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THE IMPACT OF BODY MASS INDEX TO ACUTE MYOCARDIAL INFARCTION IN-HOSPITAL PATIENTS MORTALITY RATE IN DR. KARIADI HOSPITAL

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ABSTRACT

Introduction. Populations with high BMI are at risk for cardiovascular disease because these populations usually have high levels of fat in the body. In contrast, there are several studies that prove that body weight below normal BMI also increases cardiovascular disease risk and death. The aim of this study was to determine the impact of BMI on mortality rates of in-hospital patients with acute myocardial infarction at dr. Kariadi Hospital. **Methods**. This research is a retrospective analytic observational study with cross sectional design. The sample of this study was acute myocardial infarction patients who were undergoing treatment at the RSUP dr. Kariadi between January 2013 - December 2018 complete data on body weight, height, and status of death or survival. Data comparisons were made using fisher exact test with statistical significant p value was less than 0.05. **Results**. Statistical analysis using fisher exact test showed association between body mass index and mortality rate is not significant (p = 0,258). Age is the only one confounding variable that showed significant association with mortality rate (p =0,032). Relative risk of age is 1.8 with a cutoff at 60 years. **Conclusions**. Body mass index (BMI) did not have a significant impact on the mortality rate of AMI in-hospital patients at dr. Kariadi Hospital.

Keywords: body mass index, acute myocardial infarction, mortality

INTRODUCTION

Body Mass Index (BMI) is one way to measure the nutritional status of adults. This method only requires measurement of body weight and height so that it is considered the easiest and simplest way to get anthropometric data from humans. The index is used to identify body weight from someone whether ideal or not. BMI is used to distinguish whether a person is classified as underweight, normal, overweight, or obese.(Faerstein & Winkelstein, 2012; Nuttall, 2015)

Cardiovascular disease is the number one cause of death worldwide, especially ischemic heart disease. As many as 48% of deaths due to non-communicable diseases are caused by cardiovascular disease, followed by other diseases such as cancer (21%) and respiratory disease (12%). The number of deaths from cardiovascular disease reaches 17.3 million people per year where ischemic heart disease including acute myocardial infarction is responsible for 7.3 million deaths in the world.(Svingen et al., 2014; WHO, Mendis, Puska, & Norrving, 2011) The percentage of mortality due to cardiovascular disease in Indonesia reaches 35%, ranking the highest for disease causing death in our country. The cases of acute myocardial infarction in Semarang reported 1161 at 2013, then four years later increased to 1971 cases.(Semarang, 2017; World Health Organization, 2018)

Excess body weight that can be known from the BMI shows an increased risk of someone affected by various diseases. This is related to lipid levels stored in the human body.(Hruby & Hu, 2014; WHO-World Health Organization, 1995) The prevalence of overweight and obese population has increased worldwide, namely

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857 million individuals in 1980 to 2.1 billion individuals in 2013. The proportion of overweight in Indonesia has increased from 11.5 in 2013 to 14.8 in 2018 The proportion of obese in Indonesia also increased from 13.6 in 2013 to 21.8 in 2018. Based on data from visits to primary health facilities in Central Java in 2016 and 2017, there was an increase in the number of obese visitors from 7.62% to 19, 47%.("Riskesdas", 2018; "Profil Kesehatan Provinsi Jawa Tengah", 2017) Cardiovascular disease, especially coronary artery disease is closely related with lipid in the pathophysiology. Lipids, blood cells, and cholesterols in bloodstream could form plaques which are called atherosclerosis. It is the beginning of coronary artery disease series and could occur acute myocardial infarction.(Frostegard, 2013; Thygesen et al., 2012)

In contrast, BMI below normal also indicates that the individual is unwell. Nutritional factors and certain medical conditions can cause body weight reduced. Indonesia has a quite high underweight population of 12.4%. There are several studies that prove that body weight below normal BMI also increases the risk of cardiovascular disease. A study in the United States proved that underweight populations with BMI <18 kg/m^2 are more at risk of developing cardiovascular disease compared to populations with normal BMI, especially in stroke and myocardial infarction. Similar results were also proven by a meta-analysis that tested the mortality of patients with cardiovascular disease and it was found that underweight populations were more at risk compared to overweight and obese populations. (Park, Lee, & Han, 2017; Sharma et al., 2015)

The writers wonder whether BMI associated with risk factors for cardiovascular disease also has to do with death from acute myocardial infarction. The aim of this study was to determine the impact of BMI on mortality rates of in-hospital patients with acute myocardial infarction who were hospitalized at dr. Kariadi Hospital. Dr. Kariadi Hospital was chosen as a research place because the hospital is a type A hospital and is a referral center for cardiovascular disease in Semarang.

