards the human body. The food in excess has increased in a concerning way the incidence of obesity, diabetes, the cardiovascular diseases, cancer among people, especially at children and teenagers. All these problems have represented an argument in choosing the theme of the research in which I have emphasized the relation between the variability of lipid parameters, according to the age, gender, types of diseases and the degree of impairment.

The name of lipids comes from the Greek language: lipos – fat, fatness. The fat represents compound esters of fatty acids with the trivalent alcohol of glycerin.

The lipid metabolism contains all the changes suffered by the fat from food, after it has entered the body and also its new genesis (the lipid synthesis from non lipid substance).

In order to pass the barrier of intestines, the lipids from food must be largely split (opened), a phenomenon that is happening in the digestive tract.

The lipids from food are passing from mouth to the stomach, through the pharynx and esophagus, having their structure unchanged. At gastric level, the changes suffered by fat have no significance, excepting little children who have got some enzymes from lipases category (gastric lipase) with which they split the fat from milk and eggs. The real digestive changes take place at the level of duodenum, under the influence of bile and pancreatic juice and also at the level of small intestine due to the action of intestinal lipase. The bile is the secretion and excretion of liver, even though it hasn't got any enzymes (excepting the alkaline phosphatase) and it has got a great importance in splitting the molecules of lipids, because of its bile salts, which are developing because of the cholesterol. The bile performs the emulsification of fats (splitting them in droplets), enabling in the same time the activity of intestinal lipases and also the absorption of fatty acids (ALBU R.M.). After the emulsification, the fat is easier to be split by the lipases, which are realizing its hydrolysis. The pancreatic lipase, which is activated by the bile salts, by the ions of calcium and by the amino acids is making the split of the lipids in fatty acids and glycerol (glycerin). A certain quantity of fat is split under the action of the intestinal lipases. After the hydrolysis, a little quantity of mycelium appears, as little droplets, much smaller than those resulted from the bile emulsification, which are composed of: products of hydrolysis (fatty acids and glycerin), diglycerides, monoglycerides and a little quantity of not split triglycerides. Fatty acids and glycerol are freely passing or esterified again, through the walls of intestines, reaching the lymph

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and the blood, after the absorption. Some of the triglycerides from food are absorbing themselves. The absorption of fatty acids and glycerol are helping the passing beyond the walls of intestines of the liposoluble vitamins (A, D, E, F, K).

In the general circulation, the lipids and their products of enzymatic hydrolysis are reaching on the lymphatic way (75 – 85%) and the blood stream, using the portal vein (15 – 25%). Most of the lipids which are reaching the lymph are arriving in the lungs, where are oxidized under the influence of pulmonary lipase. This means that, by increasing the amplitude of breath, the fat is directly burned. The ratio in which the lipids are following a way comparing with others (by lymph or by blood) depends on the degree of their decomposition during the digestion. Some of the glycerides which weren't decomposed and the ones which are esterified again, are absorbed only passing on the lymph way. But the free fatty acids are mostly passing in the portal vein. In the liver, using the portal vein, are arriving only about 20% of fat. If the fat which arrives in the liver is stored here for a long period of time, the fat infiltration takes place (hepatic steatosis), having as a consequence the decreasing of the function of this organ of a vital importance. The perturbation takes place on one hand when the liver is poor in glycogen and on the other hand the evacuation of the fat from the cells of the liver is obstructed. The second situation appears as a consequence of a deficient forming of phospholipids due to the lack of lipotropic factors. The liver is not designed for storing the lipids and if these are being accumulated at this level, the perturbations are taking place. The main store for the fat is represented by the adipose tissue but its overload is leading to the decrease of muscles and to obesity.

At the level of human body, the lipids are having an energetic, functional and constitution role.

After absorption, the lipids are following many ways, which can intersect between them:

- are stored in the adipose tissue, as substance of reserve, under the form of triglycerides;
- are temporary stored in the liver;
- after some reactions, they are a part of the complexes structures (lipoproteins), some of them remaining in the blood circulation;
- are oxidized in the tissues till they become carbon dioxide and water, with the releasing of energy (1 gram of lipids can release 9.3 kcal).

