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Hypercholesterolemia Differences based on Body Fat Percentage in Diabetic Patients at Pasar Minggu Primary Health Care 2018

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Abstract

Hypercholesterolemia is the leading predictor of various cardiovascular disease (CVD) which is the leading cause of death in the world. This study aims to determine whether there are any differences the incidence of hypercholesterolemia based on factors related to it in people with diabetes mellitus at Pasar Minggu Primary Health Care in 2018. This study used a cross-sectional method with a sample size of 126 respondents using consecutive sampling. Research variables studied were incidence of hypercholesterolemia, sex, duration of diabetes mellitus, family history of diabetes mellitus, smoking habit, physical activity, stress level, body fat percentage and fat intake. The results of this study showed that the prevalence of hypercholesterolemia incidence in DM patients was 56.3% with 37.1% in men and 63.7% in women. Of all independent variables studied, significant differences with statistical analysis were in sex (OR = 2.947, p = 0.009), family history (OR = 0.443, p = 0.018) and smoking habits (OR = 1,233; p = 0.038). Meanwhile, there was no significant the incidence of hypercholesterolemia differences based on duration of diabetes mellitus, physical activity, stress level, body, fat body percentage and fat intake due to p > 0.05. To conclude, there were significant differences in sex, family history of diabetes mellitus and smoking habits with hypercholesterolaemia incidence, with an increased risk of hypercholesterolemia in line with female sex, family history of DM and active smoking habits.

Key words: diabetes mellitus, hypercholesterolemia, body fat percentage

Abstrak

Hiperkolesterolemia merupakan salah satu prediktor kuat berbagai penyait jantung yang merupakan penyebab utama kematian di dunia. Penelitian ini bertujuan untuk mengetahui apakah ada perbedaan berbagai faktor yang berkaitan dengan kejadian hiperkolesterolemia pada penderita diabetes melitus di Puskesmas Pasar Minggu pada tahun 2018. Penelitian ini menggunakan metode cross-sectional dengan jumlah sampel sebesar 126 responden menggunakan consecutive sampling. Variabel penelitian yang diteliti adalah kejadian hiperkolesterolemia, jenis kelamin, lama menderita diabetes melitus, riwayat DM keluarga, kebiasaan merokok, aktivitas fisik, tingkat stress, persen lemak tubuh dan asupan lemak. Hasil dari penelitian ini menunjukkan bahwa prevalensi kejadian hiperkolesterolemia pada penderita DM adalah 56,3% dengan 37,1% pada pria dan 63,7% pada wanita. Dari seluruh variabel independent yang diteliti, perbedaan yang bermakna dengan hasil uji chi square adalah jenis kelamin (OR = 2,947; CI = 1,326-6,672), riwayat keluarga (OR = 0,443; CI = 0,209-0,895) dan kebiasaan merokok (OR = 1,233; CI = 0,990-11,898). Sementara itu, tidak terdapat perbedaan bermakna kejadian hiperkolesterolemia berdasarkan lama menderita DM, aktivitas fisik, tingkat stress, persen lemak tubuh dan asupan lemak karena p > 0,05. Disimpulkan, terdapat perbedaan yang signifikan pada jenis kelamin, riwayat DM keluarga dan kebiasaan merokok dengan kejadian hiperkolesterolemia. Peningkatan risiko hiperkolesterolemia utamanya terjadi pada perempuan, adanya riwayat DM keluarga dan kebiasaan aktif merokok.

Kata kunci: diabetes mellitus, hiperkolesterolemia, persen lemak tubuh

Introduction

High levels of blood cholesterol (hypercholesterolemia) which will pile up and thicken the blood vessel walls causing calcification is the biggest risk factor for atherosclerosis (1). Atherosclerosis is a condition due to the inflammatory response in blood vessels because of the presence of plaque in the arteries. This condition is progressive and causes thickening and hardening of the arterial walls, resulting in arterial stiffness and fragility (2). Hypercholesterolemia is the predictor of various cardiovascular disease (CVD) which is the leading cause of death in the world (1).

In Indonesia, the population aged >15 years who have a total cholesterol level above normal is 35.9% (3). The main risk factors which increase blood cholesterol levels are family history of premature death, high blood pressure, diabetes mellitus, smoking, low HDL cholesterol, obesity and lack of physical activity (4).

