ORIGINAL ARTICLE

Factors Associated With Severity of Atherosclerosis Lesion Among Patients With Coronary Heart Disease in Indonesia: An Analysis of Angiographic Characteristics

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ABSTRACT

Introduction: Coronary heart disease (CHD) is currently the biggest cause of death in the Asia-Pacific area, exceeding cancer and diabetes. Limited studies identified factors associated with the severity of coronary atherosclerosis lesions in patients diagnosed with CHD, which may different with the factors associated with CHD. The purpose of this study was to identify factors associated with the severity of coronary atherosclerosis lesions. **Methods:** A cross-sectional study was conducted in this study at the cardiac center in one of the biggest private hospital in West Java, Indonesia. The severity of coronary arterial lesion was measured from angiograph results. Factors related to severity were analyzed using linear regression analysis. **Results:** A total of 110 patients diagnosed with coronary heart disease were recruited in this study. The mean age was 58.8 (SD=8.3); 86.4% were males. The most prevalent modifiable CHD risk factors were smoking (63.6%). the majority of the respondent having lesion at left anterior descending (LAD) with the mean severity of lesion was 85.11% (SD=12.85). Hypertension (B=0.321, SE: 0.16, p-value=0.047) and lack of physical activity (B=0.480, SE=0.195, p-value=0.015) were significant factors associated with severity of atherosclerotic lesions with with R^2=23.4%. **Conclusion:** Hypertension and lack of physical activity had a significant relationship with the severity of coronary atherosclerosis lesions. Further research exploring the relationship of CHD risk factors with the severity of coronary atherosclerosis lesions, with a larger number of samples, is needed to confirm this finding. Promoting physical activity is very important to reduce the severity of the lesion.

Keywords: Coronary heart disease, Risk factors, The severity of arteriosclerosis lesions, Angiographic characteristics, Cross-sectional study

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INTRODUCTION

Cardiovascular disease is the largest cause of death worldwide, accounting for approximately 17.9 million fatalities in 2016, or 31% of all deaths worldwide. More than three-quarters of deaths due to cardiovascular occur in developing countries (1). Coronary heart disease (CHD) and acute coronary syndrome (ACS) account for around 7 million deaths each year (1). CHD is now the leading cause of death in the Asia-Pacific region, accounting for about half of total deaths (2). In Indonesia, approximately 17.3 million people died of heart disease and 3 million died under 60 years of age in 2018 (3).

CHD is a condition caused by low oxygen levels, usually brought about by atherosclerosis in the coronary arteries (4). CHD is one of the fatal diseases. The diagnosis of CHD should therefore be done quickly and precisely in order to reduce the mortality rate. Electrocardiography (ECG) and coronary angiography tests are the most common diagnostic tests for CHD (5). ECG plays a key role in diagnosing CHD, including determining the duration, extent, location, and other underlying abnormalities (6). In addition, coronary angiography or cardiac catheterization is an investigation used to determine the anatomical

aspects and function of the heart to determine the location, extent, degree of obstruction, collateral circulation, and severity of blockages in coronary arteries (5).

The severity of a coronary lesion is measured by how much obstruction it causes, and if the obstruction is greater than 50% it is considered significant (6). CHD is most often classified as a single-vessel lesion, double-vessel lesions, and triple-vessel lesion. (4) Treatment recommendations for patients are based on the extent and severity of coronary heart disease (7). Coronary catheterization is an important CHD management, and Percutaneous Transluminal Coronary Angioplasty (PTCA) is the method for treating the most severe type of CHD (8).

