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ASSOCIATION OF TRIGLYCERIDE / HIGH-DENSITY LIPOPROTEIN RATIO (TG/HDL RATIO) TO SPECIFIC RISK FACTORS OF DIABETES AND PREDIABETES

Nasution Melati Silvanni [*1], Pase Muhammad Aron [1] Nasution Ali Nafiah [2]

[1]*Division of Endocrine, Metabolic and Diabetes, Department of Internal Medicine, Faculty of Medicine, Universitas Sumatera Utara, Medan, Indonesia*
[2]*Department of Cardiology and Vascular Medicine, Faculty of Medicine, Universitas Sumatera Utara, Medan, Indonesia*

[*]Corresponding Author: melatisilvanni@usu.ac.id

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ABSTRACT

Background: Patients with prediabetes and diabetes have several risk factors, one of which is dyslipidemia. The TG/HDL ratio was found to be positively correlated with insulin resistance and PKV. This study was conducted to find out whether there is a relationship between the TG/HDL ratio and PKV risk factors in prediabetes and diabetes.
Methods. The cross-sectional analytical study was conducted in July-December 2023. The research sample is prediabetes and diabetic patients who meet the admission criteria of the research subjects. They are tested for BMI, Fasting blood sugar, 2-hour post-prandial blood sugar, HbA1C, and lipid profiles. Data analysis using paired t-test and Pearson correlation.
Results. In this study, 12 (30%) women and 28 (70%) men were found. In the prediabetes and diabetes groups, all parameters were almost the same except that fasting blood sugar and post-prandial 2-hour blood sugar differed significantly ($p<0.001$). There was a significant correlation between the TG/HDL ratio and fasting blood sugar levels, and post-prandial 2-hour blood sugar in the prediabetes and total cholesterol groups, HDL cholesterol, LDL cholesterol, and TG in the diabetes group ($p<0.05$).
Conclusion. In the prediabetes and diabetes groups, all parameters were almost the same except for FG and 2-h PPG. There was a significant correlation between the TG/HDL ratio and FG and 2-h PPG in the prediabetes group, and TC, HDL-C, LDL-C, and TG in the diabetes group.

Keyword: Prediabetes, diabetes, TG/HDL ratio, CVD risk factors

ABSTRAK

Latar belakang *Pasien dengan pradiabetes dan diabetes memiliki beberapa faktor risiko, salah satunya adalah dislipidemia. Rasio TG/HDL ditemukan berhubungan positif dengan resistensi insulin dan PKV. Penelitian ini dilakukan untuk mengetahui apakah ada hubungan antara rasio TG/HDL dengan faktor risiko PKV pada pradiabetes dan diabetes.*
Metode*. Studi analitik potong lintang ini dilakukan pada bulan Juli-Desember 2023. Sampel penelitian adalah pasien pradiabetes dan diabetes yang memenuhi kriteria penerimaan subjek penelitian. Mereka diuji untuk IMT, Gula darah puasa, gula darah 2 jam post prandial, HbA1C, dan profil lipid. Analisis data menggunakan uji-t berpasangan dan korelasi Pearson.*
Hasil*. Dalam penelitian ini, ditemukan perempuan 12 (30%) dan laki-laki 28 (70%). Pada kelompok pradiabetes dan diabetes, semua parameter hampir sama kecuali Gula darah puasa dan gula darah 2 jam post prandial berbeda secara signifikan (p<0,001). Terdapat korelasi yang signifikan antara rasio TG/HDL dengan kadar gula darah puasa, dan gula darah 2 jam post prandial pada*

kelompok pradiabetes dan kolesterol total , kolesterol HDL, kolesterol LDL, dan TG pada kelompok diabetes (p<0,05).
Kesimpulan. *Pada kelompok pradiabetes dan diabetes semua parameter hampir sama kecuali gula darah puasa dan 2 jam postprandial. Ada korelasi yang signifikan antara rasio TG/HDL dan kadar gula darah 2 jam post prandial dan HDL pada kelompok pradiabetes, dan kolesterol total, kolesterol HDL, kolesterol LDL, dan TG pada kelompok diabetes.*

Keyword: *Pradiabetes, diabetes, rasio TG/HDL, faktor risiko CVD*

1. Introduction

Diabetes mellitus (DM) is a disease caused by inadequate control of blood glucose levels. DM has many subclassifications, including type 1, type 2, maturity-onset diabetes of the young (MODY), gestational diabetes, neonatal diabetes, and steroid-induced diabetes [1]. Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia due to defects in insulin secretion, insulin action, or both. The chronic hyperglycemia of diabetes is associated with long-term damage, dysfunction, and failure of various organs, especially the eyes, kidneys, nerves, heart, and blood vessels [2]. Type 2 diabetes is an important cause of death worldwide, especially related to cardiovascular disease [3].