METHODS

This research is a retrospective analytic observational study with case control design. The sample of this study was acute myocardial infarction patients who were undergoing treatment at the RSUP dr. Kariadi between January 2013 - December 2018 complete data on body weight, height, and status of death or survival. This research subjects were determined using the consecutive sampling method, which is a sampling technique of all subjects obtained and fulfilling the criteria included in the study until the number of subjects fulfilled. Total sample size for each group is at least 41 patients, so the total sample is 82 patients at a minimum. The data used in this study are secondary data taken from the medical record of dr. Kariadi hospital. Ethical clearance was requested from the Medical and Health Research Ethics Commission of the Faculty of Medicine, Diponegoro University. Data comparisons were made using Pearson Chi-Square test with statistical significant *p* value was less than 0.05

RESULTS

The author found 137 in-hospital cases of acute myocardial infarction, 99 cases met inclusion criteria and could be investigated. In this study, there were 48 acute myocardial infarction in-hospital patients who died and 51 acute myocardial infarction in-hospital patients who survived and experienced health improvement. 38 of

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cases were included in the exclusion criteria so that they could not be used as research samples because of incomplete medical record data. Characteristics of the subjects in this study are showed in table 1 below.

Table 1. Characteristics of Subjects

Characteristics	**Status** **Death** (n = 48)	**Survive** (n = 51)	**Total** (n = 99)
Age (years)			
80-89	2 (4,2%)	3 (5,8%)	5 (5%)
70-79	9 (18,8%)	7 (13,72%)	16 (16,2%)
60-69	16 (33,3%)	6 (11,8%)	22 (22,2%)
50-59	11 (22,9%)	10 (19,6%)	21 (21,2%)
40-49	7 (14,6%)	20 (39,2%)	27 (27,3%)
30-39	3 (6,25%)	5 (9,8%)	8 (8%)
Sex			
Male	35 (72,9%)	40 (78,4%)	75 (75,8%)
Female	13 (27%)	11 (21,6%)	24 (24,2%)
Body Mass Index			
Obese	17 (35.4%)	14 (27,5%)	31 (31,3%)
Overweight	8 (16.7%)	16 (31,3%)	24 (24,2%)
Diabetes Mellitus			
Yes	19 (39,6%)	12 (23,5%)	31 (31,3%)
No	29 (60,4%)	39 (76,5%)	68 (68,7%)
Smoking History			
Yes	15 (31,3%)	24 (47%)	39 (39,4%)
No	33 (68,8%)	27 (52,9%)	60 (60,6%)
Hypertension			
Yes	30 (62,5%)	29 (56,9%)	59 (59,6%)
No	18 (37,5%)	22 (43,1%)	40 (40,4%)
Dyslipidemia			
Yes	17 (35,4%)	18 (35,3%)	35 (35,4%)
No	31 (64,6%)	33 (64,7%)	64 (64,6%)

The other risk factors of death caused by AMI are diabetes mellitus, smoking, hypertension, and dyslipidemia which were related to mortality. These four risk factors are commonly found in AMI patients and few patients do not have these risk factors at all. Mortality in the most common cases of IMA is caused by cardiac arrest, heart failure, or as a result of the AMI itself.

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Table 2. Association between variables and acute myocardial infarction in-hospital patients mortality

Variable	p value
Body Mass Index	0,258[b]
Age (years)	0,032[b]*
Sex	0,522[a]
Diabetes Mellitus	0,085[a]
Smoking History	0,108[a]
Hypertension	0,568[a]
Dyslipidemia	0,99[a]

Explanation : * Significant ; [a] Pearson Chi-Square ; [b] Fisher Exact Test

Table 2 showed the association between body mass index-mortality and confounding variables-mortality. Statistical analysis using fisher exact test showed association between body mass index and mortality is not significant. Age is the only one confounding variable that showed significant association with mortality (p<0,05). Comparison of deaths and survives from each age category is shown in the chart below.