Several studies have identified risk factors for atherosclerosis as a cause of CHD including older age, male, and having a family history of cardiovascular disease, however limited studies exploring the factors associated with the severity of (9). The 2018 American Heart Association reports that people are more likely to experience CHD when they're over 45. Other studies reported that age 45-65 years is the highest risk age for CHD. (10). Men are at higher risk than women (11). Utami and Azam (10) emphasized a significant relationship between family history and the incidence of CHD. Other studies reported modifiable risk factors associated with the risk of CHD to include hypertension, diabetes mellitus, smoking, dyslipidemia, obesity, and lack of physical activity. For example, hypertension has a 2.66 times risk of developing CHD compared to respondents who are not hypertensive (12). Diabetes increases the risk of coronary heart disease by 8.43 times compared to people who do not have diabetes (13). Smoking can increase the risk of developing CHD 2 times greater than non-smoking subjects. Patients with high cholesterol have a 9.2 times greater risk of developing CHD compared to someone with normal cholesterol . Someone with a BMI> 25 has a 2.7 times higher risk than someone with a BMI <25 (14). Lack of exercise is an important factor that contributes to CHD, someone who lacks physical activity has a risk of 2.63 times the risk of CHD compared to someone who has routine physical activity (15).

Understanding the risk factors is very important in the implementation of risk stratification and the determination of prognosis in patients with coronary heart disease. Numerous studies were done to investigate the risk factors of CHD. Despite extensive research, few studies have identified factors that affect the severity of coronary atherosclerosis lesion in patients with CHD. The purpose of this study was to determine factors associated with the severity of coronary atherosclerosis in patients with CHD in Indonesia.

MATERIALS AND METHODS

Study design and sample

A cross-sectional study was conducted in this study at a cardiac center in one of the biggest private hospitals in West Java, Indonesia from December 21, 2019, to February 20, 2020. Samples in this study were patients diagnosed with coronary heart disease (CHD) post percutaneous coronary intervention (PCI), aged over 35 years old, without complication. Exclusion criteria were patients with decreased consciousness and pregnant women.

Instruments

A standard online form was used to obtain demographic and medical information. A series of demographic measures were recorded, including age, sex, employment, and the likelihood of having cardiovascular disease in the family. Smoking status (current and former smoking) was documented in the medical history. Physical activity was measure only using two questions: 1) do you routinely doing physical activity? 2). How much time do you exercise in a week?.

The physical examination comprised the measurement of systolic and diastolic blood pressure, as well as the measurement of body height and weight. A digital sphygmomanometer was used to measure blood pressure. Measurements were conducted for two sequential periods and the mean was the final outcome. Hypertension was identified as systolic blood pressure greater than 140 mmHg and diastolic blood pressure was greater than 90 mmHg. Underweight (body mass index (BMI) less than 18.5 Kg/m2), normal (BMI ranged from 18.5 to 24.9 Kg/m2), overweight (BMI ranged from 25.0 to 29.9 Kg/m2), and obese (BMI over 30 Kg/m2).

The review of medical records was performed to extract data on diabetic Mellitus, receiving BP-lowering medication (yes or no), and hypercholesterolemia. The severity of coronary arterial lesion was measured from angiograph results and categorized into 3 classes, proportion of single vessel (lesion in one location), double disease (lesion in two locations), and triple vessel (lesion in three locations).

Procedure

Patients were identified by a nurse at the cardiac center and refer to the researcher. The researcher has collected information on demographics and self-reported medical history using an online standard form and accomplished physical examination for measured blood pressure, body weight, and height. A review of medical records was performed by the researcher to collect information on laboratory data and angiograph results after the clinical consultation and the information registered in the online specific form.

Data Analysis

Descriptive statistics were used to calculate the baseline socio-demographic and modifiable risk factors. Different between characteristics based on the severity of atherosclerotic lesions were evaluated using chi-square and one-way ANOVA. Factors related to severity were analyzed using regression analysis. Data were analyzed using IBM SPSS Statistics Base version 22.0.

Ethical Considerations

Thi study has been approved by Institutional Review Board of affliated university (III/456/STIKep/PPNI/JBR/III/2020). Consent was collected from each patient before data collection and documented to reflect their understanding of the implications of their participation. This study adheren to the ethical principles for research on human beings established in the Declaration of Helsinki.

RESULTS

Demographic characteristics and Coronary Heart Disease Risk Factors

A total of 110 patients diagnosed with coronary heart disease were recruited in this study. The mean age was 58.8 (SD=8.3); 86.4% were males. The majority of them were working as an entrepreneur (28.2%) and government officers (24.5%), and 22.7% having a family history of cardiovascular disease (Table I).