Diabetes mellitus and dyslipidemia are the main factors associated with cardiovascular diseases. The term diabetic dyslipidemia supports the hypothesis that insulin resistance is a potential cause of dyslipidemia (5). Dyslipidemia affects people with diabetes to a higher level than non-diabetic people, which further aggravates the severity of diabetic dyslipidemia (6). Thus, information is needed on the factors that influence cholesterol levels to prevent diabetic dyslipidemia.

In DKI Jakarta Province, South Jakarta has a dyslipidemia prevalence of 22.6% which exceeds the national and provincial prevalence. Pasar Minggu Health Center is one of the primary health facilities located in South Jakarta with high diabetes cases, which is 549 cases in 2017. The high prevalence of hypercholesterolemia in diabetics is a consideration for researchers to choose Pasar Minggu Health Center as a sample in the study. On this research, the study conducted analysis to determine the factors associated with total blood cholesterol levels in diabetics at the Pasar Minggu Health Center in 2018.

Method

This study was an observational research with a cross-sectional design using primary data, information from research subjects was collected simultaneously. The purpose of this study was to analyze at the relationship between percentage of body fat, individual characteristics (sex and duration of diabetes mellitus), family history of diabetes mellitus, lifestyle (physical activity, smoking habits and stress level), and fat intake as an independent variables in the occurrence of hypercholesterolemia. Dependent variable was hypercholesterolemia occurrence divided into 2 (two) categories that were high when total blood cholesterol ≥240 mg/dL and normal when total blood cholesterol <240 mg/dL based on WHO classification as the global standard (7). Determination of the measuring result of each independent variables was carried out by the method of scoring then made into a measurement result in the form of categorical (8–12).

This study was conducted in April to May 2018 starting from the preparation (permission to conduct research), including research ethics, and the continue to data collection, processing and analysis. This research was located at the Pasar Minggu Health Center and was selected by purposive sampling citing location in the high number of diabetes cases with 549 cases in 2017.

Based on the calculation of obtained a

large sample of 120 diabetics who were determined according to the hypothesis test formula for two different population proportions from Lameshow (13).

The minimum required number of samples expressed with n, the level of significance (for $\alpha = 0.05$ is 1.96) declared $Z_{1-\alpha/2}$, the power of test (for $1-\beta = 80\%$ is 0.842) declared $Z_{1-\beta}$, the proportion of the hypercholesterolemia incident in the group with positive risk factor was P1, while P2 was the proportion of the hypercholesterolemia incident in the group with negative risk factor, P was averaging P1 and P2. Because sampling techniques were clusters, then large samples were calculated by the design of the effect (times two) (13). The minimum sample calculation result was 30 respondents, then multiplied by two because it is for testing two different proportions, then doubled again because the sampling technique is not random sampling. Therefore, the number of samples needed is 120 respondents.

The research instrument used a questionnaire with interviews, checking cholesterol levels and measuring body fat percentage. Before the data is collected, the researcher asked first for the willingness of the respondents to read their informed consent. Data processing is carried out through three stages, specifically data editing, coding, and tabulation. Data analysis using univariate analysis and bivariate analysis with chi-square.

Results

Univariate analysis was performed to report the distribution of the variables studied. The overall N is 134, after cleaning up the data; then 126 samples were obtained. Univariate analysis is obtained in the following Table 1.

Table 1. Data Distribution of Respondents at Pasar Minggu Health Center in 2018

Variables	Total	%	*x* ± SD	Median	Min-Max
Total Blood Cholesterol					
High (≥ 240 mg/dL)	71	56,3%	248,3 ± 68,58	250,5	116,0-400,0
Normal (< 240 mg/dL)	55	43,7%			
Total	126	100%			
Sex					
Female	91	72,2%	-		
Male	35	27,8%			
Total	126	100%			
Smoking Habits					
Smoker	25	19,8%	-		
Non-smoker	101	80,2%			
Total	126	100%			
Family History of Diabetes Mellitus					
Yes	68	54,0%	-		
No	58	46,0%			
Total	126	100%			
Duration of Diabetes Mellitus					
> 10 years	50	39,7%	5,33 ± 4,89	4	0,0-19,0
≤ 10 years	76	60,3%			
Total	126	97.7%			

