

Total cholesterol and HDL cholesterol as risk factor of prediabetes and diabetes in Palembang city

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Abstract

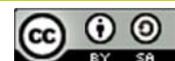
This study aimed to determine the incidence of prediabetes and diabetes with total cholesterol and HDL as a risk factor for the incidence of prediabetes and diabetes in Palembang. The study design used a cross sectional approach. The number of samples is 329 respondents. Data collection was carried out by home visits and biomedical measurements of blood sugar and total cholesterol. Data were analyzed using chi-square. The results showed that the incidence of prediabetes was 19.8% and the incidence of diabetes was 14%. There was a significant relationship between total cholesterol and the incidence of prediabetes (p value=0.003) and diabetes (0.137).

Keywords: total cholesterol; prediabetes; diabetes

Abstrak

Penelitian ini bertujuan untuk menentukan kejadian pradiabetes dan diabetes dengan kolesterol total dan HDL sebagai faktor risiko untuk kejadian pradiabetes dan diabetes di Palembang. Desain penelitian menggunakan pendekatan *cross sectional*. Jumlah sampel sebanyak 329 responden. Pengumpulan data dilakukan dengan kunjungan rumah dan pengukuran biomedis gula darah dan kolesterol total. Data dianalisis menggunakan *chi-square*. Hasil penelitian menunjukkan bahwa kejadian pradiabetes 19,8% dan kejadian diabetes 14%. Ada hubungan yang signifikan antara kolesterol total dan kejadian pradiabetes (nilai $p=0,003$) dan diabetes (0,137).

Kata kunci: kolesterol total; pradiabetes; diabetes



INTRODUCTION

International Diabetes Federation (IDF) estimate that the diabetes will continue to increase. The increasing prevalence of diabetes poses a threat to public health. According to IDF in 2017 there are 425 million adults suffering from DM worldwide and are expected to increase to 693 million in 2045. Indonesia ranks sixth with the largest number of diabetes in the world. The prevalence of diabetes in Indonesia is 5.95% and the highest prevalence is in the age range 40 to 79 years (IDF, 2017). Palembang city itself based on data from the Health Office of 2017, the prevalence of type 2 DM increases every year (Dinas Kesehatan Kota Palembang, 2017). In 2014 the prevalence of type 2 DM is 0.8%, in 2015 1.5%, in 2016 2.7% and in 2017 the prevalence of type 2 DM increases almost twice from 2016 is 4.5%. The increasing prevalence of DM in Palembang further reinforces that DM is a public health problem that should be prevented as early as possible.

Prediabetes is a condition of abnormal blood glucose levels, but has not met the diagnostic criteria for diabetes mellitus (Tabak et al., 2012). These conditions include impaired fasting blood glucose (GDPT) and impaired glucose tolerance (TGT). In 2017, IDF managed to record prediabetes in Indonesia, and found 27.7 million people with prediabetes. The results of the National Basic Health Research (Riskesdas) in 2013 also showed a high prevalence of prediabetes and found prediabetes prevalence in Indonesia of 36.6% (GDPT) and 29.9% (TGT) (Kementrian Kesehatan RI, 2013). Meanwhile, in Palembang, the incidence of prediabetes is not known yet.

Several studies have shown that people with diabetes or prediabetes have higher total cholesterol values when compared to individuals with normal glucose tolerance (Zheng et al., 2012). There is abnormal lipid profile metabolism in prediabetes and diabetes, so it can trigger the occurrence of dyslipidemia. Dyslipidemia is a lipid metabolic disorder characterized by increased or decreased lipid fraction in the blood. The major lipid fraction abnormalities are elevated total cholesterol, triglyceride, low density lipoprotein (LDL), and decreased levels of High Density Lipoprotein (HDL) (Olsson et al., 2005).

Total cholesterol and elevated LDL levels can be an early predictor of pancreatic β cell dysfunction (Zarmal et al., 2016). Increased LDL conditions and decreased HDL levels may inhibit insulin secretion (Zheng et al, 2012). Research results Kawamoto et al (2011) also showed that elevated triglycerides may interfere with insulin secretion. This dyslipidemia can disrupt cholesterol homeostasis. Cholesterol homeostasis affects the function of pancreatic β -cell insulin secretion. Excessive accumulation of cholesterol in β cells can lead to lipo- toxicity inducing hyperglycemia, reducing insulin secretion resulting in pancreatic β cell function (Zheng et al, 2012). Pancreatic β cell dysfunction caused by dyslipidemia may lead to type 2 diabetes and is an independent risk factor for the onset of type 2 diabetes (PERKENI, 2015). Prediabetes and diabetes are complex conditions, with the essence of pancreatic β cell dysfunction.