The fat from human body is found under the form of triglycerides, phospholipids, cholesterol and free fatty acids. The biosynthesis of cholesterol can be realized by all the nucleated cells from the body, excepting the mature nervous cell and it starts from the acetyl-CoA, the central place being taken also by the liver. Recently, it has been discovered that, excepting the three forms of cholesterol already known: HDL (lipoproteins with high density) – “good cholesterol”, LDL (lipoproteins with low density) – “bad cholesterol” and VLDL (lipoproteins with a very low density), the last two of them being involved in the apparition of cardiovascular diseases and the fourth type of cholesterol produced by the liver, MGminLDL (extra thick), with more serious involvement in apparition and deposit of the atheroma plaque and so increasing the risk of apparition of myocardium heart attack and cerebral stroke at old people and diabetics. The daily amount of cholesterol is 0.3-0.6 g and the amount of fat for a person of 70 kilos is around 70 – 100g daily.

Excepting some disorders, disturbances or a short period of time – in the case of a diet reach in fat, the lipid compounds of blood are maintained between constant limits, due to some elaborated neuro-hormonal mechanisms. Their normal values are shown in the tab.1.

Table 1 - The normal values of the constants of lipids (1).

The liquids from plasma	The name of the constant	Normal values
Total lipids	Lipemia	500-700mg% (5-7h/l)
Triglycerides	Triglyceridemia	max. 200mg% (2g/l)
Cholesterol	Cholesterolemia	120-180mg% (1,2-1,8g/l)

The metabolism of lipids is found under the endocrine control, developing with the participation of anterior pituitary, thyroid, pancreatic and suprarenal hormones and also of the nervous system. The lipolysis and the lipogenesis are adjusted by the hormones involved in the metabolism of carbohydrates: the insulin blocks the storage of the

lipids in the adipose tissue and diminishes the concentration of the fatty acids from the blood plasma. The adrenaline and noradrenaline are stimulating the lipolysis of the triglycerides and they are getting the increase of concentration of fatty acids in plasma, having an opposite effect.

The metabolism of lipids is strongly influenced by the functional status of the thyroid gland (4). The hyperthyroidism gets a rapid consumption of lipids, but the hypothyroidism enables their storage. The somatotrophic hormone (STH) enables the storage of fatty unesterified acids in plasma in the case of young bodies.

It is very important to take into consideration that during the energetic disintegration, the metabolic priority is granted to the carbohydrates, which are totally oxidizing during a period of 24 hours, because the capacity of storage of the glycogen is very limited. In such conditions, the lipids, if there aren't immediate energetic needs, are stored in the adipose tissue (2). The only substances which are directly fattening are the exogenous lipids, the other compounds well-known as providers of extra kilos are indirectly acting. When the target is to decrease the weight, in the same time with a decreased quantity of animal and vegetal fat from the food, it must be consumed only the carbohydrates which have a decreased rate of absorption and the quantity of carbohydrates which enters the body must be decreased and it must be avoided their consumption with the lipids.

Material and method

In our days, between the nourishments problems which determine the apparition of diseases like diabetes, obesity or myocardium heart attack, even at young ages, it is also the consumption of fat under different forms in the same time with the carbohydrates. During 50 years, the opinions of specialists in nutrition, biochemists and doctors have changed, but the role of balanced nourishment, without excesses, remains more and more actual.

In cooperation with the laboratory of medical analyses from the County Hospital from Bacau city, I had the opportunity to realize some investigations following the normal and pathological values of the cholesterol and total lipemia for a number of 120 subjects having different cardiovascular diseases, diabetes and other nourishment diseases admitted in the hospital and an equal number of subjects who didn't suffer of these diseases and who were considered the control group.

