Possible Association of Some Factors with Diabetes Mellitus

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Abstract: - 118 patients with DM and control group members were studied. The average age of patients was 60.6. In our case, no reliable data revealed a relationship between the disease and gender. On the other hand, when the BMIs of patients and healthy individuals were compared, a significant disparity was observed regarding normal weight. Specifically, patients with normal weight comprised only 4.2±1.8% of the total studied individuals, while in the healthy group, this figure was five times higher at 21.2±3.8%. It should be noted that patients are quantitatively predominant in all obesity categories. The prevalence of the O (I) blood group was significantly higher in the control group, as the obtained results indicate. Based on these data, we can conclude that individuals with the O (I) blood group are more resistant to developing the disease. B (III) and AB (IV) phenotypic groups prevalence was seven times higher in affected individuals, suggesting they can be classified as disease-susceptible groups.

Key-Words: - Blood antigens, Rh factor, ABO, Diabetes Mellitus, Body mass index, Gender.

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1 Introduction

Diabetes Mellitus (DM) ranks among the most common metabolic disorders and falls within the category of complex, multifactorial diseases. DM is primarily characterized by hyperglycemia, which arises from inadequate insulin secretion or impaired insulin action; in some cases, both factors may be involved. The chronic hyperglycemia associated with diabetes can lead to long-term damage, dysfunction, and failure of various organs in the body. The most affected organs include the eyes, kidneys, nerves, heart, and blood vessels, [1]. Chronic hyperglycemia often results in significant metabolic disorders and severe complications. Moreover, diabetes mellitus is escalating rapidly across diverse world populations, [2].

Certain intrinsic and extrinsic factors exhibit a stronger correlation with DM. As a multifactorial condition, DM is associated with genetic and non-genetic determinants. Growing evidence suggests that sex, gender, and age are critical considerations in the epidemiology, pathophysiology, treatment, and outcomes of many diseases; nevertheless, they seem specifically relevant in non-infectious diseases.

In contemporary times, numerous organizations emphasize incorporating sex and gender into biomedical research to enhance the scientific rigor and social relevance of the knowledge, technologies, and/or innovations produced, [3].

Several factors, including age, body mass index, lifestyle choices, smoking, and alcohol dependence, influence the development of DM. Notably, an elevated BMI and obesity are recognized as significant risk factors for the onset of DM.

Furthermore, investigating specific diseases associated with certain biomarkers is essential. The ABO and Rh blood group systems are considered general biomarkers, as numerous studies have demonstrated their correlation with various health conditions, [4], [5], [6], [7], [8], [9].

The ABO and Rh blood groups are widely acknowledged and utilized in medical classification, particularly in contexts such as blood transfusions, organ transplants, and maternal-fetal health. Increasing evidence suggests that these antigens may influence susceptibility to certain diseases. One notable example is diabetes mellitus, characterized by persistently elevated blood sugar levels, or hyperglycemia, resulting from impaired insulin

action, reduced production, or a complete lack of this essential protein, [10]. Researchers have begun investigating the impact of specific blood groups on the risk of developing diabetes, particularly type 2 diabetes mellitus (T2DM), which is the most prevalent type of the disease.

T2DM is typically associated with insulin resistance, a condition in which the body cells fail to respond effectively to insulin. Over time, this resistance contributes to reduced insulin production by the pancreas, ultimately resulting in persistently elevated blood sugar levels, [11]. Various studies regarding the relationship between blood groups and T2DM have observed that certain blood types are more common among individuals with diabetes than in the healthy population.

Studies have indicated a potential correlation between blood type and susceptibility to developing certain diseases. For instance, a study conducted in Turkey revealed that individuals with blood type A had a higher susceptibility to developing T2DM, indicating that this blood type could increase the risk of diabetes, [12]. Conversely, a study published in the Libyan Journal of Medicine in 2010 examined 70 patients and found that most individuals with blood types A and O did not have diabetes, [13]. This implies that these blood types may protect against T2DM in specific populations. These differences highlight the necessity of investigating various populations to better understand how blood type influences susceptibility to diabetes.