Prediabetes is a "golden period" in preventing diabetes (Liberty & Kodim, 2017). According to the American Diabetes Association (ADA, 2018), more than 70% of people with prediabetes will develop into diabetes. Prediabetes can increase the absolute risk to DM by 2 to 10 times (Setiawan, 2011). In Palembang City, the incidence of prediabetes is not known yet, based on data from the Health Office of Palembang, the achievement of DM type2 service is only 36% (not achieved). Meanwhile, the incidence of DM type2 is

increasing. This ensures that early prevention measures and programs of DM are necessary through the treatment of prediabetes. Early identification and management of prediabetes patients should be done by knowing the risk factors for prediabetes.

Research on prediabetes and diabetes has been widely practiced, but based on literature search in Indonesia there have been no studies specifically looking at lipid profiles as a risk factor for prediabetes and diabetes. Whereas the occurrence of dyslipidemia which is the impact of lipid profile abnormality can increase the incidence of DM. Prediabetes can increase the risk of absolute into DM, by knowing lipid profile as a risk factor of prediabetes hence can be done program of early prevention so that decrease incident DM.

RESEARCH METHODS

This research used analytic observational method with cross sectional research design. The population in this study were ≥ 40 years old population living in Palembang city. The way of sampling is by proportional random sampling. The number of samples is 329 respondent. The inclusion criteria were the aged ≥ 40 years, live in Palembang. The exclusion criteria were suffering from type 1 DM, while pregnant (gestational DM), and suffering from thyroid disorders.

The samples were 329 people taken randomly from each subdistrict in Palembang. The independent variable is total cholesterol and the dependent variable is blood sugar at the time. Total cholesterol is categorized as abnormal if total cholesterol levels > 200 mg / dL and categorized as normal if ≤ 200 mg/dL. Blood glucose is categorized as normal (< 140 mg/dL), prediabetes (140-199) and diabetes (≥ 200 mg/dL). The study was conducted by field surveyor that are 16 health analyst and the sampling method was using home visit. Each respondent will be visited to his house then performed a medical examination in the form of postprandial blood sugar examination and total cholesterol.

After data collected, univariate and bivariate data analysis was performed and continued with multinomial regression to see the risk of each prediabetes and diabetes group. Univariate analysis was used to see the incidence of prediabetes and diabetes and bivariate analysis was used to determine the association of total cholesterol with the incidence of prediabetes and diabetes. Bivariate analysis was done by chi-square test.

RESULTS AND DISCUSSION

Table 1. Distribution of prediabetes and diabetes occurrences in Palembang City

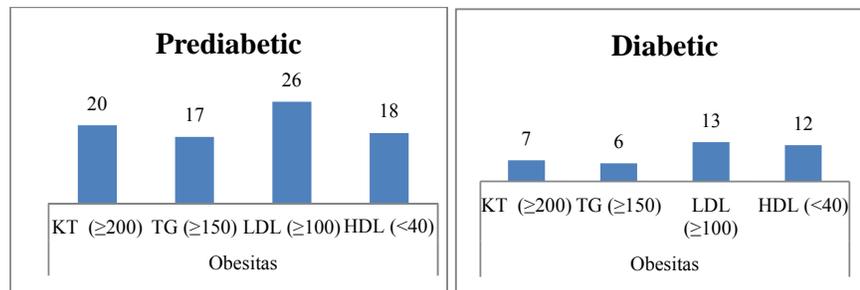
Blood Glucose Level	N	%
Diabetes	46	14
Prediabetes	65	19.8
Normal	218	66.3
Total	329	100

Based on table 1, the distribution of the incidence of prediabetes in Palembang at the highest normal blood sugar level was 218 (66.3%).

Table 2. Characteristic of sample

Characteristic	N	%
Age		
Elderly	109	33.1
Pre Elderly	220	66.9
Total	329	100
Gender		
Female	209	63.5
Male	120	36.5
Total	329	100
Body Mass Index		
Obesity	104	31.6
Normal	225	68.4
Total	329	100

Based on table 2, the sample characteristics of the pre-elderly age were more than 220 (66.9%) compared to the elderly with 109 (33.1%). Gender characteristics in female were more than 209 (63.5%) compared to male with 120 (36.5%). The characteristics of a normal body mass index were 225 (68.4%) compared to obesity of 104 (31.6%).