Prediabetes is a precursor to the diagnosis of diabetes mellitus. Adults with prediabetes may often show no signs or symptoms of diabetes but will have higher-than-normal blood sugar levels. Normal blood glucose levels are between 70 mg/dL to 99 mg/dL. In patients with prediabetes, blood glucose levels are elevated between 110 mg/dL - 125 mg/dL. Because it often shows no signs and symptoms, many people do not realize that they have prediabetes [4,5].

In addition to type 2 diabetes mellitus, prediabetes is a risk factor for the development of cardiovascular disease, and stroke. Once diagnosed with prediabetes, patients should be checked for progression to type 2 diabetes every one to two years. Several risk factors can play a role in the occurrence of prediabetes and diabetes. One of them is dyslipidemia with HDL cholesterol levels of less than 40 mg/dL (for men) and less than 50 mg/dL (for women) or triglyceride levels of more than 250 mg/dL [1-5].

Dyslipidemia is defined by elevated triglycerides (TG), increased low-density lipoprotein (LDL), and decreased high-density lipoprotein cholesterol (HDL-C) levels. Among these lipid profile parameters, previous observational studies have shown that the ratio of TG to HDL-C (TG/HDL-C) is positively associated with insulin resistance and cardiovascular disease. Although homeostasis model assessment of insulin resistance (HOMA-IR) may play an important role, it is not routinely evaluated in general clinical practice. Therefore, the TG/HDL-C ratio has become a surrogate marker for insulin resistance. It is an easy and economical measurement to perform in a clinical setting [6,7,8]. This study was conducted to determine whether there is a relationship between the TG/HDL ratio and the incidence of prediabetes and diabetes.

2. Methods

The diagnosis of Prediabetes and Diabetes was pre-determined by examination of fasting blood glucose, post-prandial blood glucose, and HbA1c. All patients underwent screening, including medication history and physical examination. Patients were assessed for age, height, weight, and BMI. After taking a history of previous illnesses and medications, each patient underwent lipid profile screening in the laboratory. Descriptive data presentation will be presented in textual and tabular form to see the basic characteristics of research subjects and research variables. Numerical variables will be displayed in the form of mean and use standard deviation if the data distribution is normal, if it is not normal then the median is displayed with the minimum maximum value. Meanwhile, nominal variables will be displayed in the form of numbers and percentages

3. Results

Based on Table 1, the results of the study it was found in the female 12 (30%) and male 28 (70%). In the prediabetes and diabetes groups, all parameters were almost the same except FPG and 2-h PPG were significantly different ($p<0.001$).

Table 1 Characteristics of Research Subjects

Variable		Prediabetes (n = 40) mean±SD	Diabetes (n = 40) mean±SD	**p**
Age	(year)	54 ± 12.2	55.23 ± 8.95	0.163
BMI	(kg/m²)	27.8 ± 3.89	24.53 ± 5.84	0.235
FBG	(mg/dl)	98.7 ± 14.94	151.15 ± 58.99	0.001*
2-H PPG	(mg/dl)	131.7 ± 33.49	219.05 ± 89.54	0.001*
HbA1C	(gr %)	6 ± 0.2	10.93 ± 14.23	0.038
TC	(mg/dl)	169.75 ± 46.08	173.75 ± 57.02	0.134
HDL-C	(mg/dl)	39.33 ± 11.6	38.83 ± 9.37	0.210
LDL-C	(mg/dl)	115.05 ± 42.19	113.54 ± 47.39	0.173
TG	(mg/dl)	130.35 ± 55.68	148.5 ± 67.58	0.125
TG/HDL Ratio	(mg/dl)	3.53 ± 1.61	6.8 ± 13.51	0.020

BMI : Body Mass Index ; FBG : Fasting Blood Glucose ; 2-h PPG : 2 hours postprandial blood glucose ; TC: Total Cholesterol ; TG: triglycerides; HDL-C: high-density lipoprotein Cholesterol; LDL-C: low-density lipoprotein Cholesterol; *p < 0.01 was considered as statistically significant difference

Based on Table 2, there was a correlation significantly between TG/HDL ratio and 2-h PPG and HDL levels in the prediabetes group and TC, HDL-C, LDL-C, and TG in the diabetes group (p<0.05).

