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Review Article

Early Blood-Based Diagnostic Criteria in Cardiovascular Diseases

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Abstract

The present era is characterized not only by an increase in the number of diseases but also by their occurrence at younger ages. Modern medical advances are sometimes unable to prevent an increase in mortality. Naturally, the growing number of diseases also directly depends on social and environmental, medical and biological, ecological, and other factors. In such a period, early diagnosis of diseases means successful treatment and longer human life. Cardiovascular diseases are among the most serious public-health problems both worldwide and in Azerbaijan. According to statistical data, cardiovascular diseases account for a large proportion of deaths in the country. The results of blood tests performed at Memorial Clinic in April 2026 once again confirm the high prevalence of these diseases and show that approximately 80% of the examined individuals suffer from them. A comparative analysis of the results of patients who underwent troponin testing revealed elevated levels mainly in elderly men. This is a key diagnostic criterion for myocardial infarction and other acute heart diseases. Triglyceride and LDL test results were also elevated mainly in middle-aged individuals. The same change in HDL levels was observed in all women and men who underwent blood testing. The obtained indicator confirms a high risk of ischemic heart disease. Modern lifestyles and stress factors also contribute to the spread of the disease. Early diagnosis and preventive measures play an important role in preventing complications. Timely examinations can significantly reduce the risk of myocardial infarction and stroke. In this respect, the presented article may be regarded as a step toward protecting human health and is statistically significant.

Keywords: CVD, IHD, troponin, LDL, HDL, triglyceride, physiological age.

1. Introduction

Despite the fundamental achievements of medical science and technological progress in the modern era, humanity continues to struggle with cardiovascular diseases (CVDs), which remain among the most serious threats to human health. In the world today and in our country, pathologies of the cardiovascular system rank among the leading causes of death and disability. According to official World Health Organization (WHO) data, approximately 32% of all deaths each year, or 17.9 million lives, are lost because of this group of pathologies. Global environmental transformations, the intensification of anthropogenic effects, the impact of poor nutrition on metabolism, chronic distress factors that disrupt homeostatic adaptation mechanisms, and the sharp decline in daily physical activity are the main triggers accelerating this group of diseases. Cardiovascular pathologies, previously encountered mainly among older generations, are now rapidly becoming widespread among younger people as well. This indicates a “rejuvenation” of CVDs. The methodological opportunities provided by modern molecular biology, genetics, bioinformatics, and other medical sciences have demonstrated that the fundamental basis of many CVDs is hereditary predisposition, specific gene polymorphisms, pathological changes in biochemical signaling

pathways, or other similar genetic disorders. The prevalence of cardiovascular pathologies in Azerbaijan is analyzed mainly by region. In highly urbanized areas, such as Baku and the Absheron Peninsula, the incidence of CVDs is higher than in mountainous regions.

Cardiovascular diseases are a broad group of pathologies that are among the most prevalent and fatal diseases worldwide and encompass structural and functional disorders of the heart, the principal organ of the cardiovascular system, and of the blood vessels extending from it to organs and tissues. According to the latest WHO statistics, approximately 32% of deaths each year, or 17.9 million lives, are lost because of this group of pathologies. CVDs are most frequently encountered in large, developed countries. This is due to expanding urbanization, unhealthy nutrition, and other factors. Although cardiovascular diseases were formerly observed only in older individuals, they are now also encountered in young people. This phenomenon is referred to as the "rejuvenation" of the disease.

According to modern medicine, cardiovascular diseases rank first among causes of death worldwide. The principal causes of cardiovascular diseases include atherosclerosis, arterial hypertension, diabetes mellitus, changes in the rheological properties of blood, and others. A sedentary lifestyle, or physical inactivity, also leads to CVD. Based on global prevalence and high mortality, CVDs are classified as follows:

1. Ischemic heart disease (IHD): the most common form within the CVD group;

2. Cerebrovascular diseases: the second leading cause of death within the CVD group. Cerebrovascular disease has two main forms: ischemic stroke (thrombosis of cerebral vessels) and hemorrhagic stroke (intracerebral bleeding caused by rupture of a vessel).