**Figure 1.** Lipid profile on obesity

Obesity is a group of respondents who have a BMI ≥ 25 kg/m² and more than 25 kg/m² while not obese is a group of respondents who have a BMI less than 25 kg/m². Figure 1 illustrates the differences in lipid profiles in diabetes and prediabetes based on the obesity group while Figure 1 illustrates the differences in the lipid profile of diabetes and prediabetes based on the non-obese group. It was concluded that both in the obesity group and not obesity, dyslipidemia was more common in prediabetes than diabetes.

The result of bivariate analysis with chi-square test showed that there was a significant correlation between total cholesterol with the incidence of prediabetes and diabetes. Table 3 shows that the association of lipid profiles as risk factors for prediabetes and diabetes.

Table 3. Relationship of total cholesterol with the incidence of prediabetes and diabetes

Variable	Blood Glucose Level (%)			N	PR (95% CI)	
	Diabetes	Pre DM	Normal		Prediabetes	Diabetes
Total Cholesterol					<i>p-values</i> (0.003)	<i>p-values</i> (0.137)
Abnormal	15.5	25.1	59.4	187	2.52	1.64

Variable	Blood Glucose Level (%)			N	PR (95% CI)	
	Diabetes	Pre DM	Normal		Prediabetes	Diabetes
Normal	12.0	12.7	75.4	142	(1.36-4.61)	(0.85-3.16)

The incidence of prediabetes and diabetes was more prevalent in the group of respondents with abnormal total cholesterol. Based on the results of statistical tests on alpha 5% obtained P-value 0.006 which means there is a significant relationship between total cholesterol with the incidence of prediabetes and diabetes.

Table 4. Multinomial regression analysis

Blood Glucose Level		Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
				Lower Bound	Upper Bound
Diabetes	TotalCholesterol	0.001	3.514	1.716	7.195
	HDL	0.095	1.781	0.905	3.505
Prediabetes	TotalCholesterol	0.004	3.066	1.438	6.535
	HDL	0.004	3.373	1.486	7.656

Based on the results of multinomial regression analysis (table 3), it was found that respondents with abnormal total cholesterol level higher risk of having prediabetes than diabetes. Respondents with abnormal total cholesterol levels were at risk 2.52 times (95% CI 1.36-4.61) were higher for prediabetes compared to respondents who had normal total cholesterol levels. Respondents with abnormal total cholesterol levels were at risk 1.64 times (95% CI 0.85-3.16) for diabetes than respondents who had normal total cholesterol levels.

Table 4 shown the risk factor of prediabetes and diabetes. Based on multinomial analysis (table 4) the risk factors of prediabetes are total cholesterol and HDL but for diabetes only total cholesterol as a risk factor. The results of this study are same with the study of Zheng et al (2012) which shows that people with diabetes or prediabetes have higher total cholesterol when compared to individuals with normal glucose tolerance (Zheng et al., 2012). According to Zarmal et al. (2016) increased total cholesterol levels can be an early predictor of pancreatic β cell dysfunction. Abnormalities in these lipids indicate dyslipidemia that can disrupt cholesterol homeostasis. Cholesterol homeostasis affects the function of pancreatic β -cell insulin secretion. Excessive accumulation of cholesterol in β cells can lead to lipotoxicity inducing hyperglycemia, reducing insulin secretion resulting in pancreatic β cell function (Zheng et al, 2012). Pancreatic β cell dysfunction caused by dyslipidemia may lead to type 2 diabetes and is an independent risk factor for the onset of type 2 diabetes (PERKENI, 2015). Prediabetes and diabetes are complex conditions, with the essence of pancreatic β cell dysfunction.

Prediabetes is a risk factor for diabetes and microvascular or macrovascular disorders, including obesity, elevated triglyceride levels, low levels of high-density lipoprotein (HDL), and hypertension (Tabak et al., 2012). Research on Kansal and Kambel (2016) found that total cholesterol, low density lipoprotein (LDL), triglycerides (TG), TG/HDL and LDL/HDL ratios increased significantly in prediabetes individuals compared with normal glucose tolerance, whereas high density lipoprotein HDL) was significantly lower in prediabetes individuals compared with normal glucose tolerance.

CONCLUSION

The incidence of prediabetes is higher than diabetes in Palembang City. There is a significant relationship between total cholesterol and the incidence of prediabetes and diabetes in Palembang City. A person with abnormal total cholesterol levels is at higher risk for prediabetes than diabetes.

SUGGESTION

The increasing of total cholesterol levels can be an early predictor of pancreatic β cell dysfunction. Prediabetes can increase the absolute risk to diabetes. By knowing lipid profile as risk factor of prediabetes, early prevention program can be conducted to decrease the diabetes incidence.

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