The exact mechanisms underlying these associations remain unclear; however, complex genetic and immunological factors are thought to play a role. It is hypothesized that blood group antigens might influence inflammation and vascular function, critical in the onset of metabolic disorders like T2DM. For instance, individuals with non-O blood types are likely to exhibit elevated levels of specific proteins, such as von Willebrand Factor (vWF), which is involved in blood clotting and can contribute to inflammation, [14]. Increased inflammation is widely recognized as a significant risk factor for insulin resistance and diabetes.

Moreover, in addition to genetic predisposition, environmental factors contribute to the relationship between blood group antigens and metabolic disorders. Elements of one’s lifestyle, such as dietary habits, levels of physical activity, and stress, may influence genetic factors, including blood type, impacting an individual's risk of developing diabetes, [15]. In conclusion, emerging evidence suggests that certain blood types may be prone to developing T2DM. These findings highlight the need for further investigations into the underlying mechanisms of antigens affecting metabolic pathways, particularly diseases like T2DM, which could significantly influence prevention and treatment strategies.

The main goal of the current research was to study various demographic characteristics of individuals diagnosed with diabetes mellitus and reveal any potential association with ABO and Rh blood groups.

2 Research Materials and Methods

2.1 Research Materials

One hundred eighteen patients with diabetes mellitus, aged 44 to 79, including 62 females and 56 males, were studied. The inclusion criteria for the study were defined, with age and diagnosis as the primary selection factors. Volunteers who did not meet these criteria were excluded from participation. The research was conducted from October 2023 to May 2024 and was approved by the clinic's ethics committee (N52, 28.09.2023). 118 control (healthy individuals) group members were also studied. Before the study commenced, patient volunteers received written information outlining the goals and objectives of the study, as well as details regarding the use of their biological samples for this purpose. Those who agreed to participate signed a special written consent form.

At the initial stage of the study, the patients were interviewed using a special questionnaire. The questionnaire included various multiple-choice questions regarding their age, gender, nationality, marital status, living conditions, educational background, medical history, daily medication intake, sleep patterns, weight, height (body mass index), dietary habits, smoking habits, and consumption of drugs and alcohol, among other factors. The interviews were conducted individually, allowing for a relaxed, less stressful atmosphere with a brief and appropriate duration. Each interview lasted approximately 10 to 15 minutes.

Blood samples were collected from the patients at the study's next step. A total of 5 mL of blood was drawn into special tubes, both with and without anticoagulant, in two aliquots from each patient. The sample collection occurred at the LLC "Health" clinic, with field specialists actively involved.

The control group was assigned to the study. The inclusion criteria for individuals who consented to participate were as follows: 1) Participants must be healthy, with no clinically evident signs of diabetes mellitus or any previous diagnosis of this metabolic disorder. 2) Participants must be between

45 and 80 years old. 3) Both male and female individuals were included in the control group. Additionally, the relationship between the disease and body mass index was examined.

Height and weight are calculated using body mass index (BMI). BMI is determined by dividing an individual's weight (kg) by the square of their height (m): BMI = kg/m². A high BMI may indicate a higher level of body fat. Weight categories are assessed based on BMI, which may suggest potential health risks. However, BMI does not directly measure body fatness or determine an individual's overall health (Table 1).

Table 1. BMI and its categories according to the international standard

Category	Body mass index (BMI) K/sm^2
underweight	<18
Normal mass	18,5-24,9
Overweight	25-29,9
Obesity I degree	30-34,9
Obesity II degree	35-39,9
Obesity III degree	>40

The study samples were further processed at the Laboratory of Immunogenetics of Batumi Shota Rustaveli State University. Blood components were isolated for further applications by centrifuging anticoagulant tubes. The obtained serum was extracted and preserved for future use under specific conditions.

The group antigens of the ABO and Rh systems in the erythrocyte mass have been studied. These group antigens were identified using the immunoserological forward method with monoclonal anti-A, anti-B, anti-AB, and anti-D antibodies. This method relies on the agglutination reaction when antigens and antibodies interact within the sample. Biological waste is disposed of in compliance with established biosafety protocols.