3. Peripheral arterial disease: although direct mortality is low, these patients have a high risk of stroke and myocardial infarction;

4. Rheumatic heart disease: streptococcal infection causes damage to the heart valves. This form is regarded as one of the causes of death and disability at a young age;

5. Congenital heart defects: congenital heart defects account for one-third of all forms of CVD;

6. Arrhythmias;

7. Heart failure;

8. Deep vein thrombosis (DVT), etc. [1], [2].

Ischemic heart disease (IHD): in modern medicine, elevated levels of "bad" cholesterol in the coronary arteries that supply the heart muscle cause narrowing or complete blockage of the vessels. Consequently, blood flow slows, and an imbalance develops between the oxygen delivered to the heart and the heart's oxygen demand. Among CVDs, ischemic heart disease (IHD) ranks first among conditions that most frequently cause disability and death.

IHD differs markedly across age groups. According to WHO data, there are 10 deaths per 100,000 people aged 25–34 years, while this figure rises to 1,000 in the 55–64-year age group. IHD is more common in men than in women [3], [4]. When the degree of coronary artery narrowing exceeds 50%, IHD manifests clinically; that is, clinical symptoms appear. In addition to narrowing of the coronary arteries due to "bad" cholesterol, other factors—including smoking, alcoholism, consumption of unsaturated fats, physical inactivity, bronchial asthma, diabetes mellitus, hypothyroidism, gallstone disease, and others—also play an important role in the development of IHD [4], [5], [6].

Numerous clinical studies demonstrate that biomarkers such as atherogenic lipoproteins, fibrinogen, homocysteine, and TSH (thyroid-stimulating hormone) correlate closely with major risk factors such as dyslipidemia, hypertension (high blood pressure), obesity, and diabetes mellitus. At the same time, assessing inflammatory indicators such as C-reactive protein (CRP) together with standard biochemical tests makes it possible to predict disease risk more accurately. Specific markers such as high-sensitivity troponin T (hsTnT) and NT-proBNP play a major role in the early diagnosis of heart failure and myocardial infarction. These substances begin to rise above normal blood levels only 1–2 hours after an acute cardiovascular event [7], [8]. The most

important markers of myocardial injury are troponin T and troponin I. An increase in blood TnT and TnI above normal levels leads to increased pressure in the right ventricle and, consequently, acute myocardial injury. An elevated serum troponin I (TnI) level in patients with cardiac rhythm disorders is not merely a laboratory indicator; it is also a clinical warning that the patient may experience a stroke or myocardial infarction at any time. Serum troponin is considered one of the principal markers indicating the latent development of vascular atherosclerosis [9], [10].

The lipid profile is of great importance in CVD. Lipoproteins are complex molecules that transport lipids such as cholesterol and triglycerides throughout the body in the bloodstream and consist of hydrophobic and hydrophilic layers. A lipoprotein is a spherical molecule with cholesterol esters and triglycerides inside and an outer covering composed of protein and membrane components. Fat particles are covered externally by a protein layer. This causes them to aggregate and obstruct blood vessels. The ratio of protein to fat determines whether the lipoproteins are HDL or LDL, that is, their type.

In a healthy individual, the optimal LDL level should be below 100 mg/dL. If this level rises to 100–129 mg/dL (2.6–3.3 mmol/L), it is considered a risk factor. Unlike other disorders of lipid metabolism, particularly familial hypercholesterolemia manifested by high cholesterol levels, atherosclerosis or coronary heart disease does not necessarily develop in every patient with acute hypertriglyceridemia or chylomicronemia syndrome. Initially, this paradox raised doubts about the role of triglycerides in cardiovascular pathologies; however, it was explained by the fact that at extremely pathological concentrations (triglycerides >50 mmol/L), triglyceride-rich lipoproteins are too large to enter the inner layer of the vessels and therefore cannot cause atherosclerosis. Conversely, at mildly and moderately elevated pathological triglyceride concentrations (2–10 mmol/L), lipoprotein particles are small enough to penetrate the arterial intima; consequently, they accumulate in the tunica intima and have the potential to cause atherosclerosis. For this reason, clinical epidemiology focuses primarily on subclinical elevations in triglycerides. Triglyceride levels are higher in men than in women. However, when women and men with cardiovascular diseases were compared, it became clear that at the maximum triglyceride level, affected women had a higher risk of developing cardiovascular pathologies than men. Analysis of blood tests in women and men of different ages and investigation of their role in the early diagnosis of CVD. The purpose of the study was to analyze the test results affecting CVD according to the number, sex, and age of the patients

2. Materials and Methods

Various scientific methods were used in the study. Theoretical analysis and synthesis were applied to systematically examine and generalize the available scientific literature on the topic. Comparative and pathophysiological analyses were conducted to assess the diagnostic significance of specific biochemical blood biomarkers that play an important role in the early diagnosis of cardiovascular diseases (cardiac troponins, high-sensitivity C-reactive protein [hs-CRP], lipid profile, and other metabolic indicators). Statistical methods were used to analyze the incidence of pathological conditions and the correlations among biomarkers across various indicators. In addition, the study and systematization of clinical and laboratory data made it possible to obtain practical findings aimed at detecting cardiovascular diseases at an early stage.

