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Diabetes mellitus and the impact on triglycerides

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Abstract. Atherosclerosis at the diabetic patient is based on lipoproteins in the form of small and dense particles with an increased capacity for subendothelial penetration and the production of atheroma plaque.
We conducted a retrospective study on a number of 217 patients with diabetes mellitus, with an average age of 61.53 years, being analyzed the importance of age, sex, type of diabetes, body mass index on triglyceride values.
Although no significant correlations were found between body mass index and triglyceride value, to improve glycemic control and lipid profile in obese patients with diabetes, weight loss is recommended
No statistical correlation was found between the value of the body mass index and glycated hemoglobin, respectively the value of triglycerides, there was observed a correlation, even if it was weak, between the value of glycated hemoglobin and triglycerides, underlining the importance of a permanent glycemic control in the prevention of atherosclerosis.
Keywords: Diabetes mellitus, triglycerides, atherosclerosis, glycated hemoglobin.

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INTRODUCTION

Diabetes mellitus (DM) causes a series of complications, atherosclerosis secondary to DM causing cerebrovascular disorders, ischemic heart disease, peripheral arterial disease, or other vascular diseases, which are major causes of death for patients with DM and significantly reduce their quality of life (10, 11, 12, 13).
DM causes a two-fold increase in the risk of excess vascular outcomes (ischemic coronary heart disease, ischemic stroke and vascular deaths) independent of other risk factors, a fact demonstrated in the meta-analysis of 102 prospective studies - The Emerging Risk Factor Collaboration (1).
The mechanisms by which the risk of coronary artery disease (CAD) increases at patients with DM are due to the decrease in HDL-cholesterol and the moderate increase in pre-prandial and postprandial triglycerides (TG) (2).
The most important factors involved in the progression of atherosclerosis in DM patients are insulin resistance (14, 15) and hyperglycemia (16). In the pathogenesis of diabetic complications, prolonged exposure to hyperglycemia plays an important role, being recognized as the primary occasional factor (17, 18). Hyperglycemia accelerates the progression of atherosclerosis through three major mechanisms: nonenzymatic glycosylation of proteins and lipids; oxidative stress; activation of protein kinase C (19).
Atherosclerosis and DM are both severe chronic diseases that cause huge problems on families and society. Recently, the connections between the two diseases have attracted particular attention worldwide. In Romania, the association between DM and atherosclerosis is not well explored, previous studies at the population or community level were few and were performed on relatively small sample sizes. The study aimed to explore the relationship between diabetes and triglycerides.

MATERIAL AND METHOD

We conducted a retrospective study on a number of 217 diabetic patients, admitted to the "Sf. Apostol Andrei" Galati, in the period 01/08/2018 - 31/10/2018 with an average age of 61.53 years.
The socio-demographic characteristics, clinical and paraclinical data of the subjects of the lot were collected from the observation sheets, data such as age, sex, type of diabetes, glycosylated hemoglobin, body mass index (BMI), analyzing their influence on triglyceride values.
The criteria for diagnosis of DM were according to the “2019 ESC Guide for diabetes, pre-diabetes, and cardiovascular diseases made in collaboration with the European Association for the Study of Diabetes (EASD)”. Also, the level of glycosylated hemoglobin (Hb glyc) and triglycerides was determined for diabetic patients.
For all diabetic patients were recorded their height and weight and was calculated their body mass index (BMI).
The database contains numerical and nominal information about 217 patients. The correlation of the scalar type data was carried out using the Pearson correlation test, considering a significance threshold of $\alpha = 0.05$. For the correlation analysis for nominal data, we calculated the coefficients φ, C and V, as well as the probabilities associated with them. We compared the mean values of two independent samples using the t-test, and to compare the means of several groups, we used the ANOVA analysis. For the statistical tests was used IBM SPSS Statistics software.

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RESULTS

The tested group consisted of 101 men and 116 women, representing 46.54% and 53.46% respectively (Figure 1).

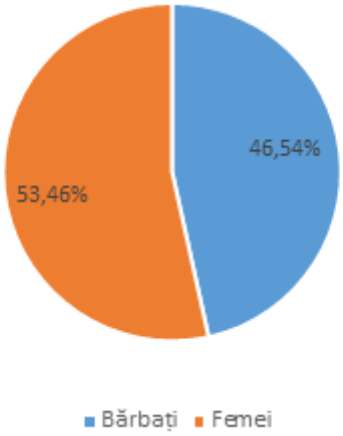

Figure 1. Distribution of patients with diabetes according to sex

The patients included in our study had both type 1 and type 2 diabetes. The group of patients with type 1 diabetes included 19 men (8.76%) and 14 women (6.45%), and the group of patients with type 2 diabetes was represented by 82 men (37.79%) and 102 women (47.00%) (Figure 2).

