Correlation of Body Mass Index (BMI) and Blood Pressure Level with LDL/HDL Ratio in Javanese Type 2 Diabetes Mellitus Patients

Verien Nafadilah WT[1], Setyoko Setyoko[2], Yanuarita Tursinawati[3], Arum Kartikadewi[4*]

[1,2,3,4]Universitas Muhammadiyah Semarang, Semarang, Central Java 50273 Indonesia
arum_kartikadewi@gmail.com

Abstract. Type 2 Diabetes Mellitus (T2DM) is a metabolic syndrome disease that could lead to coronary heart disease (CHD). The pathogenesis related to dyslipidemia. The LDL/HDL ratio could be classified as a risk indicator. Many factors can affect this ratio, including body mass index (BMI) and blood pressure (BP). This research aims to prove the correlation between body mass index (BMI) and blood pressure classification with the LDL/HDL ratio in Javanese ethnic T2DM patients. An observational analytic study with a cross-sectional design was done to 107 Javanese T2DM from several health centers in Semarang City. BMI, blood pressure, and LDL/HDL ratio were obtained from the medical records of research by Tursinawati Y, et al. BMI correlation and blood pressure classification were analyzed using the Spearman Correlation test $p < 0.05$ The mean BMI was 24.32 ± 3.31 with the majority being obese (42.1%). The mean systolic blood pressure was 138.42 ± 19.04 mmHg, and diastolic blood pressure was 80.46 ± 8.94 mmHg with the majority having prehypertension (46.7%). The mean LDL/HDL ratio was 3.36 ± 0.75. There was no significant correlation between BMI or blood pressure with LDL/HDL ratio in Javanese T2DM patients with p-value was 0,117 and 0,563 respectively. BMI and blood pressure levels did not contribute to the LDL/HDL ratio of Javanese T2DM patients.

Keywords: Blood Pressure, BMI, LDL / HDL ratio, T2DM

1. Background

Type 2 diabetes mellitus (T2DM) is a metabolic disease characterized by chronic hyperglycemia caused by insulin resistance [1][2]. Indonesia has 8.4 million people with T2DM, and become the fourth country with the most T2DM prevalence in the world [3]. Prevalence of T2DM in 2018 Java Island was 15.4%[3][4]. Javanese are the largest ethnic group in Indonesia with 40.22% population. Javanese ethnic T2DM patients have the T3200C mutation in the 16S rRNA gene and the G3316A mutation in the ND1 gene which

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is associated with the incidence of T2DM (5). Research by Tursinawati Y, et al explained that Javanese ethnic T2DM patients with genotypes 2R / 3R and 3R / 3R CAPN10 SNP19 are more susceptible to DMT2 [6].

T2DM is more susceptible of cardiovascular disease (CVD) risk factors such as CHD. It can be identified by measuring the LDL-/HDL-C ratio. The LDL/HDL ratio (Castelli's Risk Index II) describes abnormalities in the levels of LDL and HDL cholesterol fractions in the blood [7][8]. Increased levels of the LDL/HDL ratio can predict the risk of cardiovascular disease such as CHD(9) and arterial stenosis [10].

Obesity (body mass index (BMI) more than 25 kg/m) and hypertension are additional factors in DM for CHD risk factors [11][12]. Obesity causes the release of adiposal free fatty acids, which can stimulate VLDL secretion in the liver. The higher liver VLDL will increase triglycerides, and LDL, and decrease HDL [7].

The blood pressure level is related to the LDL/HDL ratio. Hypertension causes damage to the arterial endothelium and accumulates the oxidized LDL in the blood vessels walls [3][14]. When occur at the coronary artery causes CHD [15][16]. Hypertension occurs twice higher in T2DM patients and worsens complications of T2DM [16][17].

This study aimed to prove the correlation between body mass index and blood pressure classification with the LDL/HDL ratio in Javanese ethnic T2DM patients.