The prevalence of these group antigens among patients was analyzed regarding their regional frequency. Comparative analysis enables the identification of disease-susceptible groups, serving as potential biomarkers for disease prevention and complications.

The obtained material has been studied and statistically processed. Group rates were compared using a Chi-square analysis of proportions. The level of statistical significance was set at 0.05.

3 Results

The study included 118 diabetic patients, comprising 62 females and 56 males, with a mean age of 60.6 years (44–79 years). We aimed to investigate whether there were any differences in average age based on the patient's gender. However, the results indicated complete similarity, with the average age between 60.4 and 60.8 years (Table 2, Appendix).

The study cohort was divided into distinct age groups: 1. 41-50 years; 2. 51-60 years; 3. 61-70 years; and 4. 71-80 years, using a 10-year interval for classification. The smallest proportion of patients, 3.4±1.7%, was observed in the 41-50-year-old category (n=4). Following this, the 71-80 age group accounted for 11±2.9% (n=13). The 61-70 age category represented 33.9±4.4% (n=40) of the study population. The most significant proportion of patients was in the 51-60 age group, making up 51.7±4.6%. The chi-square (χ^2) statistic is 17, df = 3, CV = 7,815 (Table 3, Appendix). The P-value is .000707. The result is significant at $p < .05$.

We also focused on identifying whether the age group distribution was gender-related. As shown in the Table 4 (Appendix), the distribution of females and males across different age categories is almost equal, with a difference of only 1-2%. However, the 71-80 age category is notable, where males are represented 4% more frequently than females. The chi-square statistic (χ 2) is 1.7389. The p-value is .628324. The result is not significant at $p < .05$ (Table 4, Appendix).

We aimed to identify the nationalities of the patients involved in the study. The vast majority, 95.8 ± 1.8% (n = 113), were identified as ethnically Georgian. In contrast, only five patients, representing 4.2 ± 1.9%, were non-Georgian (Table 5, Appendix).

Body mass index was analyzed within the target groups. As is recognized, there are six main categories: Defect of Mass, Normal Mass, Overweight, Obesity I Degree, Obesity II Degree, and Obesity III Degree (Table 1). None of the patients were categorized under the Defect of Mass category. Only 4.24±1.9% of the studied patients were found to have a normal body mass (n=5). In contrast, 32.2% are grouped into the Overweight category (n=38). The remaining patients are classified into the obesity category, indicating that the vast majority of the studied patients—63.56% (n=75)—fall into this category, which is represented by three groups: Obesity I Degree at 38.14±4.5% (n=45), Obesity II Degree at 17.8±3.5% (n=21), and Obesity III Degree at 7.62±2.4% (n=9) (Table 6, Appendix).

We analyzed the relationship between body mass index and gender (Table 7, Appendix). Due to the absence of patients in the underweight Category, this group was excluded from further statistical analyses. Table 7 (Appendix) shows that the normal body mass index was almost equally distributed between males and females. A similar distribution pattern was revealed in the overweight category. Minor differences were also observed in the obesity categories. Relatively small differences were noted in the overweight category (Table 7, Appendix). The chi-square statistic was 2.5242, with a p-value of .640314, indicating that the results are not statistically significant at $p < .05$. This statistical evidence suggests an equal distribution among the qualitative variable groups, supporting the null hypothesis.

An analysis of body mass index by age category has also been conducted (Table 8, Appendix). Table 8 (Appendix) shows that body mass index was assessed across four age groups for both females and males; however, no significant differences were found within any age group. Body mass categories were almost equally represented in females and males across all ages.

The phenotypic groups of the ABO system were unequally distributed in the patient cohort, as illustrated in Figure 1 (Appendix). A significant proportion of patients, specifically 48.7±4.7% (n=56), belong to the O(I) phenotypic group, while 36.5±4.5% (n=42) are classified as group A(II). The B (III) and AB (IV) phenotypic groups show nearly equal representation, with 7.8±2.5% (n=9) and 7±2.4% (n=8) of patients, respectively. Of the total 115 studied patients, blood samples from 3 patients were not analyzed due to a technical error.