The determinations were made on serum, in "a jeun" (on empty stomach) and were realized on two groups: one is the control group and the other is the study group, made of individuals with ages between 18 and 80 years. The control group is made of individuals of both genders, with the age between 18 and 80 years, 20 individuals from each group of age (18-30 years; 31-40 years; 41-50 years; 51-60 years; 61-70 years and 71-80 years, this means 6

groups of age, each one having 20 individuals), healthy, who hadn't suffer of diseases which could influence the level of the tested parameters, and so occurring some errors. The study group was made of 120 subjects having the same range of ages (also 20 individuals on each group of age), being patients who were diagnosed with some diseases which influence the level of cholesterol and total lipemia (the total amount of fat which is found in plasma) and who were admitted in the department of internal medicine, cardiology, nutrition diseases and diabetes. The subjects' selection – patients was made on two groups of diseases – metabolic ones – hepatic, hepatic-pancreatic, diabetes and heart disease (associated with the high blood pressure degree I and II) and nervous ones – the trigger factor is the stress.

The biochemical determinations were made on the control group and also on the study group, on peripheral blood taken by vein puncture. There were taken into consideration the following stages: blood sampling, the determination and the assessment of the samples.

Blood sampling: from year 2000, in the County Hospital of Bacau city there was introduced the system of vacuum blood sampling, using vacutainers which have raised a lot the efficiency of blood sampling because:

- prevents the risk of contamination for the persons who are doing this procedure;
- assures the strict compliance of the ratios (blood – reactive);
- prevents trauma for the patient's vein;
- eliminates the stasis produced by the tourniquet which is used only for the visibility of the vein, then it is released.

This system of blood sampling uses a holder (a plastic device with a thread where the needle and the syringe will be attached), a double needle (opened towards the vein, but to the cork of the vacutainer, perfectly sterile and protected by hangers) and the vacutainers (the test tube with a gum cork, of different sizes, vacuumed and which has got the precise quantity of anticoagulant, according to the type of the analysis made).

The technique of blood sampling in a vacuumed system: it is made a stasis using the tourniquet, the vein is punctured with the holder using the needle and the vacuumed tube is attached on the other end of the needle; the gum cork pushes the muff of the needle and the blood flows into the tube (in this moment the tourniquet is released); when the tube has received the necessary quantity of blood, the blood doesn't flow anymore and we remove the vacutainer from the needle and the muff

covers the needle, so no drop of blood is trickled (the role of the muff). Before the blood sampling, it is compulsory to make a disinfection of the area with cotton and alcohol, and after the blood sampling the area is pressed with the same pad of cotton and it is applied a sterile patch (4, 6).

The determination of the biochemical parameters followed in this study: the cholesterol and the total lipids were realized using the analyzer COBAS MIRA. The normal values of these parameters are according to the group of age and it is automatically realized.

The assessment: the values of the parameters studied were written from the special paper of the automatic machine, at the end of the determinations.

After the laboratory investigations there were obtained conclusive data which were registered in diagrams and tables, comparing with the control group. This is made of a sample of 120 individuals of different genders, selected on the groups of age analyzed, in an equal number – 20 for each group of age: for 18-30 years, 31-40 years, 41-50 years, 51-60 years, 61-70 years and 71-80 years.

There were investigated an equal number of women and men, 60 from all the groups of age established, in order to eliminate the occurring errors.

The healthy persons tested are coming from different groups of age and, even if the value of the cholesterol doesn't register an excess, it is noticed that there are differences between those who come from the first group of age and those from the last group of age (fig. 1).