Physical Activity					
Inactive (< 600 MET/mnt)	81	64,3%	575,4 ± 391,2	480	0,0-1480,0
Active (≥ 600 MET/mnt)	45	35,7%			
Total	126	100%			
Stress Level					
High (27-40)	33	26,2%	23,33 ± 0,38	23	5,6-
Normal (0-26)	93	73,8%			
Total	126	100%			
Body Fat Percentage					
Risky (M: > 25%; F: 35%)	90	71,4%	34,71 ± 5,21	35,0	22,0-47,0
Not risky (M: ≤ 25%; F: ≤ 35%)	36	28,6%			
Total	126	100%			
Fat Intake					
Excessive (> 30% Total Expenditure)	63	50,0%	74,02 ± 27,04	74,05*	12,9-160,5
Sufficient (≤ 30% Total Expenditure)	63	50,0%			
Jumlah	126	100%			

Table 2. Results of Bivariate Analysis *Chi-Square*

Variable	Total Blood Cholesterol				Total		OR (95% CI)	P-Value
	High		Normal					
	n	%	n	%	n	%		
Sex								
Female	58	63,73	33	36,36	91	100	2,947	0,009
Male	13	7,1	22	2,9	35	100	(1,326-6,672)	
Duration of DM								
> 10 years	33	46,5	38	53,5	71	100	1,042	0,526
≤ 10 years	25	45,5	30	54,5	55	100	(0,514-2,112)	
Smoking Habits								
Active Smoker	14	70,0	6	30,0	20	100	1,233	0,038
Non-smoker	57	60,4	49	39,6	106	100	(0,990-11,898)	
Family History								
Yes	32	47,1	36	52,9	68	100	0,443	0,018
No	39	67,2	19	32,8	58	100	(0,209-0,895)	
Physical Activity								
Inactive	45	55,6	36	44,4	81	100	0,913	0,480
Active	26	57,8	19	42,2	45	100	(0,437-1,907)	
Stress Level								
High	19	57,6	14	42,4	33	100	1,070	0,517
Normal	52	57,8	41	42,2	93	100	(0,480-2,338)	
Body Fat Percentage								
Risky	50	55,6	40	44,4	90	100	0,893 (0,408-1,95)	0,468
Not Risky	21	58,3	15	41,7	36	100		
Fat Intake								
Excessive	39	61,9	24	38,1	63	100	1,574	0,141
Sufficient	32	50,8	31	49,2	63	100	(0,490-2,403)	

Bivariate analysis was performed to determine differences in total blood cholesterol based on factors related to it. Categorical data analysis uses the chi-square test to see whether there are any significant differences in the two different proportions.

Collectively, the prevalence of hypercholesterolemia (TC ≥ 240 mg/dL) in adult with diabetes mellitus at Pasar Minggu Health Center in 2018 was 56.3% (male: 37.1%; female: 63.7%). Significant differences were found between the variables studied, indicating that there were significant differences in sex, family history of diabetes and smoking habits with the incidence of hypercholesterolemia, with an increased risk of hypercholesterolemia in line with female sex, no family history of diabetes and active smoking habits.

Discussion

The result of this study indicates the prevalence of hypercholesterolaemia (TC ≥ 240 mg/dL) in people with diabetes at the Pasar Minggu Health Center in 2018 is 56.3%. Due to the undesirable complications caused by hypercholesterolemia in diabetic people, Indonesia should have conducted national-scale study which describes the prevalence of hypercholesterolemia in diabetics' population. This study aimed to capture the magnitude of hypercholesterolemia in diabetics in the subdistrict level which the result of this study may not represent the national profile. Hence, this percentage cannot be compared with Indonesia's national data. Meanwhile, national-scale study in India explained that the incidence of hypercholesterolemia in diabetics was only 7.76% (14). Research in China found a prevalence dyslipidemia of 67.1%, while in Ethiopia, there were 23.7% of diabetic patients who experienced hypercholesterolemia (15,16). When compared with studies in China, the percentage of the results of this study is almost the same as some of studies.

The high prevalence of hypercholesterolemia in diabetics is caused by increased economic growth and lifestyle changes in developing countries, especially populations with chronic diseases and inadequate physical activity (15). Hypercholesterolemia is a strong independent predictor in diabetic patients because it causes morbidity and mortality in people with diabetes. The high prevalence should be of particular concern for policy makers and diabetics to be able to know early and prevent the onset of hypercholesterolemia and other diabetes complications.