2. Method

This research was an analytical observational study with a cross-sectional design. BMI, blood pressure classification, and LDL/HDL ratio were obtained from medical records and research data of Dr. Yanuarita Tursinawati, M.Si.Med and dr. Arum Kartikadewi, M.Si.Med at Gunungpati Health Center, Purwoyoso Health Center, and Pandanaran Community Health Center for March 2020. Inclusion criteria were Javanese ethnic T2DM patients with in 2 descendants aged 30-70 years. The patients with CVD (stroke, heart failure, acute myocardial infarction) and pregnant were excluded. The total sample with consecutive sampling technique was 107 sample. Data were analyzed using the Spearman Correlation test.

3. Results and Discussions

The sample characteristics are summarized in Table 1. The correlation between blood pressure, BMI, and the LDL/HDL ratio in T2DM patients was analyzed by the Spearman correlation test with a significant p-value < 0.05 (Table 2).

The subject's ages were on average 58.63 ± 6.91 years old with the youngest 30 years and the oldest was 70 years. Most of the subjects were women (80.4%). The average T2DM Javanese BMI is 24.32 ± 3.31 with 42.1% have obesity. Systolic blood pressure averaged about 138.42 ± 19.04 mmHg and 80.46 ± 8.94 mmHg in diastolic blood pressure with the majority in pre hypertension stage (46. 7%). The averaged LDL/HDLratio level was 3.36 ± 0.75.

The Spearman correlation test between BMI and the LDL/HDL ratio was 0.117 ($p<0.05$). The correlation between blood pressure classification and the LDL/HDL ratio was $p = 0.563$. BMI and blood pressure classification did not correlate with LDL/HDL ratio.

4. Discussion

In this study, there was no significant correlation between BMI and the LDL/HDL ratio. It is in line with Hussain A, et al, their study stated that there was no correlation between BMI and the LDL/HDL ratio in T2DM (18) but Affanti KA, et al stated that there was a significant correlation between BMI and HDL/LDL ratio in the elderly [7]. Other study by Aurora B, et al stated that BMI correlates with the HDL/LDL ratio in adolescents without risk of cardiovascular disease [9].

Obesity (BMI ≥25 kg/m^2) cause insulin resistance because it decrease glucosa absorption into muscles and fat cells result increasing glucose blood level [19]. Obesity, increased insulin levels, and decreased beta cell mass due to insulin resistance in T2DM. This condition cause impaired regulation of lipoproteins. and glucose. The liver will increase TG production because insulin fails to suppress VLDL production. Insulin resistance in adipose cause failure of suppressing intracellular hydrolysis, resulting increased release of nonesterified fatty acids (NEFAs) in the circulation. Increased influx of NEFAs into the liver will stimulate TG synthesis, formation, and secretion of VLDL. TG will be transferred from VLDL to HDL to become.

TG-rich HDL and LDL in the form of small dense particles by the enzyme cholesterol ester transfer protein (CETP), which will then result in an increase in triglycerides, LDL, anddecreased HDL [20].

Table 1. Sample characteristic

Variable	(n)	%	Mean ± SD
Age			*58,63 ± 6,91*
Sex			
Man	21		
Woman	86		
Total	107		

Body mass index			*24.2 ± 3.31*
Uunderweight	2	1.9%	
Normal	40	37.4%	
Overweight	20	18.7 %	
Obese	45	42.1 %	
Total	107	100%	
Sistole			*138.42±19.04*
Diastole			*80.46±8.94*
Blood pressure			
Normal	9	8.4%	
Pre hypertension	50	46.7%	
Stage I hypertenssion	36	33.6%	
Stage 2 hypertension	12	11.2%	
Total	107	100%	
LDL			*198.52±55.46*
HDL			*60,37±16,96*
LDL/HDL ratio			*3,36 ±0,75*

Table 2. Corelation Between Body mass index, blood pressure and LDL/HDL ratio

	LDL/HDL ratio	
Variable	*Spearman correlation (r)*	*p*
BMI	*-0,153*	*0,117*
Blood pressure	*0,057*	*0,563*

The LDL/HDL ratio reflects the abnormal levels of the LDL/HDL cholesterol fraction in the blood which is an indicator of the risk of cardiovascular disease [7][8].

