

Original Research Article

## **The Study of Prevalence of Hypercholesterolemia of East Macedonia - Risk and Prevention**

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Received: 01/03/2016

Revised: 01/04/2016

Accepted: 27/04/2016

### **ABSTRACT**

**Introduction:** Hypercholesterolemia is a condition characterized by very high levels of cholesterol in the blood. Inherited forms of hypercholesterolemia can also cause health problems related to the buildup of excess cholesterol in other tissues. In this research are used the results of biochemical analyses and laboratory testing of cholesterol from private health diagnostic laboratory in east Macedonia of two years (2010-2011). The purpose of this research is to show the prevalence and the risk of appearance of possible hypercholesterolemia defined by gender and age.

**Results and discussion:** According to the analyzed results, we have concluded that in the male population most of the patients with higher concentration of cholesterol are in the age group between 40 and 60, but in the female population most cases of elevated higher concentration of cholesterol are in the age group over 60. It has been established a generation link i.e. elevated concentration of cholesterol appearing in two generations in one family.

**Conclusion:** Hypercholesterolemia is a disease which is primary importance is to be detected and treated accordingly in its early stages with clinical laboratory methods and criteria, and molecular diagnostic methods for detection of the genetic reason for the appearance of this disease and appropriate treatment for patients and extension of their life span.

**Key words:** Hypercholesterolemia, LDL-cholesterol, total cholesterol, FH, Cardiovascular disease, Molecular biological methods.

### **INTRODUCTION**

Hypercholesterolemia is a condition characterized by very high levels of cholesterol in the blood. Inherited forms of hypercholesterolemia can also cause health problems related to the buildup of excess cholesterol in other tissues. <sup>[1]</sup> Familial Hypercholesterolemia (FH) represents a genetic disorder mostly induced by mutation of the gene for the receptor for low density lipoproteins (LDLR) and the gene for apolipoprotein B. <sup>[1-3]</sup> FH is inherited disease and as such is characterized by elevated quantity of total cholesterol and LDL-cholesterol, as a result of the presence of dysfunctional receptors for LDL-cholesterol

or deficiency of receptors for LDL-cholesterol in the liver, which will cleanse the LDL-cholesterol from the blood. Familial hypercholesterolemia (FH) is one of the frequent genetic disease that affects 1 in 500 individuals in human population. The research shows that about 20 % of individuals with FH are diagnosed and only 7 % of them are adequately treated. <sup>[4,5,6]</sup> FH is caused by a mutation of the gene responsible like receptor for low-density lipoprotein (LDLR) and apolipoprotein B (apoB). <sup>[7-10]</sup> FH is autosomal dominant disease characterized by elevated amounts of total cholesterol and LDL - cholesterol, due to the presence of

dysfunctional receptors for LDL - cholesterol or lack receptors for LDL-cholesterol in the liver. Patients with hypercholesterolemia have chronically high concentrations of total cholesterol and high levels of cholesterol LDL (10). Patients with FH are predisposed to premature atherosclerotic cardiovascular disease and xanthomas on the skin. Conventional diagnosis of this disease can be performed at any age with clinical and biochemical tests but the early diagnosis of this disease is very important because they confirm the family medical history and prevent the risks and consequences of FH. [10,11] FH is a genetic disease very often in heterozygotes with prevalence of approximately 1 in 500 people in most Western countries, while very severe homozygous form of the disease occurring in approximately 1 in 1,000,000 people. It is estimated that over 10 million people worldwide are affected by this disease, and about 200,000 die annually of premature coronary heart disease. [7, 12-16]

#### THE MAIN OF THE RESEARCH

- To evaluate the risk of hypercholesterolemia in general population in east Macedonia, (aged more than 18 years)
- To evaluate the prevalence of hypercholesterolemia on patients from east Macedonia
- To identify which population (male or female) is most affected by the disease as hypercholesterolemia
- To determine the age structure of hypercholesterolemia that usually manifest clinically
- To explain the possible implications that occurs in hypercholesterolemia (respective to different age or gender)

#### MATERIALS AND METHODS

We used biochemical results - laboratory testing of private health diagnostic laboratory in east Macedonia, from January 2010 to December 2011 (two years), includes all social and gender

structures, ranging from 12 years-to 90 years old. Cholesterol tests are performed with biochemical analyzer Cobas C111 - Roche Diagnostics. Interpretation of the results of cholesterol are guided by the clinical interpretation of the results according to recommendations of the European Society of Atherosclerosis (European Atherosclerosis Society), which is as follows:

- If the cholesterol is below 5.2 mmol/L and triglyceride values below 2.3 mmol/L, then the patient has not lipid metabolic disorders
- If the cholesterol values ranging from 5.2-7.8 mmol/L and HDL-cholesterol if below 0.9 mmol/L, then we can say that there are possible lipid metabolic disorder in this patient
- If the values of cholesterol above 7.8 mmol / L and triglyceride values above 2.3 mmol / L, we can confirm that the patient has lipid metabolic disorders