The distribution characteristics of Rh antigens in patients, depicted in Figure 2 (Appendix), indicate that most patients (83.5±3.5%, n=96) belong to the Rh-positive group. In contrast, 16.5±3.5% (n=19) cases are found in the Rh-negative group. The chi-square statistic is 51,54, df = 1. CV = 3,841. The p-value is < .00001, demonstrating a statistically significant result at $p < .05$.

We analyzed the distribution of ABO blood groups with gender. However, no statistically significant differences were identified among the qualitative variables. The chi-square statistic was 7.7524, with a p-value of .051416, indicating that the result does not reach significance at the $p < .05$ level (Table 9, Appendix).

We also analyzed the frequency of ABO and Rh system combinations among the patients in our study. Table 10 (Appendix) illustrates the uneven distribution of the eight phenotypic groups associated with the ABO and Rh systems (Table 10).

4 Discussion

4.1 Age Association

Diabetes mellitus is a metabolic disorder and represents a group of widespread, multifactorial diseases resulting from complex inheritance. Certain countries experience a high prevalence of diabetes, with India recognized as a significant center in the global diabetes mellitus pandemic, [16]. Age is a critical determinant in the onset of diabetes mellitus, [3]. In contemporary times, effective medical treatments have enhanced the quality and longevity of life for individuals with diabetes. Research conducted in Germany indicates that individuals with diabetes tend to live longer. Among 340,000 adults with type 1 diabetes, over 100,000 are aged 70 and above. Additionally, approximately 8 million individuals have type 2 diabetes, with a quarter of this population being over 75 years old, and around 1 million exceeding 80 years of age, [17]. Our study demonstrates that the average age of patients was 60.6 years, aligning with findings reported in various studies across different countries, [18], [19].

4.2 Gender Association

The clinical significance of sexual dimorphism is emerging from studies in the field of type 2 diabetes mellitus (T2DM). Genetic predisposition, lifestyle choices, and environmental influences contribute to the rising prevalence of T2DM and its related complications, presenting significant challenges for healthcare systems. Sexual dimorphism refers to the biological distinctions between males and females, arising from variations in sex chromosomes, sex-specific gene expression on autosomes, and the influence of sex hormones on various organ systems. Women experience more pronounced fluctuations in hormones and body composition throughout their lives due to reproductive factors, [3].

In our study, no reliable data on the relationship between disease occurrence and gender were revealed. Both male and female subjects appear to be equally impacted.

4.3 Body Mass Index and Diabetic Mellitus

Body mass index (BMI) serves as a key indicator for identifying obesity, and a high BMI is associated with various comorbidities, including type 2

diabetes, osteoarthritis, cardiovascular disease (CVD), and sleep apnea. A comparative analysis of BMI was conducted between patients and healthy individuals within the study groups. A significant disparity was found in the normal weight category, specifically, among the patients, only five were of normal weight, that is, 4.2±1.8% of the studied individuals. In contrast, this was five times higher in the healthy cohort, equaling 21.2±3.8%. Furthermore, patients were quantitatively dominant across all obesity categories (Table 11, Appendix). As the Table 11 shows, five more patients are in the Obesity I category than in the healthy group. Almost 3 times more cases were recorded in the Obesity II category compared to healthy individuals, and also, healthy individuals were 2.25 times less likely in the Obesity III category.

Statistical analysis revealed specific differences between the qualitative variables, supporting the rejection of the null hypothesis. The p-value was .000116. In this case, the chi-square statistic was 23.1828, indicating the statistical reliability of the obtained data. The p-value remained at .000116. The result was significant at $p < .05$.

Several publications have studied the relationship between body mass index and diabetes. A Chinese population-based study involving 5,838 individuals aged ≥18 years (both females and males) revealed a positive association between body mass index and diabetes, [20].

One of the scientific paper reviews provides an overview of factors contributing to the onset of diabetes. Key elements include the qualitative and quantitative dimensions of dietary habits, insufficient physical activity, excessive screen time or prolonged periods of sitting, exposure to environmental noise or particulate matter, inadequate or interrupted sleep, smoking, stress and depression, and low socioeconomic status, [21]. Generally, these factors contribute to an increase in body mass index, which directly correlates to the development of diabetes, [21].

