The Assessment Metabolic Markers and Cardio Risk Index Among Controlled and Uncontrolled Type 2 Diabetic Patients in Primary Health Clinics in Medan City, North Sumatera, Indonesia: Cross-sectional Study

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ABSTRACT

Background: Diabetes mellitus is the most common metabolic disorder affecting people worldwide. Diabetes mellitus has been known to be associated with lipid metabolic disorders and macrovascular and microvascular complications. Objective: This study assesses the correlation between cardio risk index and metabolic markers in type 2 diabetes mellitus patients. Methods: This study was conducted on type 2 diabetes mellitus with the cross-sectional analytic method. The inclusion criteria of the samples were all the patients diagnosed with type 2 diabetes mellitus of both sexes. We recorded Body Mass Index, Blood Pressure, disease duration, and family history. The laboratory parameters, including Fasting Blood Sugar, Hba1c, HDL, LDL, TG, and Cholesterol, were examined by Paramita Laboratory Clinic. The data of the samples were processed using a computer with the SPSS program. Results: There were significantly different mean of age, abdominal circumference, FBG, Hba1c, cardio risk index, and HDL controlled and uncontrolled type 2 diabetes groups, but the mean cholesterol and LDL levels were not different in the two groups. At uncontrolled type 2 diabetic we found that there was a significant correlation between the cardio risk index with Cholesterol (r= 0.3 p=0.004), triglycerides (r=0.5 p=0.001), and negative correlation cardio risk index with HDL (r= -0.5 p=0.012). There was no significant correlation between the cardio risk index with LDL (r=0.157 p=0.101). Conclusion: Hba1c and FBS are higher in uncontrolled type 2 diabetes accompanied by lipid profile and cardio risk index levels that are higher than expected values are the risk of complications in type 2 diabetes mellitus.

Keywords: type 2 diabetes mellitus, cardio risk index, blood sugar levels, Hba1c, lipid profile.

1. BACKGROUND

Type 2 Diabetes mellitus is a metabolic disease characterized by hyperglycemia caused by a defect of insulin action, insulin secretion, or both - insulin resistance and dyslipidemia (1, 2). It is also an established marker of endothelial dysfunction and the risk of cardiovascular disease in diabetes, where dyslipidemia is very common among the diabetic population, especially in those with uncontrolled diabetes (3). Research states that hyperlipidemia is associated with elevated blood glucose levels and requires urgent intervention to prevent and treat diabetes in patients with dyslipidemia (4).

Diabetes is associated with a high incidence of dyslipidemia with an elevated low-density lipoprotein, cholesterol, and triglyceride (5). The cardiovascular disease (CVD) risk of DM increases further if associated with dyslipidemia. Dyslipidemia in diabetes is characterized by elevated triglyceride (TG), low levels of high-density lipoprotein cholesterol (HDL-C), and increased prevalence of small dense low-density lipoprotein cholesterol (LDL-C) particles. Serum total cholesterol (TC) and LDL-C have been used as significant laboratory measures in clinical practice to assess cardiovascular risk.

Recent studies, however, have shown that non-high-density lipoprotein cholesterol (non-HDL-C) concentration is similar to or better than LDL-C alone in the prediction of CVD incidence and mortality (6).
The research aims to evaluate and analyze the metabolic and cardio risk index (Ratio LDL/HDL) in controlled and uncontrolled type 2 diabetes mellitus.

2. OBJECTIVE
The aims of the study were: a) to assess the metabolic markers and cardio risk index in uncontrolled and controlled type 2 diabetes mellitus patients; b) to assess the correlation between cardio risk index and metabolic markers among uncontrolled and controlled type 2 diabetes mellitus patients.

3. PATIENTS AND METHODS
Participants
This cross-sectional study was conducted in Medan and Primary Health Care Centers in Binjai and Stabat, North Sumatera, Indonesia, from May to July 2020. Medical data collected included blood pressure, body mass index, disease duration, family history, and medical treatment. Laboratory data included blood glucose, glycated hemoglobin (HbA1c), and lipid profile patients with type 2 diabetes mellitus were recruited. Patients with known diabetics taking oral hypoglycemic agents or managed with diet or using insulin for glycemic control were included in the study.

Procedure and ethical considerations
The Ethical Committee of Universitas Sumatera Utara approved the study protocol. With number 90/KEP/USU/2020. Additionally, the study was conducted after review and written approval by the Administrative and Scientific Society of primary health care clinic in Medan, North Sumatera, Indonesia. The researcher informed each participant about the purpose of the study. Furthermore, all participants were informed of their rights to refuse or to discontinue their participation, according to the ethical standards of the Helsinki Declaration of 1983. Participation in the study was contingent on individual verbal consent.