As a basic indicator of possible hypercholesterolemia patients will use cholesterol values that exceed the value of 7.8 mmol/L. Patients who are the target of this research is divided into three age categories:

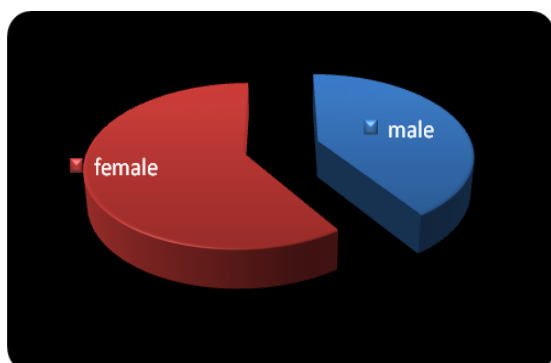
Patients below 40 ages
Patients with 40-60 ages
Patients above 60 ages

#### RESULTS

From the time of January 2010 to December 2011, in the private diagnostic laboratory in east Macedonia are completed total 2376 laboratory analysis of patients where among other analyzes and measured the concentration of total cholesterol. 904 patients (of total 2376) have a cholesterol concentration higher than 5.2 mmol/L. This results shows that 38.05 % of the total number of patients who came (2376) and made the analysis and measurement of the concentration of total cholesterol had cholesterol levels that exceed the limit of 5.2 mmol/L.

**Table 1. Display of total number of patients (males and females) with cholesterol higher the 5.2 mmol/L**

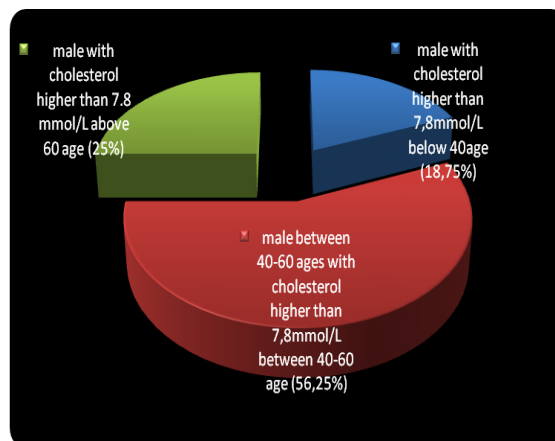
Patients with cholesterol concentration higher than 5.2 mmol/L	N <sub>0</sub>
Male	367 (40,6%)
Female	537 (59,4%)
Total	904 (100%)



**Fig.1. Graphical display of the proportional representation of elevated cholesterol among male and female patients.**

The total numbers of patients with elevated cholesterol are 904, the total number of patients who have cholesterol higher than 7.8 mmol/L is 92. 32 of them

are male patients and 60 of them are female patient.



**Fig.2. Graphic display of the male patients with cholesterol higher than 7.8mmol/L grouped by age criteria.**

**Table 2. Display of total number and the number of patients by gender, with cholesterol higher than 7.8 mmol/L.**

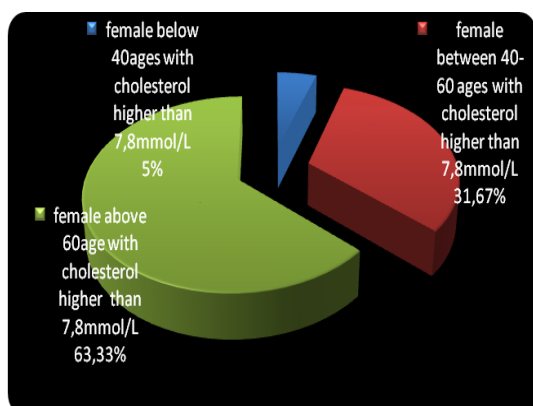
Total patients with cholesterol concentration higher than 7.8 mmol/L	92	100%
Male	32	34.78%
Female	60	65.22%

**Table 3. Display of male patients with cholesterol higher than 7.8 mmol/L by age.**

Male patients with cholesterol higher than 7.8 mmol/L below 40 age	6	18.75%
Male patients with cholesterol higher than 7.8 mmol/L between 40-60 age	18	56.25%
Male patients with cholesterol higher than 7.8 mmol/L above 60 age.	8	25%
Total male patients with cholesterol higher than 7.8 mmol/L	32	100%

**Table 4. Display of female patients with cholesterol higher than 7.8 mmol/L by age.**

Female patients with cholesterol higher than 7.8 mmol/L below 40 age	3	5%
Female patients with cholesterol higher than 7.8 mmol/L between 40-60 age	19	31.67%
Female patients with cholesterol higher than 7.8 mmol/L above 60 age	38	63.33%
Total female patients with cholesterol higher than 7.8 mmol/L	60	100%



**Fig.3. Graphic display of the female patients with cholesterol higher than 7.8 mmol/L grouped by age criteria.**

In group of the males we registered a case of a patient born in 1960 with the highest measured cholesterol (15.24 mmol