The study was conducted on the basis of laboratory results from Memorial Clinic. Venous blood samples were collected from patients who attended the clinic in April 2026, depending on the type of test prescribed. The samples obtained from patients were analyzed using biochemical and immunochemical analyzers. To maintain the accuracy of the study, particular attention was paid to the pre-analytical stage, which is the initial stage of the investigation. During the pre-analytical stage, blood samples were centrifuged at 35,000 rpm for 10 minutes to separate the serum. The patients' lipid profiles (triglycerides, HDL, LDL) and enzyme activity (AST, ALT) were determined on a fully automated biochemical analyzer using enzymatic-colorimetric and kinetic UV methods. To assess acute myocardial injury and inflammatory processes, troponin and hs-CRP markers were analyzed on a fully automated immunochemical analyzer using electrochemiluminescence immunoassay (ECLIA) and immunoturbidimetric methods, respectively.

3. Results

Analysis of the results of the scientific study. The blood test results of patients who attended Memorial Clinic are presented after division into different groups:

Analysis of troponin values

Troponin I and T are among the most important markers of myocardial injury. Even a slight change in the amount of troponin in the blood indicates narrowing of the cardiac vessels, because troponin T and I are regulatory proteins involved in the actin–myosin interaction in the heart muscle. Therefore, in modern laboratories, serum troponin T and I levels are considered the "gold standard" for CVDs, especially for the timely detection of myocardial infarction. During the study, 285 patients underwent troponin testing at Memorial Hospital in April 2026 (Figure 1).

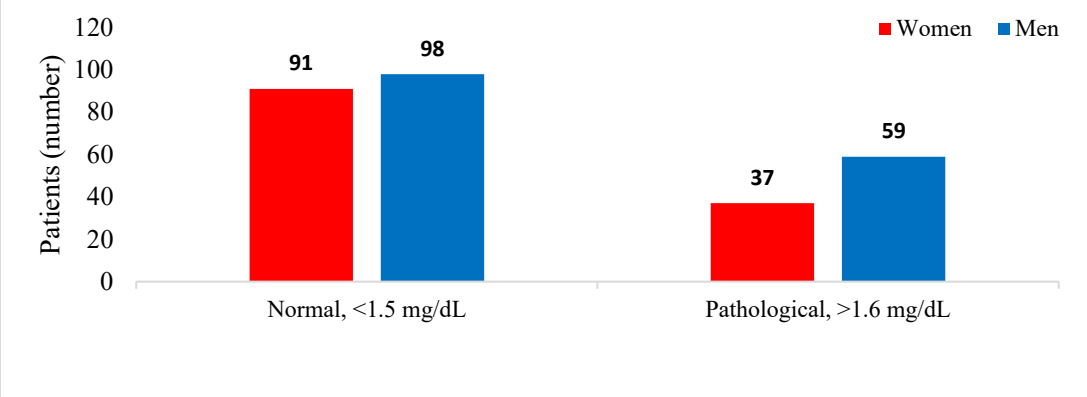


Figure 1. Comparative presentation of the test results of patients who underwent troponin testing at Memorial Clinic in April 2026.

Of the tests, 128 belonged to women and 157 to men. Among the 128 female patients, 91 had results below 1.5 mg/dL, that is, within the normal range, while 37 had results above 1.5 mg/dL, indicating a pathological value. Among the 157 male patients, 98 had results within the normal range, and 59 had pathological values. The number of male patients in the pathological group was greater than the number of female patients in that group. Analysis by physiological age showed that the patients' ages ranged from 15 to 77 years. According to physiological age, the patients were divided into two groups: Group I included 92 individuals aged 15–35 years. Troponin levels were <1.5 mg/dL in 71 individuals (33 women and 38 men) and >1.5 mg/dL in 21 individuals (8 women and 13 men). The number of patients in Group II exceeded that in Group I. In Group II, among patients aged 36–77 years, troponin levels were <1.5 mg/dL in 118 individuals (58 women and 60 men) and >1.5 mg/dL in the remaining 75 individuals. Analysis of the results showed that the measured indicator was higher in male patients, which is a factor that increases the risk of CVD.