Sex

The results of *chi-square* test showed that there were significant differences between the incidence of hypercholesterolemia and sex. For the risk measurement, women with diabetes have a 2.749 times greater risk of developing hypercholesterolemia compared with men with diabetes. From statistical tests, it was found that the incidence of hypercholesterolemia was higher in women (63.7%) compared to men (37.1%).

The result is also in line with previous studies which have explained that the prevalence of hypercholesterolemia is higher in women than in men. Dyslipidemia is also more common in women. The high prevalence of hypercholesterolemia in women shows that excess fat is more found in women. In addition, this is also caused by

differences in levels of physical activity and energy intake in men and women. Adipose tissue increases with age, and women tend to be more at risk of hypercholesterolemia, especially after menopause. Postmenopausal women have a high percentage of visceral fat, total cholesterol, and triglycerides (17–21). In addition, control of excess energy in women is done by converting energy into stored fat. Unlike the case with women, men usually use their excess energy for protein synthesis (22).

Family History of Diabetes Mellitus

The result of *chi-square* analysis showed that there was a significant relationship between the incidence of hypercholesterolemia with a family history of diabetes mellitus. People with diabetes who have a family history of diabetes have a risk of 0.433 times more likely to experience hypercholesterolemia compared with people who do not have it. The incidence of hypercholesterolemia was higher in the group without a family history of diabetes (67.2%) compared to the group who had a family history of diabetes (47.1%).

The is not in line with research conducted in Japan and in Qatar which shows a significant relationship between family history of diabetes mellitus and the presence of a metabolic syndrome that candevelop, such as hypercholesterolemia (23,24). Diabetes mellitus experienced by parents can be caused due to genetic factors so it is very possible to passed down to their children (25). In addition, parenting also affects children's food intake, so children tend to consume food provided by their parents and have the same diet as their parents. This could become a habit and carry over into adulthood, increasing the risk of developing metabolic syndrome, such as hypercholesterolemia.

In contrast, a cohort study of 1,294 adults with diabetes, followed from 1993 to mid-2016, showed that a family history of diabetes had protective risk against the development of CVD, including hypercholesterolemia as a major predictor (26). People with diabetes who already know that they have a family history of diabetes will maintain their diet and lifestyle. This is because there is a higher awareness about the risk of diabetes mellitus compared to those without a family history of diabetes. However, there is a probability of bias in collecting data such as inaccurate respondents responses so that the results of this study are inversely proportional to many previous studies.

Length suffered from diabetes mellitus

The result of bivariate analysis showed that there was no significant difference between the incidence of hypercholesterolemia and the duration of diabetes. The proportion of hypercholesterolemia rates was almost the same in diabetic with long duration of diabetes mellitus (46.5%) compared to those who had long diabetes mellitus in the short duration category (45.5%).

These results are in line with studies which explain that the duration of diabetes had more related to do the the incidence of chronic heart disease than the incidence of hypercholesterolemia (27). The duration of diabetes has an effect on the risk of someone experiencing complications and other metabolic syndromes. A person suffering from diabetes mellitus with a duration of >5 years, has a greater risk for chronic complications, one of which is CHD, as well as other metabolic syndromes such as hypercholesterolemia (28).

Smoking Habits

The result of chi-square analysis showed that there was a significant relationship between the incidence of hypercholesterolemia and smoking habits. This is in line with previous studies which showed that patients with type-2 diabetes who smoke have significant risk factors for all causes of death, especially deaths due to CVD and CHD in people with diabetes. Diabetics who smoke die on average 8 to 10 years younger than non-smokers, with age included in a multi-regression analysis (29,30).

Nicotine in cigarettes, in addition to disrupting the sympathetic nervous system which results in increased myocardial oxygen demand, also affects the lipid profile (31,32). The secretion of free fatty acids in the liver increases with triglycerides and VLDL in the blood. Smoking could weaken the walls of the arteries and make the surfaces of cell membranes more receptive to storing fat (33). In another study, it was found that the triglycerides, total cholesterol, LDL and VLDL levels in the blood were significantly higher in smokers than in non-smokers (34).

Physical Activity

The result showed that there was no significant difference between the incidence of hypercholesterolemia and physical activity. The incidence of hypercholesterolemia is almost the same in the active and inactive groups.