Table I : Demographic characteristics of studied participants (n=110)

Variables	N	%
Age, Mean (SD), years	58.8 (8.3)	
Ranged: 39-80		
Age groups		
39- 60	66	66
61- 80	44	44
Gender		
Male	95	86.4
Female	15	13.6
Occupation type		
Government officers	27	24.5
Private sectors officers	10	9.1
Entrepreneur	31	28.2
Freelance	9	8.2
Unemployed	33	30
Family history of CVD		
Yes	25	22.7
No	85	77.3

Note: CVD: cardiovascular disease

Table II shows the distribution of modifiable risk factors of a studied participant. The most prevalent modifiable CHD risk factors were smoking (63.6%), followed by hypercholesterolemia (47.3%), hypertension (38.2%), and lack of physical activity (35.5%).

Location of Coronary Artery Lesions

According to the location of coronary artery lesions, the majority of the respondent having lesion at left anterior descending (LAD) with the mean severity of lesion was 85.11% (SD=12.85). Then, about 77 persons also having a lesion in the right coronary artery (RCA) and left circumflex artery (LCX), with the mean severity of lesion was 86.43% (SD=12.89) 78.77% (SD=13.55), respectively (Table II).

Factors related to the severity of atherosclerotic lesions

Table III shows a bivariate analysis of the severity of atherosclerotic lesions with modifiable risk factors. Patients with low activity levels more likely to have a higher percentage of the double vessel (p=0.029). There were no significant differences in terms of age, gender, family history of CVD, hypertension, diabetes, smoking, hypercholesterolemia, and obesity on the severity of the lesion (p>0.05).

In multivariate analysis shows that hypertension (B=0.321, SE: 0.16, p-value=0.047) and lack of physical activity (B=0.480, SE=0.195, p-value=0.015) were significant factors associated with severity of atherosclerotic lesions with R2=23.4% (Table V).

DISCUSSION

This study found that majority of the respondent having lesions on the left anterior descending (LAD) and most of them having triple vessel disease. Having triple vessels could be associated with complex risk factors of atherosclerotic lesions such as lifestyle issues

Table II : Distribution of modifiable risk factors of studied participant (n=110)

Variables	N	%
Hypertension	42	38.2
Diabetes mellitus	14	12.7
Smoking	70	63.6
Hypercholesterolemia	52	47.3
Obesity	31	28.2
Lack of physical activity	39	35.5

Table III : Characteristics of location of coronary artery lesions

	RCA	LAD	LCX
n	77	90	77
Mean	86.43	85.11	78.77
Std. Deviation	12.89	12.85	13.55

Note: RCA: right coronary artery; LCX: left circumflex artery; LAD: left anterior descending

Table IV : Patient characteristics based on the severity of atherosclerotic lesions

Variables	Single vessel	Double vessel	Triple vessel	p-value
Age, mean ± SD	55.85±8.84	58.00±7.61	58.85±9.25	0.424
Gender				
Male	17 (17.9%)	27(28.4%)	51(53.7%)	0.944
Female	3 (20.0%)	3(20.0%)	60(54.5%)	
Family history of CVD				
Yes	4(16.0%)	9 (36.0%)	12(48.0%)	0.785
No	0 (0.0%)	25 (29.5%)	43 (50.5%)	
Hypertension				
Yes	5 (11.9%)	13 (30.9%)	24 (57.1%)	0.276
No	16(23.5%)	21(30.8%)	31 (45.5%)	
Diabetes mellitus				
Yes	2 (14,2%)	6 (42.8%)	6 (42.8%)	0.568
No	19 (19.7%)	28 (29.1%)	49(51.0%)	
Smoking				
Yes	13(16.2%)	19 (27.1%)	38 (54,2%)	0.435
No	8 (20.o%)	15 (37.5%)	17 (42.5%)	
Hypercholesterolemia				
Yes	13 (25.0%)	17 (32.6%)	22 (42.4%)	0.211
No	8 (13.7%)	17 (29.3%)	33(56.8%)	
Obesity				
Yes	7 (22.5%)	10 (32.2%)	14 (45.16%)	0.778
No	14 (17.72%)	24 (30.37%)	41 (51.89%)	
Physical activity				
Lack	11 (28.2%)	15 (38.5%)	13 (33. 3%)	0.029
Enough	10 (14.1%)	19 (26.7%)	42 (59.2%)	