Analysis of patients based on triglyceride test values

It is known from the literature that an increase in the amount of triglycerides in a patient's blood indicates a high risk of myocardial infarction. Therefore, assessing triglycerides is one of our primary objectives in blood-test analysis. Interesting findings were obtained in studies conducted at Memorial Clinic (Figure 2), where 309 patients underwent triglyceride testing. Of these tests, 149 belonged to women and 160 to men. In 124 examined patients (64 women and 60 men), the triglyceride level was 70–150 mg/dL, which is considered within the normal range. The physiological age groups of patients whose triglyceride levels were within the normal range were as follows: 1–25 years: 27 individuals (15 women and 12 men); 26–45 years: 58 individuals (31 women and 27 men); 46–65 years: 26 individuals (14 women and 12 men); and 66–80 years: 13 individuals (5 women and 8 men).

Pathological triglyceride levels were also observed. Overall, 71 patients (33 women and 38 men) had triglyceride levels of 150–190 mg/dL, which is considered the borderline range. In medicine, the borderline range is also called the "gray zone." Grouping by physiological age showed 4 patients aged 1–25 years (2 women and 2 men), 17 patients aged 26–45 years (8 women and 9 men), 21 patients aged 46–65 years (10 women and 11 men), and 29 patients aged 66–80 years (13 women and 16 men).

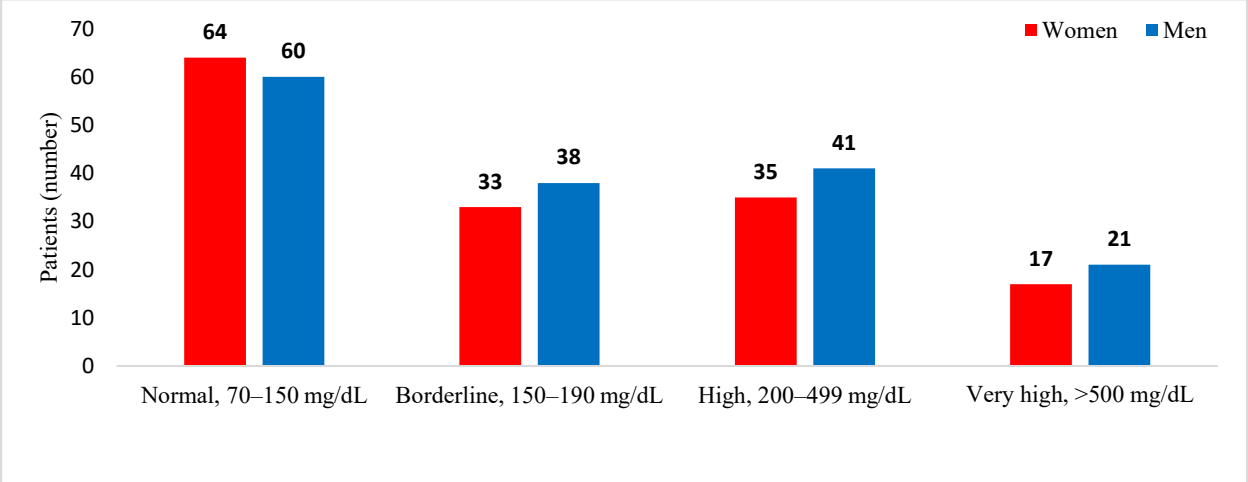


Figure 2. Results of 309 patients who underwent triglyceride testing at Memorial Clinic in April 2026.

An elevated triglyceride level is one of the risk factors. Thus, 76 patients (35 women and 41 men) had high triglyceride levels. Grouping them by physiological age showed 1 patient aged 1–25 years (a man), 18 patients aged 26–45 years (6 women and 12 men), 26 patients aged 46–65 years (12 women and 14 men), and 31 patients aged 66–80 years (15 women and 14 men).

Among the 309 patients studied, 38 had very high triglyceride values. Of these results, 17 belonged to women and 21 to men. When divided into physiological age groups, very high triglyceride values were identified in 6 individuals aged 26–45 years (2 women and 4 men), 23 individuals aged 46–65 years (6 women and 7 men), and 19 individuals aged 66–80 years (9 women and 10 men).

Thus, comparative analysis of the obtained results showed that pathological values of the studied indicator were more common at advanced ages and particularly among male patients, which increases the risk of myocardial infarction and CVD.