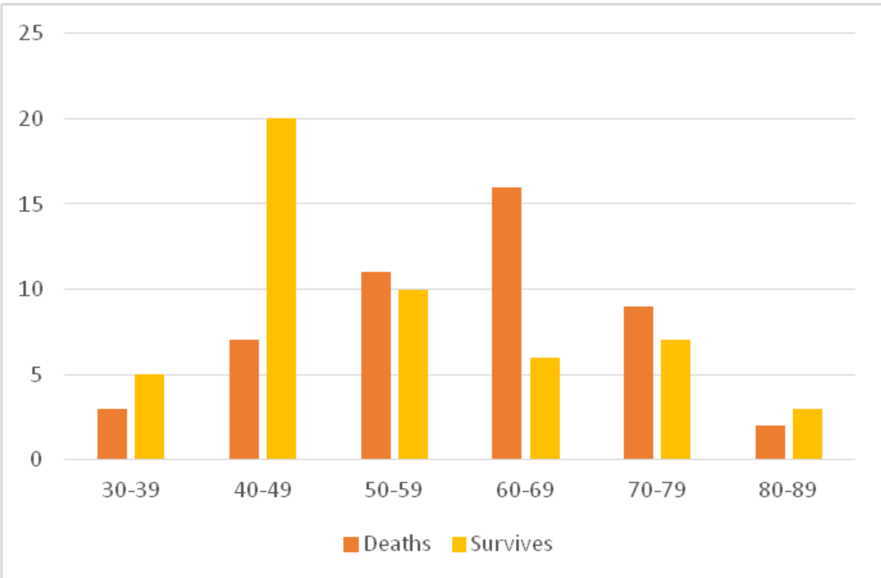

Chart 1. Comparison deaths and survives based on age

The number of deaths has increased dramatically at the age of 60-69. at the age of 50 -59 it has begun to show an increase in mortality compared to survival rates but has not been too drastic. Survival number is one number higher at the age of 80-89. Relative risk of age is 1.8 with a cutoff at 60 years.

DISCUSSION

This study has 99 samples that included in inclusion criteria. A total of 48 patients (48.5%) died and 51 patients (51.5%) lived. The mortality rate in this study is 48.5%, quite high compared to the study in United States which was only 26.4%. The other study mentioned that the mortality rate of AMI in-hospital patients in England and Wales was only 8.8%, far less than in this study. (Bradley, Borgerding, Wood, Maynard, & Fihn, 2019; Wu et al., 2019)

Based on this research, the number of AMI in-hospital patients is higher in male sex (75.8%) than in women (24.8%)

from both dead and alive patients. The age of AMI in-hospital patients in this study ranged from 30-89 years. This shows that AMI usually affects adults to the elderly and is more often suffered by men about three times more than women. (Kytö, Sipilä, & Rautava, 2015; Millett, Peters, & Woodward, 2018) Hypertension is the most modifiable risk factor possessed by this study sample was 59.6%. (Abete et al., 2009)

Based on the bivariate analysis performed on the medical records of dr. Kariadi AMI in-hospital patients in January 2015 - December 2018 obtained a non-significant association between BMI and the mortality rate of AMI patients because the $p>0.05$. This is not in accordance with the previous research which says that the lower BMI category has a higher mortality rate, but in BMI over 40 the mortality rate has again risen. In the TIMI score it is also stated that body weight below 67 kg are more at risk of AMI death which indicates that thinner patient is more prone to die even though it is not specific to a particular BMI category. Several reasons might be related to the insignificant association between BMI and the mortality of AMI patients in this study. (Bucholz et al., 2012; Silveira, Jaeger, Hatschbach, & Manenti, 2016)

First, BMI is an anthropometric measurement that calculate body weight and height, but cannot determine fat distribution in human. Distribution of fat in humans is generally divided into two types, android and gynecoid. Android type is accumulation of fat that occurs in the abdominal cavity and mediastinum. While the gynecoid type is accumulation of fat that occurs in the subcutaneous, especially around the thighs and pelvis. The distribution of fat in the abdominal region is closely related to the accumulation of triglycerides in the liver and the skeletal muscle. (Blanca M. Herrera, 2010; Nuttall, 2015; Svingen et al., 2014)

Adipocytes in visceral fat have a smaller size and more active in lipolysis activity than subcutaneous fat. Lipolysis products from visceral fat will accumulate in other organs which not contain much fat tissue, such as heart, liver, and pancreas to form ectopic fat. Ectopic fat is atherogenic and can trigger the development of chronic diseases such as type 2 diabetes mellitus, hypertension, and coronary heart disease as well as an increased risk of death. Visceral fat also produces more inflammatory cytokines such as TNF-α, CRP, IL-6, and MCP-1 so that it will worsen the prognosis of disease due to inflammation in the coronary vessel endothelium. (Ebrahimi-Mamaeghani, Mohammadi, Arefhosseini, Fallah, & Bazi, 2015; A. M. Sharma, 2004) More subcutaneous fat found in the gynecoid fat distribution producing adiponectin with higher levels than visceral fat. This hormone has a vasodilator function which is very useful to reduce the risk of death from AMI by helping to expedite coronary blood flow for myocardial reperfusion. Adiponectin also beneficial for repair endothelial blood vessels that are damaged. The number of AMI events in men in this study is related to this theory because men usually have android type fat distribution. (Ebrahimi-Mamaeghani et al., 2015; Lin & Chen, 2013)

In practice, BMI may be inaccurate as a predictor of AMI mortality because it cannot show the distribution of body fat. Body fat distribution can be measured

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accurately using CT scan. A simpler alternative to determine the distribution of body fat is waist-to-hip ratio measurement. (Blanca M. Herrera, 2010; Kaichi et al., 2017; Nuttall, 2015; Svingen et al., 2014)