One scientific paper that studied 10,074 adults aged 20 and older revealed a positive association between body mass index and migraines and diabetes, [22].

4.4 Diabetis Melitus and ABO Blood Group System Antigens

To identify disease-associated phenotypic groups, the frequency of ABO system groups was compared with its regional distribution and also with the data of blood donors in the region (Table 12, Appendix). As can be seen from Table 12 the distribution profile of ABO system antigens in patients is entirely consistent with the regional distribution and characteristics of their distribution in blood donors. However, a difference was observed between healthy controls and the patient group. The variations in the characteristics of the four phenotypic groups across these different categories provide robust statistical evidence, specifically. The chi-square statistic was 20.8321. The p-value was 013417. The result was significant at $p < .05$. This data suggests a difference among the qualitative variable categories, leading to the rejection of the null hypothesis (Table 12, Appendix).

The prevalence of the O (I) blood group is significantly higher in the control group, as the analysis shows. 48.7% of patient cases revealed the O (I) group; in healthy controls, the prevalence was 60.2±4.5%. This data suggests that individuals with the O (I) blood group may have greater resistance to disease development. In contrast, the A (II) phenotypic group appears similarly represented among patients and controls. Notably, the B (III) and AB (IV) phenotypic groups show a remarkably higher prevalence, seven times greater in affected individuals, indicating a potential association with the disease.

Conversely, a study conducted within the Iranian population revealed different findings. Specifically, the study in Iraq investigated the possible association between diabetes mellitus and ABO type. The analysis demonstrated that total cholesterol, glucose levels, and systolic and diastolic blood pressure were significantly elevated in patients with blood group O compared to other groups, with a noted decrease from group A to B and then AB, [23].

Additionally, a study involving the Chinese population presented a different perspective. These studies indicated that the risk of pancreatic cancer was associated with ABO blood type, diabetes mellitus, and chronic pancreatitis. The authors concluded that the risk was highest for individuals with blood type A and diabetes mellitus (DM), [24].

The p-value is .013417. The result is significant at $p < .05$Our study coincides with research conducted in Pakistan from 2019 to 2020. The diabetic populations of eight cities were randomly selected for the study. Blood group antigens were examined in a total of 584 diabetic individuals. The research team demonstrated that DM has some association with ABO blood groups, and individuals in group B have increased susceptibility to the development of DM, [25]. A group of authors prepared a meta-analysis article on the association between type 2 diabetes and blood groups. They retrieved 47 documents from various reputable

scientific platforms, including Web of Science, EMBASE, and PubMed. The following terms were used to find relevant literary sources: "ABO blood groups" and "type 2 diabetes." The last 15 scientific papers were deemed the most appropriate, and the remaining studies were excluded. Based on these scientific studies, it was revealed that blood group B was associated with a high incidence of type 2 diabetes. In contrast, blood group O showed minimal association with type 2 diabetes. Blood groups A and AB were almost equally distributed among diabetic and non-diabetic populations, [26].

Another meta-analysis, serving as a literature review in a ranked journal, has been conducted by a group of authors. The authors explore twenty-six studies related to the issue above. A meta-analysis was performed on 6870 patients with T2DM and 11,879 controls. Based on this meta-analysis, it was revealed that people with blood type B were at higher risk of T2DM compared to other blood groups. At the same time, blood group O has a very low risk of disease development, [27].

4.5 Rhesus System Association with Diabetes Mellitus

The distribution characteristics of Rhesus antigens in patients were compared to the regional data, specifically, to the data from blood donors in the region. A group of healthy individuals was taken as one of the control groups. The obtained data did not reveal any changes among qualitative variable characteristics. The chi-square statistic was 1.626. The p-value was .443522. The result was not significant at $p < .05$ (Table 13, Appendix). Based on the data, we can conclude that the Rhesus system is not associated with the risk of developing diabetes. Pakistani researchers studied the prevalence of the Rh system in diabetic and prediabetic patients. They based their study on the definition that the expected frequencies of the Rh group were higher in diabetics because of a larger random sample than a pre-diabetic sample. However, the expected frequency of the Rh+ group was higher within the diabetic individuals than the Rh- diabetics, [25].