Analysis based on HDL test values

Lipid disorders and atherosclerosis are also major risk factors that cause pathologies of the cardiovascular system. The principal function of HDL in the human body is to remove excess cholesterol particles from the vessel wall and transport them to the liver. For this reason, HDL is also called "good cholesterol" in medicine. In HDL disorders, excess cholesterol particles accumulated in the vessel wall are not removed, and an atherosclerotic plaque forms, resulting in the development of CVDs (Figure 3).

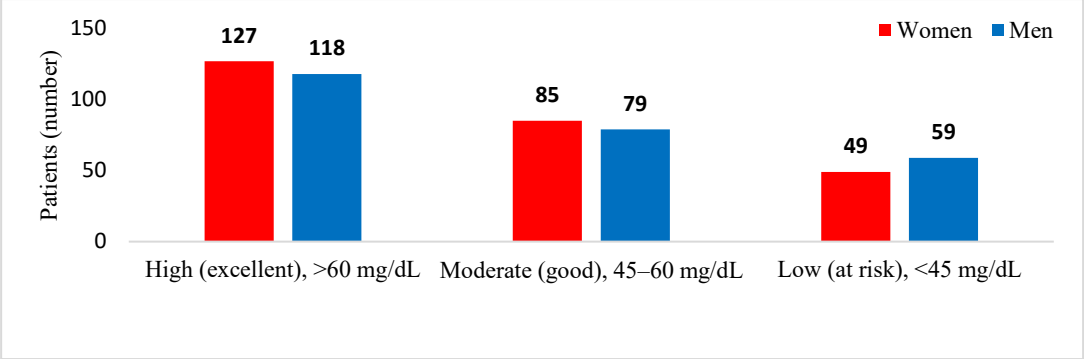


Figure 3. Graphical presentation of the test results of 517 patients who underwent HDL testing at Memorial Clinic in April 2026.

Of the 517 patients who underwent HDL testing, 261 were women, and 259 were men. In 245 individuals (127 women and 118 men), the HDL result was above 60 mg/dL, which is a good result. Patients with excellent results were divided into four physiological age groups: 64 individuals aged 1–25 years (34 women and 30 men), 78 individuals aged 26–45 years (41 women and 37 men), 58 individuals aged 46–65 years (27–29), and 47 individuals aged 66–85 years (25 women and 22 men). Thus, among the 517 patients who attended Memorial Clinic, HDL-related protection of the cardiovascular system was observed in 142 individuals aged 1–45 years.

The test results of 164 patients (85 women and 79 men) showed moderate HDL levels, and certain somatic diseases (type 2 diabetes, chronic kidney disease, etc.) were identified. The physiological age groups of these patients were as follows: 41 individuals aged 1–25 years (19 women and 22 men), 55 individuals aged 26–45 years (28 women and 27 men), 40 individuals aged 46–65 years (21 women and 19 men), and 28 individuals aged 66–85 years (17 women and 11 men).

In 108 of the examined patients (49 women and 59 men), the HDL level was below 45 mg/dL. These patients have a very high probability of developing cardiovascular diseases, and all belong to the risk group. Distribution by physiological age was as follows: only 2 male patients were aged 1–25 years; 26 individuals were aged 26–45 years (11 women and 15 men); 35 individuals were aged 46–65 years (16 women and 19 men); and 45 patients were aged 66–85 years (22 women and 23 men). Thus, comparative analysis showed that HDL levels were approximately equal in women and men and differed markedly from the norm across all age groups. The obtained indicator demonstrates a high risk of CVD.

Investigation of blood LDL levels

In medical terminology, LDL is also called “bad cholesterol.” LDL is formed when VLDL loses most of its fat content. LDL transports cholesterol from the liver to peripheral tissues. An elevated blood LDL level is a principal indicator of cardiovascular pathologies (Figure 4).