The result of bivariate analysis in this study is not in line with previous studies which state that hypercholesterolemia is associated with physical activity. According to Trisna *et.al.* (2008), there is a significant relationship between the respondents' physical activity with the incidence of hypercholesterolemia which is higher in people with low physical activity compared with high physical activity (35). In addition, another research shows that physical activity could contribute as much as 25-50% of total energy expenditure and could be an important factor for weight control and blood cholesterol (36). Low physical activity can be associated with a person's behavior both male and female. A study in the United States shows that physical activity has declined over the past 50 years and this decline is associated with an increase in average body weight during this time period (37).

Stress Levels

The results of bivariate analysis showed that there was a significant differences between the incidence of hypercholesterolemia and stress level. It was found that the incidence of hypercholesterolemia was the same for those who had high and moderate stress levels (57.6%). This is not in line with research conducted by St-Onge which showed that there was a significant difference between stress levels and the incidence of hypercholesterolemia in diabetics (38).

A study also proved that there was a significant difference between total serum cholesterol and stress levels ($p < 0.05$). The higher the stress level, the higher the total serum cholesterol (39). Stress is any condition that threatens the human body that causes the body to respond by releasing chemical substances known as stress hormones. Various stresses (such as anxiety, fear, worry and pain) stimulate the release of the hormone cortisol from the adrenal cortex. Cortisol plays a role in muscle, liver and adipose tissue to provide the body with fuel to survive stress. Cortisol causes mobilization of lipids to accumulate in

adipose tissue or other tissues, which results in high levels of lipids in the blood (40).

Fat Intake

The resultof this study indicates that there is no significant relationship between the incidence of hypercholesterolemia and fat intake. The incidence of hypercholesterolemia is higher in the group with excessive fat intake compared to those who have sufficient fat intake. Previous studies have explained that there is a positive relationship between fat intake and the incidence of dyslipidemia (31,41,42). Percent fat intake also affects body weight and total energy intake. This is because high-fat foods cause less satiety than high-carbohydrate foods. Pure fat (9 kcal/g) has more than twice the energy density compared to carbohydrates (4 kcal/g) and protein (4 kcal/g). In addition, consumption of fatty foods could cause a low satiety effect that triggers excessive consumption (43).

The high average fat intake in the hypercholesterolemia group indicates that excessive fat intake (>20% of daily requirement) could trigger hypercholesteolemia (19). The high fat intake can be due to the large number of fried foods provided around their residents and the high preference for fried food causing the uncontrolled daily fat intake of the respondents.

Body Fat Percentage

The results showed no significant difference between the incidence of hypercholesterolemia and body fat percentage (BFP). The incidence of hypercholesterolemia is almost the same in diabetics with high BFP compared to normal BFP. When a person's body fat mass is excessive, it will cause obesity, which is a risk factor for heart disease, diabetes mellitus, dyslipidemia and hypertension (44). Meanwhile, a Japanese research proved a strong correlation between hypercholesterolemia and body fat percentage after 7 years of follow- up (45). Research in India also supports that body fat percentage is the most powerful predictor of blood cholesterol levels compared to abdominal circumference and BMI (46).

Both lipid and body fat profiles have been shown to be important predictors for metabolic syndromes such as dyslipidemia, hypertension, diabetes mellitus, heart disease, hyperinsulinemia etc. Obesity is explained to affect individuals suffering from diabetes while dyslipidemia is associated with obesity and diabetes mellitus (47).

The distribution of body fat, especially the accumulation of visceral fat tissue, is found as a major correlation factor for the abnormalities of various types of diabetogenic and atherogenic risk disorders that are explained by metabolic syndrome. Various studies in the world also prove that the risk of metabolic syndrome (including an increase in total serum cholesterol) increases along with an increase in BFP ratio (48–50).

Conclusion

Personal factors include female sex, no family history of diabetes and active smoking habits are found to be the increased risk of hypercholesterolemia in diabetic patients in the Pasar Minggu Primary Health Care. It is necessary to actively monitor the cholesterol profile of diabetics to diminish undesirable complication caused by hypercholesterolemia diabetes. Primary health care should provide health

education or counselling related to hypercholesterolemia diabetes, especially for female and active smokers. Preferably, smoking cessation treatment and intervention could be integrated in primary health care. There is also a need for active participation of the diabetic patients to stop smoking and enrich themselves of valid information related to hypercholesterolemia diabetes. For further research, authors recommend using comprehensive measures of cholesterol level, such as LDL which considered as more specific bad cholesterol in many previous studies.

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