The management of the sample in this study varies according to the presence or absence of ST elevation on ECG examination and contraindications to the drug in each patient. The aim of STEMI management in the emergency department is to control chest pain, identify patients who need immediate primary reperfusion therapy, triage the patient, and prevent mistake in returning patients who actually have STEMI. (Hwang & Levis, 2014; Irmalita, 2018) Oxygen therapy can be given if the patient experiences hypoxemia. The main tool for triage of patients is a 12-lead ECG examination. Patients with significant ST segment elevation need immediate primary reperfusion therapy. Primary reperfusion therapy can be done by administering fibrinolytic drugs or by installing primary PCI depending on the situation and condition of the patient and related health care facilities. The main pharmacological management of STEMI is antiplatelets and anticoagulants to maintain patency of the arteries that cause infarction. Other drugs that are useful for STEMI therapy are β-blockers, ACE-I, and nitroglycerin. NSTEMI patients do not need reperfusion therapy because the occlusion caused by atherosclerotic plaque rupture has not really obstruct blood flow. Bed rest is mandatory for patients with ECG monitoring. Patients may be transferred from the ICU / ICCU if there is no re-ischemia and no signs of necrosis are found based on cardiac biomarkers for 12-24 hours. The initial medical therapy that is routinely given is nitrate, β-blockers, CCBs, morphine sulfate (analgesic) and antithrombotics. Patients who have been allowed home are educated to make modifications to the risk factors for AMI. Further therapy given is β-blockers, statins, ACE-I, ARBs, and antithrombotics. Differences in management in each sample of this study may be confounding in this study because the administration of drugs or other interventions are adjusting the conditions of each sample. (Loscalzo J., 2015)

Age was the only confounding variable that had a significant association with AMI mortality in this study because the p value <0.05. These results are in accordance with the study of Smilowitz et al which mortality rate increases in older ages. In this study, a cutoff was obtained at 60 years old and age above it had a risk of death 1.8 times higher than the age below 60 years old. That is related with changes in the structure and function of blood vessels. Blood vessels in the elderly experienced dysfunction in the endothelial layer which has decreased in vasodilation and antithrombotic function accompanied by an increase in reactive oxidative species (ROS) and inflammatory cytokines. Blood vessels stiffed due to increased collagen and decreased elastin in the structure of blood vessel walls. These two things can interfere with reperfusion after AMI attacks. (Paneni, Diaz Cañestro, Libby, Lüscher, & Camici, 2017; Smilowitz et al., 2017)

Sex, diabetes mellitus, smoking history, hypertension, and dyslipdemia did not have a significant association with the mortality rate of AMI in bivariate analysis. This is not in accordance with several other studies. Kyto et al's study states that women are more vulnerable to death than men. In this study, there were more samples of males of working age than females. Work stress may have corellation with the mortality rate of the male sample in this study. (Arnold, Smolderen, Buchanan, Li, & Spertus, 2012; Kytö et al., 2015) Diabetes mellitus, hypertension, and dyslipidemia are

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comorbid diseases that are closely related to AMI. History of smoking is also commonly associated with AMI mortality and it is always asked to cardiovascular patients for deciding diagnosis and prognosis. In this study, four risk factors of AMI death were not have significant association with the mortality rate of AMI ($p>0.05$). This is not in accordance with some studies before. The study from London said that the outcome of patients with diabetes mellitus was three times worse. A smoking history is associated with a poor long-term prognosis for AMI patients.(Bucholz, Beckman, Kiefe, & Krumholz, 2016; Kapur & De Palma, 2007) This study also does not fit the other researchs which hypertension and dyslipdemia increase the risk of death in AMI patients.(Chou, 2012; Kang et al., 2009)

One study said that someone with one or more of these risk four factors tended to be more aware of complications that they might experience in the future. People with comorbid diseases or someone with history of smoking who have been educated already understand well the condition of their body and will be more obedient if given treatment when complications occur in that person. This explanation may be experienced by the sample in this study. So there is no meaningful association between the four factors with the mortality rate of AMI.(Rachel Hajar, 2017)

This study has some limitations. The management of sample varies according to the AMI management algorithm based on the patient's situation and condition (STEMI or NSTEMI, drugs or intervention contraindications, availability of drugs or intervention devices, etc.) that can be confounding. Information about the time interval between onset and reperfusion therapy also not recorded in medical record.

CONCLUSION

Body mass index (BMI) did not have a significant impact on the mortality rate of AMI in-hospital patients at dr. Kariadi Hospital. Mortality rate of in-hospital AMI cases at that hospital in January 2015 - December 2018 amounted to 48.5%. AMI in-hospital patients over 50 years old have a risk of death 3.8 times higher than patients under 50 years old.

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