These differences results are influenced by various factors, including differences proportion between men and women, age, sampling location, number of samples, ethnicity, characteristics of the sample. Almost sample are controlled DM patient who regularly take antidiabetic drugs. Russo G, et al stated that the LDL/HDL ratio is significantly higher in men than women in T2DM patients [21]. The decrease of testosterone and estrogen levels will cause suppression of lipase activity in the liver [22][23][24]. This condition disrupt the regulation of lipoprotein lipase which is responsible for hydrolyzing TG into VLDL, increasing LDL levels and reducing HDL levels [22][24].

This research samples were obtained from three different areas, namely Gunungpati (rural), Pandanaran (urban), and Purwoyoso (urban). Research by Tursinawati Y, et al states that

LDL and HDL levels in Javanese ethnic T2DM sufferers in urban (rural) areas are higher than in rural (urban) areas [25]. Residents of rural areas mostly have jobs that require a lot of physical activity, while residents of urban areas have jobs that require less physical activity [26]. Differences in LDL and HDL levels in different urban and rural areas in this study may influence the LDL/HDL ratio.

The research sample consisted of controlled T2DM patients who routinely consumed antidiabetic drugs, resulting in LDL/HDL ratio levels could not be compared with those before routine treatment. Consumption of sulfonylureas can reduce HDL levels, acarbose increases HDL levels [27]. The combination of metformin and glibenclamide shows a significant reduction in total and LDL cholesterol levels [28].

Research by Tursinawati Y, et al states that Javanese ethnic T2DM sufferers with the 2R / 3R and 3R / 3R CAPN10 SNP19 genotypes are more susceptible to T2DM. (rs3842570) does not play a role in increasing the BMI of Javanese T2DM sufferers [29].

Insulin resistance and hyperinsulinemia can increase peripheral vascular resistance and vascular smooth muscle contractility through excessive response to norepinephrine and angiotensin II. This condition causes an increase in blood pressure through physiological feedback mechanisms and the Renin-Angiotensin-Aldosterone system. Blood pressure can affect the LDL/HDL ratio value because high blood pressure will cause damage to the arterial endothelium. Damaged arteries will react with LDL to form oxidized LDL which will accumulate in the walls of blood vessels [15].

The endothelium produce endothelial nitric oxide synthases (eNOS) which are vasodilator and protective, while macrophages produce inducible nitric oxide synthases (iNOS) as oxidative antimicrobials. When iNOS is higher than eNOS, atherosclerosis is easy to form [31][32]. Macrophages which phagocytose an oxidized LDL become foam cell formation. Smooth muscle cells will proliferate and take lipoproteins. It also synthesize extracellular matrix proteins that underlie fibrous cap formation [32].

The differences in results were influenced by various factors including differences in the proportion between men and women, age, sampling location, number of samples, ethnicity. Sample characteristics were controlled DM patients who routinely consumed antidiabetic and antihypertensive drugs which could affect levels. LDL/HDL ratio. Based on research by Nishida Y, et al, the antihypertensive drug candesartan can reduces HDL levels significantly [33]. Research by Nandeesha et al, shows that atenolol and thiazides can significantly increase TG, VLDL, LDL/HDL ratio, and reduce total/HDL cholesterol [34]. The enalapril group of drugs can reduce total cholesterol, TG, VLDL, non-HDL, and TG/LDL [34]. In experimental research by Dangi NB, et al the antihypertensive drug Calcium Channel Blocker can significantly reduce the lipid profile, including triglycerides, LDL, VLDL, and increase HDL [35].

The CAPN10 gene polymorphism SNP-19 (rs3842570) does not play a role in increasing blood pressure in Javanese ethnic T2DM sufferers [9].

5. Conclusion and Recommendation

Blood pressure and BM I in T2DM do not related with LDL/HDL ratio of T2DM.

The study dis not compared controlled and uncontrolled T2DM, so the blood pressure and lipid profile could be influenced by mediaction.

For the next research we suggest match the uncontrolled and controlled T2DM sample.

Authors' Contribution. VN prepare first darft mnuscrip including EC and literature search. YT and AK were prepared the pre elimary data and reasearch from sample. ST and AK critically revised manuscript and wrote the final version.

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