Results and discussions

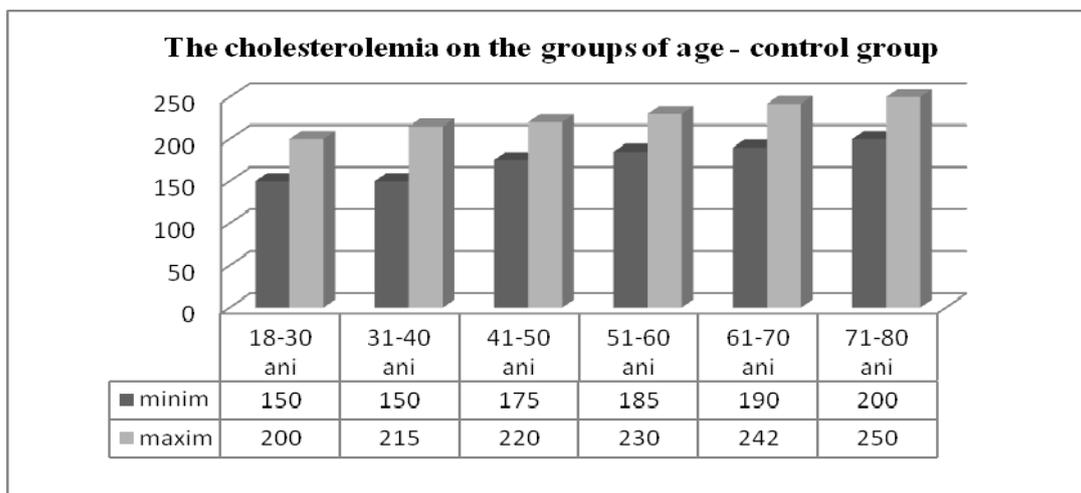


Fig. 1 - The variability of the cholesterolemia on groups of age for the individuals from the control group.

The age attracts itself some increased values of total lipemia for the maximum values, while the

minimum values register a slowly increase, around the value of 400 mg% (fig. 2).

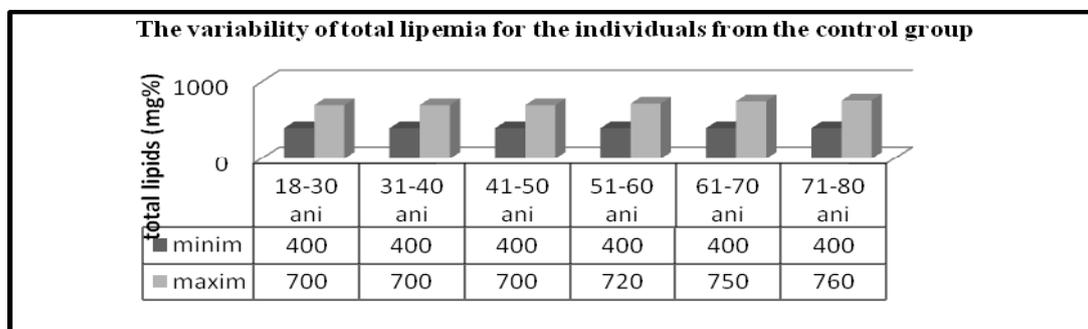


Fig. 2 - The variability of total lipemia on groups of age for the control group

The patients from the study group who have been diagnosed with high values of the cholesterol and total lipemia, selected from different groups of age between 18 and 80 years, are been diagnosed with ischemic heart disease, diabetes, dislipoproteinemia, obesity, hepatic and pancreatic affections and also the stress factor is responsible for some clinical changes of the blood constants (fig. 3).

From the patients with ischemic heart disease, the group of age with the most cases is 51-60 years, followed by the group of age 41-50 years and on the last place is situated the group of old age, meaning 71-80 years old, this fact being explained also by the morpho-physiological changes and the sclerosis of some anatomical structures which have

lost their elasticity (fig. 4). In what regards the stress factor incriminated in apparition of some metabolic disorders with consequences towards the blood constants, the most affected is the group of 18-30 years, when the young people are finishing their studies and want to look for a job, to start a family, the group of age 41-50 years when the opportunities are disappearing facing the unemployment, incapability and a lifestyle and nourishment totally unbalanced, and the group with the most cases is 51-60 years, when the retirement can represent an exit from the usual life, social life, usefulness for the society and so the depression occurs or “drowning in alcohol”.