Table V : Factors related to the severity of atherosclerotic lesions

Variables	B	SE	95% CI (Min-Max)		*p-value*
Demographic					
Age	0.132	0.153	-0.172	0.436	0.392
Gender	0.350	0.255	-0.156	0.856	0.173
Family history of CVD	-0.054	0.176	-0.403	0.294	0.758
Modifiable risk factors					
Hypertension	0.321	0.160	0.038	0.604	0.047
Diabetes mellitus	0.158	0.245	-0.327	0.643	0.520
Smoking	0.221	0.191	-0.600	0.157	0.249
Hypercholesterolemia	0.111	0.187	-0.260	0.481	0.555
Obesity	0.189	0.209	-0.604	0.226	0.369
Lack of physical activity	0.480	0.195	0.094	0.866	0.015

including smoking or lack of activity, diet problems, or other risk factors that lead to worsening of the lesion (16). Atherosclerotic lesions are asymmetrical forms of thickening of the innermost lining of the arteries which are composed of cells, connective tissue elements, and debris. Inflammatory factors originating from blood and immune cells are an important part of atheroma formation, the rest is the work of vascular endothelial cells and smooth muscle cells (16). Atherosclerotic lesions are classified as non-progressive intimal lesions or progressive atherosclerotic lesions (16). Understanding the atherosclerotic lesions is important to decide treatment and care for the patients.

The results showed that hypertension had a significant relationship with the severity of coronary atherosclerosis lesions. In hypertensive individuals, alterations in blood vessels are defined by blood vessel thickness and loss of flexibility as a result of inflammatory response and accumulation of fatty material, cholesterol, substances in the body, minerals, and several other chemical products in the blood vessel wall. (17). Increasing systolic blood pressure by 20 mmHg and increasing diastolic blood pressure by 10 mmHg increases the chance of developing coronary heart disease by a factor of 2 (17). At age below 45 years old, men have a higher risk of hypertension than women. Between the ages of 45-64 years, men and women have the same percentage of incidence of hypertension, and after age 64 years, women have a higher percentage of incidence of hypertension than men (18). Therefore, there is need a more attention more on the treatment of hypertension to reduce the severity of the lesion.

Physical activity was a significant relationship with the severity of coronary atherosclerosis lesions (15). which states that there is a positive correlation between physical activity and the occurance of CHD. This is because physical activity can reduce plasma fibrinogen concentration. When plasma fibrinogen is low, clot formation is less likely, and plasminogen activator (tPA) and plasminogen activator inhibitor-1 (PAI-1) drop, as well as a decrease in platelet adhesion or aggregation which will have an impact on reducing the risk of possible the occurrence of CHD (15). When compared with people who had daily sedentary activities, those who had regular physical activity had a more effective fibrinolytic profile and a reduced risk of thrombus formation. Physical activity for 30 minutes carried out regularly 3-5 days a week can reduce the amount of low-density lipoprotein (LDL) cholesterol by 10 mg / dL and increase HDL cholesterol by up to 4 mg / dL (15). A significant reduction in overall cholesterol and LDL profiles followed by an increase in HDL cholesterol is known to have a positive effect on cardiovascular health. Promoting physical activity for patients with atherosclerosis may reduce severity of lesion.

CONCLUSION

This study found that majority of respondent having lesion on left anterior descending (LAD) and most of them having triple vessel disease. Hypertension and lack of physical activity had a significant relationship with the severity of coronary atherosclerosis lesions.

Further research exploring relationship of CHD risk factors with the severity of coronary atherosclerosis lesions, with a larger number of samples is needed to confirm this finding. Promoting physical activity is very important to reduce the severity of lesion.

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