Table 2 Correlation of TG/HDL ratio with all risk factors of cardiometabolic in Prediabetes and Diabetes groups

Variable	TG/HDL Ratio			
	Prediabetes		Diabetes	
	r	p	r	p
Age	-0.082	0.615	-0.040	0.807
BMI	-0.010	0.950	0.254	0.114
FBG	-0.160	0.324	0.123	0.450
2-H PPG	-0.154	0.344	-0.035	0.830
HbA1C	1.33	0.414	0.001	1.000
TC	0.278	0.082	0.464	0.003*
HDL-C	-0.464	0.003*	-0.348	0.028*
LDL-C	0.180	0.267	0.376	0.017*
TG	0.782	0.001*	0.853	0.001*

BMI : Body Mass Index ; FBG : Fasting Blood Glucose ; 2-h PPG : 2 hours post prandial blood glucose ; TC: Total Cholesterol ; TG: triglycerides; HDL-C: high-density lipoprotein Cholesterol; LDL-C: low-density lipoprotein Cholesterol; *p < 0.05 was considered as statistically significant difference

4. Discussions

This study was a cross-sectional study in prediabetic and diabetic patients to look at the TG/HDL ratio in each group. Several previous studies have shown that when the TG/HDL ratio increases, free fatty acids in the body will increase, leading to the accumulation of triglycerides and liver LDL. High TG levels are more likely to cause insulin resistance [8,9]. When the TG/HDL ratio is high, too much TG binds to insulin receptors, preventing insulin receptors from functioning properly, reducing insulin sensitivity, causing insulin resistance, and eventually leading to impaired glucose tolerance in prediabetes and the incidence of diabetes [8-11].
Central obesity, insulin resistance, dyslipidemia, and hypertension increase the risk of cardiovascular disease (CVD) and DM. Triglycerides and HDL-C are important risk factors for cardiovascular disease [9,13] From previous studies, although hypertriglyceridemia may be associated with an increased risk of CVD, the association weakens when adjustments are made for other risk factors, especially HDL levels that often accompany elevated plasma triglyceride levels. However, even after adjustment for HDL levels, elevated triglycerides remain a risk factor for CVD [12-14]. Thus, the TG/HDL ratio has been proposed as a more practical and easy-to-use atherogenic marker, making it a good marker for CVD [15-20].

In this study, it was found that there was no relationship between the TG/HDL ratio of prediabetes and diabetes patients even though the values were both increased in both. The results of this study are inconsistent with the study conducted by Gong et al which stated that an increase in the TG/HDL ratio was positively correlated with the risk of prediabetes and diabetes in the Chinese population [8]. This may be due to the previous consumption of drugs that improve lipid function in the samples that were not previously excluded. Likewise, the diet that patients consume every day can affect improving the patient's lipid function.

The TG/HDL ratio in diabetic patients was found to be higher than in prediabetic patients in this study. This study differs from previous studies where the TG/HDL effect value was more significant in younger populations and more significant in populations with BMI 18.5-24, which was the majority of the study, but had a low proportion of diabetes [8] This may be because the prediabetes group had never had lipid screening before, so they had never received therapy or treatment before.

There was a negative association between age, 2-h PPG, and HDL level on TG/HDL ratio in prediabetic and diabetic patients in this study. Patients with diabetes, obesity, or metabolic syndrome due to insulin resistance tend to have low HDL due to lower lipoprotein lipase activity and triglyceride enrichment. CETP exchanges triglycerides and cholesterol between very low-density lipoprotein (VLDL) and HDL. In the presence of high triglyceride levels, the balance will shift to cholesterol reduction and triglyceride enrichment [13]. This also leads to a smaller number of HDL particles with a higher rate of catabolism, which contributes to lower HDL. HDL from diabetic patients is functionally defective due to changes in particle composition [17,19]. The weakness of this study is that it did not examine other factors that may affect the TG/HDL ratio and it seems that other methods of diagnosing prediabetes are needed, such as the Impaired Glucose Tolerance Test or HOMA -IR.

5. Conclusions

In the prediabetes and diabetes groups, all parameters were almost the same except FPG and 2-h PPG. There was a correlation significantly between TG/HDL ratio and 2-h PPG and HDL levels in the prediabetes group, and TC, HDL-C, LDL-C, and TG in the diabetes group. This shows that the TG/HDL ratio can be used as a risk factor for cardiovascular disease.

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