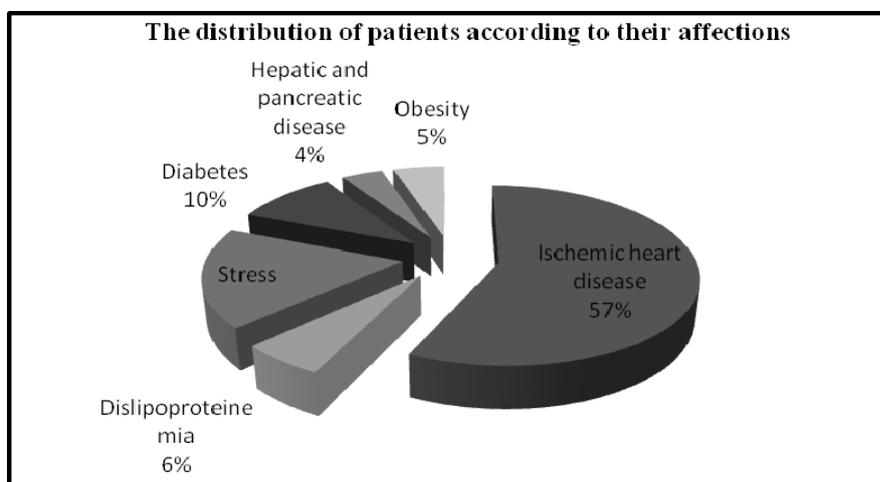


Fig. 3 - The distribution of patients according to their affections

In the case of the patients with diabetes, it is very worrying the diagnose of this disease at young people, where the first cause is not the heredity, but a lifestyle based on refined carbohydrates, poor in proteins and fibres and also the fat from the fast-foods, all aggravating the situation. The apparition

of diabetes type II, which is a consequence of unbalanced nourishment, especially affects the adult over 40 years, but also the old person whose power of regeneration of the liver decreases significantly (fig. 5).

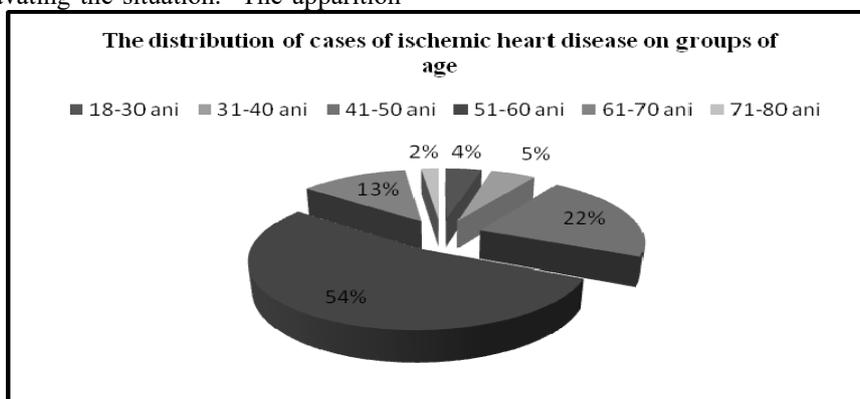


Fig. 4 - The distribution of cases of ischemic heart disease from the studied group on groups of age.

Almost 55% percent of the Romanian population register some deviations from the plasma concentrations of the cholesterol and triglycerides, accompanied by the decrease of the HDL cholesterol (“good cholesterol”). The affectation of the groups of age of 18-30 years and of 31-40 years is due to the food with a lot of calories in saturated lipids (animal lipids), “trans” fatty acids from the margarine and refined sugar, the sedentary lifestyle

(using the car for moving), drinking alcohol 30 mg daily, smoking – over 10 cigarettes daily (2,3), psychosocial stress (increases VDL and LDL – “the bad cholesterol”), drinking express coffee and so on. Over the age of 40, the human body is losing its elasticity and the senescence settles, being responsible of all these changes of the blood constants.