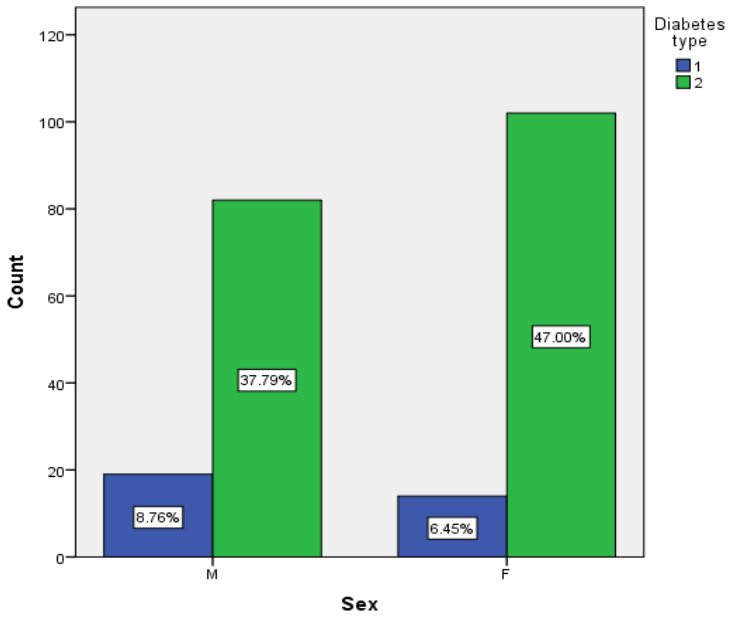

Figure 2: Graphic representation of patients according to type of diabetes and sex

(F = female, M = male)

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Most of patients were from the urban environment, their share being 60.37% (131 patients) of which 22 (10.14%) with type 1 diabetes and 109 (50.23%) with type 2 diabetes. 39.63% (86 patients) came from rural areas, of which 11 (5.07%) patients with type 1 diabetes and 75 (34.56%) patients with type 2 diabetes (Figure 3).

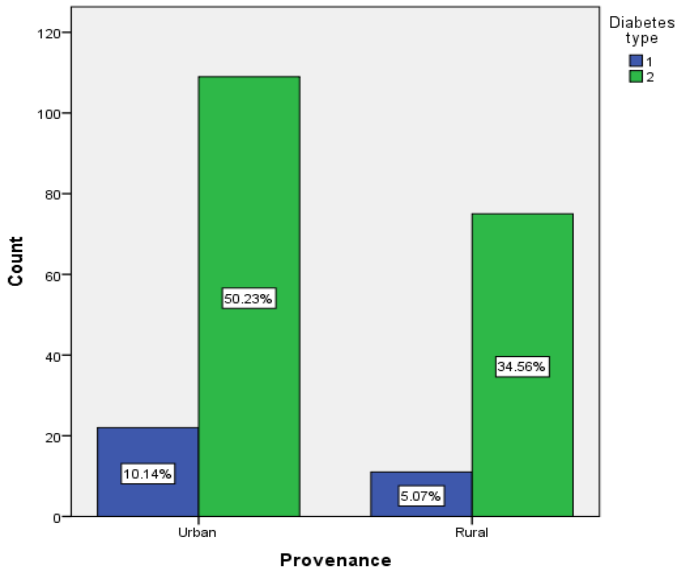

Figure 3 Graphic representation of patients by function of the type of diabetes and the environment of origin

Table 1 contains the analytical data obtained from the analyzes performed on blood samples collected from patients with diabetes mellitus type 1 and 2. From the analysis of the data entered in table 1, high values above the allowed limits for blood glucose (< 100 mg/dL), glycosylated hemoglobin (< 7%), triglycerides (men: 40-140 mg/dL; women: 35-140 mg/dL), in both women and men. The exception is total cholesterol, the values found being lower than 200 mg/dL.

Table 1 Clinical and paraclinical characteristics of the study group

	Sex	N	Mean	Std. Deviation	Std. Error Mean
Age of diabetes	M	101	9.693	9.0849	0.9040
	F	116	9.353	8.1029	0.7523
Blood sugar	M	101	299.149	131.3151	13.0663
	F	116	301.224	146.5917	13.6107
Hb glic	M	101	8.908	2.5474	0.2535
	F	116	8.956	2.3395	0.2172
Cholesterol	M	101	191.277	95.2118	9.4739
	F	116	193.957	49.1212	4.5608
TG	M	101	254.089	435.5010	43.3340
	F	116	192.043	109.3464	10.1526

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According to the data entered in tables 2 and 3, after performing the correlation tests for nominal type values (ϕ, C and V), it turned out that there is no correlation between gender and the type of diabetes, nor between the environment of origin and the type of diabetes ($p > 0.05$).

Table 2: Statistical correlation between the type of diabetes and sex of patients

Provenance * Diabetes type Crosstabulation

Count

		Diabetes type		
		1	2	Total
Provenance	Urban	22	109	131
	Rural	11	75	86
Total		33	184	217

Table 3 Statistical correlation between the type of diabetes and the environment of origin

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.055	.422
	Cramer's V	.055	.422
	Contingency Coefficient	.054	.422
N of Valid Cases		217	

After performing the Pearson correlation test, using a significance threshold $\alpha = 0.05$, we obtained that glycemic Hb and TG are correlated ($p < 0.001$), but the correlation is at a low level ($r = 0.295$) (Table 4).