Measures
Height and weight were measured with the subjects standing in light clothes. Body mass index (BMI) was calculated by dividing weight in kilograms by the square of the height in meters (kg/m2). Blood pressure values were taken as the mean of two measurements after the subjects had been seated for at least five minutes. Subjects fasted overnight to provide a blood specimen. Blood samples were collected (using a syringe) and transferred to Paramitha Clinical Laboratory immediately to be conducted fasting blood sugar, hemoglobin glycosylate, and lipid profiles, including Triglyceride, High-Density Lipoprotein (HDL), Low-Density Lipoprotein (LDL), Cholesterol, Total, and cardio risk index. The examination of blood sugar levels was done by using hexokinase methods, hemoglobin glycosylate using HPLC methods, cholesterol using CHOD PAP, Triglycerides using GPO PAP, HDL using direct CHOD PAP, and LDL cholesterol using direct CHOD PAP.

Statistical analysis
SPSS version 24.0 (SPSS Inc., Chicago, Illinois) We used statistical software for statistical analysis. All the variables in this sample of the study were tested using Shapiro–Wilk; the standard distribution variables (p > 0.005) were tested by a parametric correlation test, but the abnormal distribution variables (p < 0.005) were tested by a non-parametric test.

4. RESULTS
Demographic and Clinical Characteristics
Total patients were 131; 57 (43.2%) had controlled type 2 diabetic (males,20) (female 37) (age range, 35 – 79 years), uncontrolled type 2 diabetic patients were 74 (male 23) (female 51) (age range, 37-79). There is a significantly different age between the two groups (p<0.005). The Mean Body Mass Index (BMI), blood pressure, and duration of illness of the patients with controlled and uncontrolled diabetes were not significantly different between the two groups (p>0.005). Still, there was a significant difference in abdominal circumference (p<0.005) (Table 1). Regarding metabolic parameters, mean fasting blood glucose (controlled group, 131.56 mg/dL vs uncontrolled group, 336.4 mg/dL), HbA1c (controlled group 6.86 %vs uncontrolled group 10.44%), triglyceride (controlled group 187.82 mg/dL) vs uncontrolled groups 264.04 mg/dL), cardio risk index (Ratio LDL/HDL) (controlled group 3.63) vs (uncontrolled groups 4.74), HDL (controlled group 49.04 mg/dL) vs (uncontrolled group 45.03 mg/dL), Cholesterol (controlled group 204.95 mg/dL) vs (uncontrolled group 219.50 mg/dL), LDL (controlled group 128.26 mg/dL) vs (uncontrolled group 126.28 mg/dL) there was a significantly different between two groups of the mean of FBG, HbA1c, triglycerides, HDL and cardio risk index at controlled and uncontrolled type 2 diabetic. The mean cholesterol and LDL levels were not different in the two groups. (Table 2). Table 3 showed that the Pearson and Spearman correlation. There was a significant correlation at a controlled type 2 diabetic between cardio risk index with cholesterol (r=0.5 p=0.000) and cardio risk index with HDL, (r=0.3, p=0.012), cardio risk index with LDL (r=0.4 p=0.181) and cardio risk index with Triglyceride (r=0.4 p=0.001). At uncontrolled type 2 diabetic we found that there was a significant correla-

| Variable                              | Controlled diabetic | Uncontrolled diabetic | p value |
|---------------------------------------|---------------------|-----------------------|---------|
| Age (years)                           | 57                  | 74                    |         |
| BMI (kg/m²)                           | 121                 | 216                   | 0.002   |
| Abdominal circumference (cm)          | 133                 | 216                   | 0.002   |
| Systole (mmHg)                        | 100                 | 209                   | 0.002   |
| Diastole (mmHg)                       | 65                  | 111                   | 0.002   |
| Duration of illness (years)           | 1                   | 3                     | 0.002   |

Table 1. Characteristic of the samples (n=131 samples of diabetic patients)
5. DISCUSSION