Based on a study of 15 scientific articles, the authors demonstrated they could not find an association between Rh+ and Rh- blood groups and type 2 diabetes (Meo et al., 2016). A similar result was observed in a meta-analysis of other authors involving twenty-six scientific studies, [27].

A limitation of the study is the insufficient number of patients. It is planned to study more patients and analyze additional risk factors associated with diabetes, such as lifestyle, physical activity, psychological state, socioeconomic status, and others. Moreover, it is planned to study biomarkers related to the disease, including leukocyte antigens and their encoding genes. It also does not include materials for those over 80. However, more studied materials will enable more valuable conclusions and recommendations.

5 Conclusion

The findings from the present study indicate that specific characteristics, such as age, body weight, and blood type, are associated with diabetes mellitus. The average age of participants diagnosed with diabetes is approximately 66 years. Additionally, an increasing body mass index is directly related to the manifestation of clinical symptoms associated with diabetes mellitus. Furthermore, B and AB blood groups appear to be associated with diabetes mellitus, while individuals with the O blood group have a lower risk of developing DM. The study also reveals no significant association with the Rh factor.

Declaration of Generative AI and AI-assisted Technologies in the Writing Process

The authors wrote, reviewed and edited the content as needed and they have not utilised artificial intelligence (AI) tools. The authors take full responsibility for the content of the publication.

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Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

- Marina Koridze had oversight and leadership responsibility for the research activity planning and execution.
- Kristine Makharadze prepared the research questionnaire
- Marina Nagervadze prepared the published work, specifically visualization/data presentation.
- Sophiko Tskvitinidze prepared the published work, specifically writing the initial draft.
- Rusudan Khukhunaishvili was responsible for the development and design of the research methodology.
- Nato Zosidze was responsible for the Statistics.
- Shorena Gabaidze conducted research and investigation, specifically performing the experiments and data/evidence collection.
- Ketevan Dolidze was responsible for formulating research goals and aims.
- Aleena Parveen Shaik conducted a research and investigation process,
- Salome Glonti was provided with study materials from the clinic.

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Conflict of Interest

The authors have no conflicts of interest

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APPENDIX

Table 2. Age indicators of patients.

	Female	Male	total
Middle age	60,4	60,8	60,6
Age range	From 50, including 75	From 44, including 79	From 50, including 75
Scattering range	25	35	35
Total Quantity	56	62	118

Table 3. Age categorization of patients

Age categories	n	%	$\chi 2$
41-50	4	3.4±1.7	17 df 3. CV – 7,815
51-60	61	51.7±4.6	
61-70	40	33.9±4.4	
71-80	13	11±2.9	

Table 4. Age categories of patients by gender

41-50				51-60				61-70				71-80			
Woman		Man		Woman		Man		Woman		Man		Woman		Man	
n	%	N	%	n	%	n	%	n	%	n	%	n	%	n	%
2	1.7±1.2	2	1.7±1.2	31	26.3±4.1	30	25.4±4	19	16.1±3.4	21	17.8±3.5	4	3.4±1.7	9	7.6±2.5

Table 5. Nationality of the patients.

Georgian		Non-Georgian		$\chi 2$
n	**%**	n	**%**	
113	95.8 ± 1.8	5	4.2 ± 1.9	49.4 df 1. CV – 3.841.