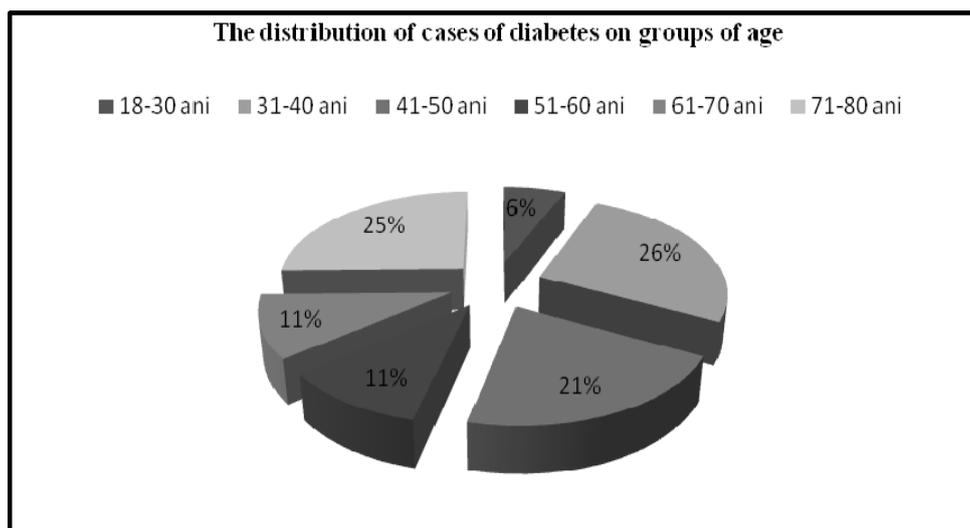


Fig. 5 - The distribution of cases of diabetes on groups of age on the studied group

The apparition of obesity at young people is due to the mistakes of nourishment from the childhood, when the adipose tissue is deposed and it is very difficult to eliminate it, and at the group of old age of 71-80 years there are not so many patients with obesity, knowing that this affection attracts other affections which don't afford the person to reach an old age. The hepatic and pancreatic affections are due to a nourishment reach in carbohydrates and lipids but also to the increase of the quantity of alcohol ingested during a period of 24 hours. The maximum is reached at the group of age of 51-60 years.

Taking a global look to the incidence of the diseases from above on the groups of age studied here, together with the values of total lipemia, it is noticed that almost all the subjects investigated, with the age between 18 and 80 years have got pathological values of total lipemia in the following diseases: ischemic heart disease, diabetes and stress.

The highest values of the cholesterol are registered at the group of age of 51-60 years, exceeding the value of 400 mg%. The triggering factors for the patients of female gender are the

metabolic disorders and stress and for the male gender the more obvious is the stress. According to the type of affection and its complications and the values of the cholesterol in blood stream, the obesity comes on the first place, being followed by diabetes and dislipoproteinemia.

As in the case of total lipemia, the groups of age most affected are those over 40 years, when the aging process worsens the clinical overview.

Conclusions

The increase of the level of cholesterol and of total lipids in the blood stream under the aspect of the conjuncture in which this is generated, in many cases was especially a metabolic one.

The presence of stress of some of the subjects from the groups of age of 41-50 years and of 51-60 years has lead to the equalization of both conjunctures.

At all the decades of age the increase of both parameters: total lipemia and the cholesterol, it was noticed in the same measure at male subjects and also at female subjects.

The pathological context, in which this increase is more obvious, settles the following order: obesity, diabetes, dislipoproteinemia, heart diseases, hepatic and pancreatic affections.

The exploring of the metabolism of lipids by both parameters considered has an important and decisive role in following the evolution and the efficiency of the treatment.

The strategies of decreasing the lipidemia, by their longitudinal sizes, are opening great expectations of metabolic exploring, studying some factors of risk in order to discover and treat the most widespread metabolic affections of our times: dislipoproteinemia, diabetes and obesity.

Rezumat

Excesul de lipide din alimentația populației asociat cu sedentarismul a dus la creșterea incidenței diabetului, a bolilor cardiovasculare, obezității și cancerului de colon. Realizarea acestui studiu a vizat relația dintre variabilitatea acestor parametri lipidici în funcție de vârstă, sex, tipuri de maladii și gradul

de afectare a populației. S-au folosit două loturi: unul martor și altul de studiu, cu indivizi de ambele sexe având vârsta cuprinsă între 18 și 80 de ani selectați dintre pacienții diagnosticați cu diferite boli cardiovasculare, de nutriție și diabet. Nivelul ridicat al colesterolului și a lipidelor totale din organismului se datorează în principal metabolismului, afectează în egală măsură ambele sexe și se înregistrează chiar la persoanele foarte tinere.

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