This study compared different parameters of type 2 controlled and uncontrolled diabetic patients and evaluated the correlation between cardio risk index and metabolic parameters. We found a significant difference in Fasting Blood Sugar levels, Hba1c, TG level, cardio risk index among/ between two groups, and HDL in controlled type 2 diabetes mellitus. Still, there was no significant difference in cholesterol and lipoprotein levels in both groups. The Research showed that blood glucose levels and lipid profile parameters (except HDL) were significantly increased in uncontrolled diabetics and moderately controlled diabetics compared to controlled diabetics (6). The resulting Research reported a significant correlation between HbA1c and various circulating lipid parameters and a significant difference in lipid parameters in controlled and uncontrolled type 2 diabetes based on glycated hemoglobin (≤7.0% and >7.0%) (7). The other Research reported that diabetic patients with poor glycemic control exhibited a significant increase in cholesterol and TG and a decrease in HDL without any significant alteration in LDL and the findings of this study show that Hba1c is not only a reliable biomarker of glycemic control and a good predictor of serum lipid profile in diabetic patients (8). Our results showed a significant correlation between the two groups’ cardio risk index with cholesterol, HDL, and TG levels. As we know that the high atherogenicity associated with diabetic dyslipidemia is probably related to the characteristic finding of low plasma concentrations of HDL-C, elevated levels of apolipoprotein B, and elevated TG levels (9, 10). Dyslipidemia is an established risk factor for cardiovascular disease in patients with type II DM and nondiabetic patients. It is likely to play a leading role in the increased CVD risk associated with diabetes (11, 13, 14). Dyslipidemia associated with type II DM is typically more complex than the simple elevation of systemic low-density lipoprotein cholesterol (LDL-C). The LDL-C levels seen in diabetic populations may not be significantly different from those seen in nondiabetic populations. There was no significant correlation between the cardio risk index and LDL levels in the two groups. The glycated Hb was associated with diabetic dyslipidemia is probably related to the characteristic finding of low plasma concentrations of HDL-C, elevated levels of apolipoprotein B, and elevated TG levels (9, 10). Dyslipidemia is an established risk factor for cardiovascular disease in patients with type II DM and nondiabetic patients. It is likely to play a leading role in the increased CVD risk associated with diabetes (11, 13, 14). Dyslipidemia associated with type II DM is typically more complex than the simple elevation of systemic low-density lipoprotein cholesterol (LDL-C). The LDL-C levels seen in diabetic populations may not be significantly different from those seen in nondiabetic populations. There was no significant correlation between the cardio risk index and LDL levels in the two groups. The glycated Hb was associated with diabetic dyslipidemia is probably related to the characteristic finding of low plasma concentrations of HDL-C, elevated levels of apolipoprotein B, and elevated TG levels (9, 10).

Table 2. Metabolic parameters of patients with 131 type 2 diabetic patients

| Parameters | Controlled Type 2 DM | Uncontrolled type 2 DM | Correlation Coefficient | P value | Correlation Coefficient | P value |
|------------|----------------------|------------------------|-------------------------|---------|-------------------------|---------|
| Cholesterol | R=0.5                | P=0.00                 | R=0.3                   | p=0.004 | R=0.01                  | P=0.001 |
| Triglycerides | R=0.4                | P=0.001                | R=0.5                   | P=0.001 | R=0.012                 | P=0.000 |
| HDL         | R=0.3                | P=0.157                | R=0.157                 | P=0.101 | R=0.181                 | P=0.101 |

Table 3. Correlation between cardio risk index with other variables

- Correlation between the cardio risk index with Cholesterol (r = 0.3 p=0.004), cardio risk index with HDL, (r = -0.5 p=0.012) and cardio risk index with Triglyceride (r = 0.5 p=0.001). There was no significant correlation between the cardio risk index with LDL (r=0.157 P=0.101). We found that in the controlled type 2 diabetic at controlled type 2 diabetic groups we found that We found the higher the cardio risk index (r=0.5), the higher the HDL, the lower the cardio risk index, and otherwise (r=-0.3). We found the strength of the correlation between the ratio and LDL to be moderate (r = 0.4), that the higher the LDL, the higher the cardio risk index (r=0.4), the higher the triglyceride, the higher the cardio risk index (r=0.4).
- In the uncontrolled group, there was a strong correlation between the cardio risk index and low cholesterol (r=0.3); the higher the cardio risk index, the higher the HDL, the lower the cardio risk index, and vice versa (r=-0.5), the higher the triglyceride, the higher the cardio risk index (r=0.5)
mellitus self-management practices, and this is an essential part of the management of uncontrolled type 2 diabetes mellitus (T2DM) (20, 21). Other researchers also indicated that HbA1c could be a valuable biomarker of long-term glycemic control and a good predictor of lipid profile (21). Another researcher stated that in terms of age, Middle-aged and elderly adults with hypertriglyceridemia, hypercholesterolemia, and low HDL-C were at higher risk for developing diabetes. Non-HDL-C, TG, TC/HDL, and TG/HDL have more excellent performance than other lipid parameters in predicting T2DM incidence (22). And the other Research mentioned that the reliable glycemic index HbA1c using as a predictor of dyslipidemia so early diagnosis of dyslipidemia can be used as a preventive measure for the development of CVD in patients with T2DM (23).

6. CONCLUSION

HbA1c and FBS are higher in uncontrolled type 2 diabetes accompanied by lipid profile and cardio risk index levels that are higher than normal values are the risk of complications in type 2 diabetes mellitus.

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