Table 6. Body mass index in the studied patients

Category	Body mass index (BMI) K/sm^2	n	%	$\chi 2$
Underweight	<18	0		The chi-square statistic is 15.65, df 4. CV – 9,488.
Normal mass	18,5-24,9	5	4.24±1.9	
Overweight	25-29,9	38	32.2±4.3	
Obesity I degree	30-34,9	45	38.14±4.5	
Obesity II degree	35-39,9	21	17.8±3.5	
Obesity III degree	>40	9	7.62±2.4	

Table 7. Body mass index in females and males

Category	Body mass index (BMI) K/sm^2	female		male		$\chi 2$
		n	%	n	%	
Normal mass	18,5-24,9	2	1.7±1.2	3	2.5±1.5	The chi-square statistic is 2.5242.
overweight	25-29,9	20	16.9±3.5	18	15.3±3.3	
Obesity I degree	30-34,9	19	16.1±3.4	26	22±3.8	
Obesity II degree	35-39,9	9	7.6±2.5	12	10.2±2.8	
Obesity III degree	>40	6	5.1±2	3	2.5±1.5	

Table 8. Age categories and body mass index.

Age categories		41-50		51-60		61-70		71-80	
		n	%	n	%	n	%	n	%
BMI categories	gender								
Normal mas	Male	0	0	0	0	1	0.9±0.9	2	1.7±1.2
	Female	0	0	2	1.7±1.2	0	0	0	0
Overweight	Male	0	0	8	6.8±2.3	5	4.2±0.8	5	4.2±0.8
	female	1	0.9±0.9	12	10.2±2.8	5	4.2±0.8	2	1.7±1.2
Obesity I degree	Male	1	0.9±0.9	18	15.3±3.3	6	5.1±2	1	0.9±0.9
	Female	0	0	11	9.3±2.7	7	5.9±2.2	1	0.9±0.9
Obesity II degree	Male	1	0.9±0.9	3	4.8±2.7	7	5.9±2.2	1	0.9±0.9
	Female	1	0.9	4	3.4±1.7	4	3.4±1.7	0	0
Obesity III degree	Male	0	0	1	0.9±0.9	2	1.7±1.2	0	0
	Female	0	0	2	1.7±1.2	3	4.8±2.7	1	0.9±0.9

Table 9. ABO blood groups in females and males

ABO blood groups	Patients				χ^2
	Female		male		
	n	%	n	%	
O (I)	33	28.7±4.2	23	20±3.7	The chi-square statistic is 7.7524.
A (II)	20	17.4±3.5	22	19.1±3.7	
B (III)	1	0.9±0.9	8	7±2.4	
AB (IV)	5	4.3±1.9	3	2.6±1.5	
Total	59	51.3±4.7	56	48.7±4.7	

Table 10. ABO and Rh system combinations in patients

ABO blood groups	Patients			
	Female		Male	
	N	%	n	%
O (I) Rh+	31	27±4.1	18	15.6±3.4
O (I) Rh-	2	1.7±1.2	5	4.4±1.9
A (II) Rh+	15	13±3.1	18	15.6±3.4
A (II) Rh-	5	4.4±1.9	4	3.51.7
B (III) Rh+	1	0.9±0.9	6	5.2±2.1
B (III) Rh-	0	0	2	1.7±1.2
AB (IV) Rh+	4	3.5±1.7	3	2.6±1.5
AB (IV) Rh-	1	0.9±0.9	0	0

Table 11. Body mass categories in patients and healthy individuals

Category	**Body mass index (BMI) K/sm^2**	**Patients**		**Healthy controls**		χ^2
		n	%	n	%	
underweight	<18	0	0±0	2	1.7±1.2	The chi-square statistic is 23.1828.
Normal mass	18,5-24,9	5	4.2±1.8	25	21.2±3.8	
Overweight	25-29,9	38	32.2±4.3	39	33.1±4.3	
Obesity I degree	30-34,9	45	38.1±4.5	40	33.9±4.4	
Obesity II degree	35-39,9	21	17.8±3.5	8	6.8±2.3	
Obesity III degree	>40	9	7.6±2.5	4	3.4±1.7	

Table 12. Distribution of the ABO system in patients and comparison with other data

Phenotypic variations of ABO	Total material of the studied patients		Regional distribution (*Нагервадзе, М. 2012).*		Blood donors [28]		Healthy controls		χ^2
	N	%	n	%	n	%	N	%	
O (I)	56	48.7	238	47.6	504	49.95	71	60.2±4.5	The chi-square statistic is 20.8321.
A (II)	42	36.5	182	36.4	349	34.58	45	38.1±4.5	
B (III)	9	7.8	57	11.4	109	10.8	1	0.9±0.9	
AB (IV)	8	7	21	4.2	47	4.6	1	0.9±0.9	
Total	115	100	498	100	1009	100	118	100	