Table 4: Correlation between glycosylated hemoglobin value and triglyceride value

Correlations

		Hb glyc	TG
Hb glic	Pearson Correlation	1	0.295**
	Sig. (2-tailed)		0.000
	N	217	217
TG	Pearson Correlation	0.295**	1
	Sig. (2-tailed)	0.000	
	N	217	217

**. Correlation is significant at the 0.01 level (2-tailed).

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In the case of patients with type 1 diabetes, we found that BMI (Body Mass Index) is not correlated with triglyceride (TG) ($r = 0.091$, $p = 0.614 > 0.05$), neither with Hb glyc ($r = 0.131$, $p = 0.648 > 0.05$) (tabelul 5).

Table 5: Correlation between body mass index and glycated hemoglobin, respectively the value of triglycerides, at patients with diabetes type 1.

		TG	Hb glic
BMI	Pearson Correlation	0.091	0.131
	Sig. (2-tailed)	0.614	0.468
	N	33	33

For patients with type 2 diabetes, it turns out that BMI is not correlated with TG ($r = 0.095$, $p = 0.198 > 0.05$), nor with Hb glyc ($r = 0.008$, $p = 0.914 > 0.05$) (table 6).

Table 6: Correlation between BMI and glycated hemoglobin, respectively the value of triglycerides, in patients with diabetes type 2

		TG	Hb glyc
BMI	Pearson Correlation	0.095	0.008
	Sig. (2-tailed)	0.198	0.914
	N	184	184

DISCUSSIONS

The global prevalence of DM is continuously increasing. In some countries such as China and India, which are now adopting the west lifestyle, the prevalence has increased to 10% of the population.
In 2017, it was estimated that ~60 million adults in Europe had type 2 DM, half of whom were undiagnosed. These figures have led to the prediction that by 2045, globally, more than 600 million individuals will develop DM type 2, with a similar number of persons developing prediabetes. (1)
Considering that the effects of DM on the cardiovascular health of the individual create difficulties in public health, the authorities are trying to address it globally by implementing health programs.
In our study, it was found that women were more numerous both in the group of patients with type 1 diabetes and in the group of patients with type 2 diabetes.
According to two studies published in 2018, when women are diagnosed with DM, they are no longer protected against early cardiovascular disease, as observed in the general population. (3,4)
A 1% decrease in glycosylated hemoglobin in patients diagnosed with DM type 2 is associated with a 15% decrease in the relative risk of non-fatal MI, but without beneficial effects on cerebrovascular events, cardiovascular events, mortality or hospitalizations for heart failure, as it was noticed by a meta-analysis of three major studies: Action to Control Cardiovascular Risk in Diabetes (ACCORD), Action in Diabetes and Vascular Disease: Preterax and Diamicron Modified Release Controlled Evaluation (ADVANCE) and the Veterans Affairs Diabetes Trial (VADT). On the other hand, for patients without CVD, diagnosed with DM of short duration, in whom the basic values of glycosylated hemoglobin are lower, intensive glycemic control brought benefits regarding CV events. (5,6). Glycosylated hemoglobin and mean blood glucose in patients diagnosed with DM are more strongly associated with cardiovascular risk factors than basal blood glucose, continuous glucose monitoring being used in the determination of postprandial blood glucose and determinations of glycemic variability. (7)

Although in the studied group no correlation was found between the BMI (body mass index) and the value of triglycerides, to improve glycemic control and the lipid profile in obese patients with DM, a weight loss of more than 5% is necessary (8).
The mechanisms by which triglycerides increase in patients with diabetes are based on peripheral resistance to insulin, which causes the release of free fatty acids from the muscle level into the blood. These will reach at the liver and cause excess synthesis of very low density lipoproteins (VLDL cholesterol) containing an increased amount of triglycerides (TG). Insulin resistance will also decrease the activity of lipoprotein lipase, which would normally lyse triglycerides in the periphery, causing hypertriglyceridemia. At the same time, the formation of high-density lipoproteins (HDL) is achieved only after the decrease of TG from VLDL, which is the reason why, in diabetic patients, low values of HDL cholesterol are found (9).
The high values for triglycerides, found by us in patients with diabetes, indicate that they may constitute an important risk factor for the occurrence of heart diseases.
Atherosclerosis in the diabetic patient is based on lipoproteins in the form of small and dense particles with an increased capacity for subendothelial penetration and production of atheroma plaque.

CONCLUSIONS

In the studied group, it was found that more patients with diabetes were female and from urban areas, both in the group with type 1 diabetes and in the group with type 2 diabetes, without any statistical correlation between these values. No statistical correlation was found between the value of the body mass index (BMI) and glycosylated hemoglobin, respectively the value of triglycerides, but a correlation was observed, even if it was at a low level, between the value of glycosylated hemoglobin and triglycerides, underlining the importance of a permanent glycemic control and hyperglycemia in the prevention of atherosclerosis.

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