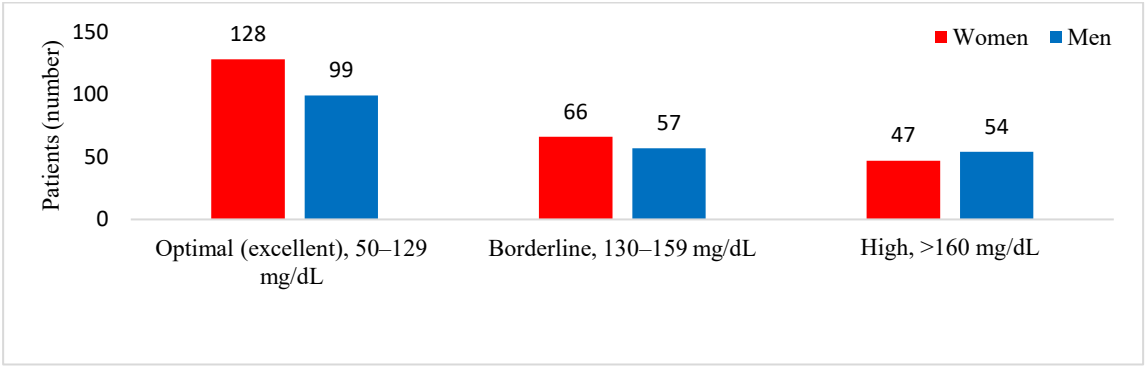


Figure 4. Results of the investigation of blood LDL levels in 451 patients tested at Memorial Clinic in April 2026.

In April, 451 patients (241 women and 210 men) underwent LDL testing at Memorial Clinic. In 227 of these patients (128 women and 99 men), the test result was 50–129 mg/dL, which is considered the normal range. Values within the normal range were recorded most frequently among patients aged 1–45 years (134 individuals) and in 93 individuals aged 46–85 years. These figures show that blood LDL levels increase with age. In 123 patients (66 women and 57 men), the test result ranged from 130 to 159 mg/dL, which is considered the borderline range. Of the patients in this range, 86 were aged 46–85 years. In 101 patients (47 women and 54 men), the test result was above 160 mg/dL. The vascular structure is altered in these patients, which may lead to atherosclerosis. The largest number of patients was in the 66–85-year age group (54 individuals: 23 women and 31 men).

Thus, analysis of LDL levels showed higher values among male patients. When taking the patients' life histories (anamnesis vitae), we determined that alcoholism was one of the principal reasons for the predominance of men. This increases the risk of atherosclerosis, IHD, and other cardiovascular diseases.

Cardiovascular diseases are considered one of the most serious public-health problems in Azerbaijan. According to statistical data, cardiovascular diseases account for a large proportion of deaths in the country. Approximately 60% of all deaths in Azerbaijan are associated with cardiovascular diseases. In recent years, increases have been observed in arterial hypertension, ischemic heart disease, and myocardial infarction. Cardiovascular diseases are widespread both among people of working age and among the elderly population. Heart and vascular diseases rank first among causes of death in the country. Unhealthy nutrition, physical inactivity, smoking, and excess weight are considered important risk factors in the development of these diseases. High blood pressure and high blood cholesterol increase the risk of developing cardiovascular diseases. According to specialists, part of the population is unaware of their blood pressure and does not undergo regular medical monitoring. Modern lifestyles and stress factors also contribute to the spread of the disease. Early diagnosis and preventive measures play an important role in preventing complications. Timely examinations can significantly reduce the risk of myocardial infarction and stroke. State programs and awareness-raising measures aimed at preventing cardiovascular diseases are being implemented in Azerbaijan. Nevertheless, the prevalence of the disease keeps the problem relevant. Cardiovascular diseases are regarded not only as a medical problem but also as a socioeconomic one. Early detection and effective prevention of these diseases are particularly important for improving the population's quality of life and reducing mortality. Promoting a healthy lifestyle in Azerbaijan is considered one of the main approaches to combating cardiovascular diseases. The study conducted once again demonstrated the high risk level of these diseases.

4. Conclusion

Cardiovascular diseases are considered one of the most serious public health problems in Azerbaijan. According to statistical data, cardiovascular diseases account for a large proportion of deaths in the country. The results of blood tests performed at Memorial Clinic in April 2026 confirm the high prevalence of the diseases and show that approximately 80% of the examined individuals suffer from them. Comparative analysis of the results of patients who underwent troponin testing at Memorial Clinic in April 2026 identified elevated levels mainly in elderly men. This is a key diagnostic criterion for myocardial infarction and other acute heart diseases. Triglyceride and LDL test results were also elevated mainly in middle-aged individuals. The highest incidence among men was recorded at advanced ages, which may be associated with harmful habits, an unhealthy lifestyle, stress, and other factors. The same change in HDL levels was observed in all women and men who underwent blood testing. This increases the risk of atherosclerosis, IHD, and other cardiovascular diseases. Modern lifestyles and stress factors also contribute to the spread of the disease. Early diagnosis and preventive measures play an important role in preventing complications. Timely examinations can significantly reduce the risk of myocardial infarction and stroke.

Author Contributions

The sole author is responsible for conceptualizing, collecting, and analyzing data, and writing and editing the manuscript.

Conflict of Interest

The authors declare no conflicts of interest.

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