/L). In this same patient are observed very high concentration of triglycerides (11.40 mmol/L). Another case with a very high concentration of cholesterol is found in a patient born in 1972, with measured 14.47 mmol/L cholesterol and triglycerides in concentration of 4.70 mmol/L. The youngest male patient with high cholesterol is observed in patients born in 1985 and it has the concentration of cholesterol 9.04 mmol/L. It must be noted that in two cases (work for different families) are met by elevated concentrations of cholesterol in different generations. The first case is the aforementioned patient with the highest measured concentration of 15.24 mmol / L

born in 1960 and his son was born in 1988 with the measured concentration of cholesterol in serum of 8.5 mmol / L. The second case is a female patient born in 1945

with measured concentration of cholesterol by 9.04 mmol/L and her daughter born in 1974 with the cholesterol concentration of 9.84 mmol/L.

**Table 5. Diagnosis (Hypercholesterolemia is diagnosed if total cholesterol levels exceed the cut point)**

Age (years)	Total cholesterol cutpoints (mmol/L)			
	First-degree relative with hypercholesterolemia	Second-degree relative with hypercholesterolemia	Third-degree relative with hypercholesterolemia	General population
<20	5.7	5.9	6.2	7.0
20-29	6.2	6.5	6.7	7.5
30-39	7.0	7.2	7.5	8.8
≥40	7.5	7.8	8.0	9.3

The risk of FH in the general population in east Macedonia is present, but it isn't possible to fully display the real situation due to effects of the external factors.

- ❖ Based on available information from the diary of the patients we conclude existence and risks of hypercholesterolemia based on a fact that 38.05 % of the patients had cholesterol levels that exceed the limit from 5.2 mmol / L.
- ❖ The total number of laboratory tests made in private diagnostic laboratory in east Macedonia for the time of two years (2010-2011) is 2.376, revealed a total of 92 patients with a total cholesterol concentration higher than 7.8 mmol/L. Expressed as a percentage this is 3.87 %

## DISCUSSION

Hypercholesterolemia is caused by a combination of genetic and environmental factors, such as diet, smoking, intake of foods, stress. On the concentration of cholesterol and affecting factors such as gender, age, health status, certain diseases such as health problems related to heart, diabetes and proneness to fattening - obesity. The results of the study shows that the increased concentration of cholesterol is present in most females 59.4 %, than in men's (this percentage is 40.6 %). 65.22 % of the female population have a cholesterol greater than 7.8 mmol/L, which is the possible diagnosis of FH and they are much more prevalent among men (that percentage is 34.78 %).

- The results of the study that the male population between 40-60 years is the most threatened population with cholesterol higher than 7.8 mmol/L followed by the number of cases.
- In the female population the most risks population is aged over 60 years. The high level of cholesterol in the group between 40 to 60 years of men's population is results by reducing the secretion of testosterone which has not the anabolic effect of androgen and testosterone, which contributes to an increase in the concentration of cholesterol.
- Most patients with high levels of cholesterol, females are aged over 60, than from 40 to 60 years we have also a number of patients and have the lowest number of patients under 40 years. This ratio could be explained by the effect of female hormones that speed up metabolism, intensifying the process of storing fat, increase HDL-cholesterol and lower LDL-cholesterol.

The FH clinical phenotype has been shown to be associated with increased coronary heart disease and premature death. Mutations in the low density lipoprotein receptor gene (LDLR) can result in the FH phenotype, and there is evidence that receptor-negative mutations result in a more severe phenotype than do receptor-defective mutations. <sup>[12]</sup> Although it is recognized that in heterozygous familial hypercholesterolemia, large extracranial carotid vessels are affected by atherosclerosis, <sup>[6,15,17,18]</sup> the risk of fatal stroke after treatment with cholesterol-

lowering therapy remains uncertain. [15]  
Haemodynamically significant peripheral vascular disease appears to be more prevalent in FH patients than is generally assumed. [16]

## CONCLUSION

Early diagnosis of hypercholesterolemia is very important for patients. Important in terms of treatment would be recommended in these patients and it would be prevented lethal outcome in these individuals because they have risks of coronary artery disease. The clinical diagnostic criteria for hypercholesterolemia suggests the need for genetic testing in cases where there are confrontational factors such as the level of cholesterol in the final ceilings, vague family history, mainly in patients where there is diagnostic dilemma. The main value of molecular diagnostics is the use in predicate testing for FH of family members. This is important for early detection of FH, in order to prevent cardiovascular diseases and insurance for family members about whether they have the disease or not.

## ACKNOWLEDGEMENT

The authors are thankful to laboratory technician Vlatko Atanasovski for his support and cooperation in the study.

**Conflict of interest:** authors not declare any conflict of interest.

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How to cite this article: Velickova N., Milev M. The study of prevalence of hypercholesterolemia of east Macedonia - risk and prevention. *Int J Health Sci Res*. 2016; 6(5):133-138.

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