Table 13. Rh blood group phenotype distribution in the studied patients compares with the regional distribution and blood donors

Rh Phenotypes	Patients		Regional distribution (*Нагервадзе, М. 2012).*		Blood Donors, [28].		Healthy controls		χ^2
	Number (n)	Percent %	Number (n)	Percent %	Number (n)	Percent %	Number (n)	Percent %	
Rh^+	96	83,5±3,5	388	78,2	848	84,3	105	89±2,9	The chi-square statistic is 1.626.
Rh^-	19	16,5±3,5	109	21,8	161	15,7	13	11±2,9	
Total	115	100	498	100	1009		118	100	

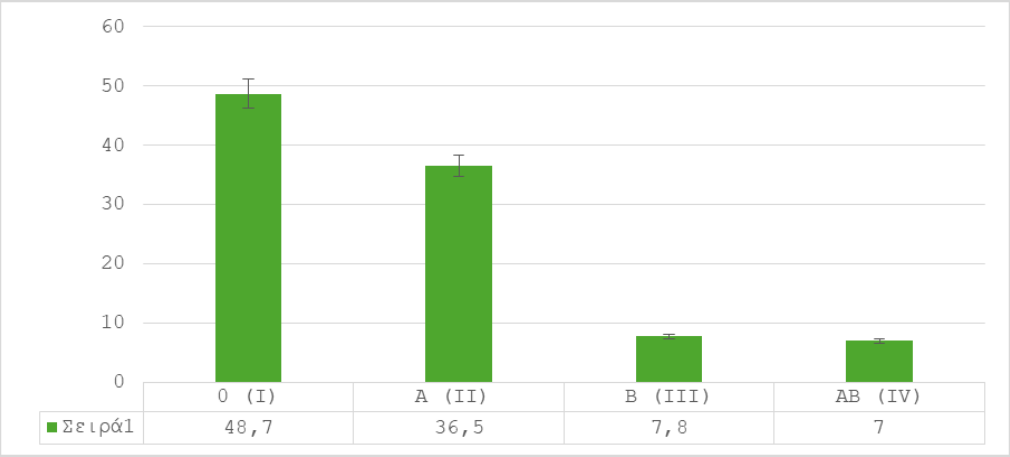

Fig. 1: Features of the distribution of ABO system phenotypic groups in the studied patients

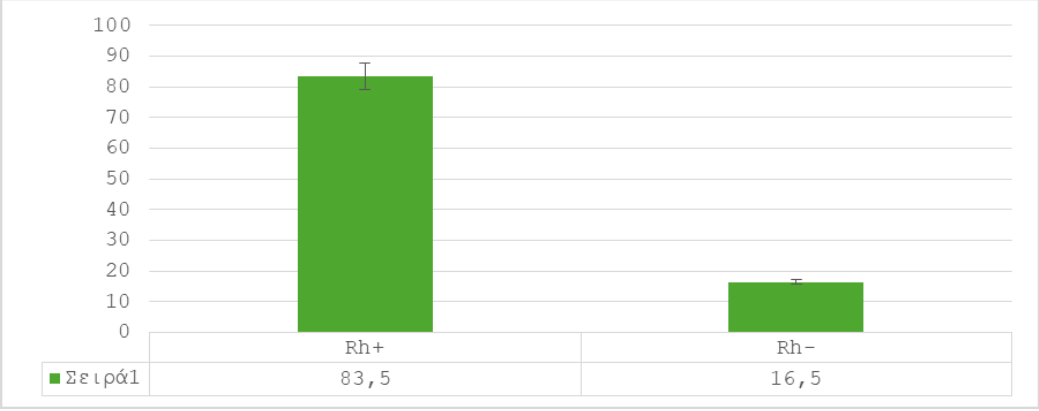

Fig. 2: Rhesus system phenotypes in the studied patients