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Obesity and Clinical Outcomes of Acute Decompensated Heart Failure

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ABSTRACT

Introduction: Obesity is an independent risk factor that raises the prevalence of heart failure, but it is paradoxically associated with a better prognosis. This study examined the relationship between obesity and clinical outcomes of acute decompensated heart failure at Dr. Soetomo General Academic Hospital, Surabaya.

Methods: This was an analytic observational study using a prospective cohort design. Patients with acute decompensated heart failure who were admitted to the inpatient care unit of Dr. Soetomo General Academic Hospital, Surabaya, from December 2021 to July 2022 were chosen using a purposive sample technique. The data were analyzed using the International Business Machines Corporation (IBM) Statistical Package for Social Sciences (SPSS) version 26.0.

Results: There were 58 patients (n=58) representing different categories, with an average age of 55 years old, and were predominately males (58.6%). This study found that clinical outcomes in obese acute decompensated heart failure patients were better than those of non-obese patients in terms of shorter lengths of stay (p=0.825), lower rates of rehospitalization (p=0.458), and lower rates of all-cause mortality (p=0.673).

Conclusion: The difference between the clinical outcomes in obese acute decompensated heart failure patients and non-obese patients was not statistically significant.

Highlights:
1. Clinical outcomes in obese acute decompensated heart failure patients were found to be better than those of non-obese patients but not statistically significant.
2. Acute decompensated heart failure patients were dominated by males.

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Introduction

Cardiovascular disease is the leading cause of death, contributing to the highest number of fatalities globally, reaching 17.9 million in 2018 and 65,000 deaths nationally in 2016, among the four main types of non-communicable diseases.[1] One cardiovascular condition that is a major and growing global health concern is heart failure. The prevalence of heart failure has increased over the past few decades. It is expected to continue rising in the future, primarily due to the growing proportion of the elderly population and improved survival rates for patients with both cardiac and non-cardiac diseases. In 2017, 64 million people worldwide experienced heart failure.[1] Heart failure patients are at significant risk of mortality or being readmitted to the hospital after leaving the hospital, with a 3-month rate of 14% for death and nearly 25% for rehospitalization.[1]

The prevalence of obesity has grown. In people over 18 years old, it grew from 13.4% in 2013 to 21.8% in 2018.[2] Obesity is linked to a high incidence of heart failure and other cardiovascular risk factors such as hypertension, diabetes, and dyslipidemia.[3] It causes various hemodynamic changes that affect cardiac morphology changes and ventricular function damage, which can contribute to the development of heart failure. It doubles the likelihood of developing heart failure and is a standalone risk factor for cardiovascular morbidity and mortality. Evidence suggests that the risk of cardiovascular death is higher in individuals with heart failure who have normal weight (body mass index/BMI 18.5-24.9 kg/m2) and lean (BMI <18.5kg/m2) than it is in patients who are overweight and moderately obese.[4] The obesity paradox refers to this phenomenon. Although the precise explanation of this phenomenon is unknown, it might be linked to other factors, such as the age at which obese people are initially diagnosed with heart failure, the highly catabolic nature of the disease, and other factors.[4–6]

This study examined the relationship between obesity and length of stay, all-cause mortality, and rehospitalization in patients with acute decompensated heart failure because few studies discuss the clinical outcomes of acute decompensated heart failure in regions outside Europe and the United States (US). The findings of this study are meant to increase understanding of the phenomenon and can serve as a guide for future development in cardiology, particularly in managing heart failure.

Methods

This was an analytic observational study using a prospective cohort design. Using a purposive sampling method, the selected study subjects were acute decompensated heart failure patients admitted to the inpatient care unit of Dr. Soetomo General Academic Hospital, Surabaya, from December 2021 to July 2022. Medical records were used to gather information regarding BMI and other demographic and clinical characteristics, such as age, gender, past medical history, signs and symptoms, and vital signs. Interviews were conducted by contacting patients or their families' numbers to obtain information about patients' mortality and rehospitalization 30 days after discharge. The data were analyzed using the International Business Machines Corporation (IBM) Statistical Package for Social Sciences (SPSS) version 26.0.[7]

Patients with a normal BMI and obese were the two categories into which the subjects were split based on their BMI. Patients with normal BMI ranged from 18.5-24.99 kg/m^2, while those who were obese had a BMI of 25 kg/m^2 or higher. Patients with a BMI under 18.5 kg/m^2 were excluded. The length of stay, mortality, and rehospitalization information was distributed based on the BMI. It was analyzed using Fisher exact or Spearman tests to determine the relationship between obesity and length of stay, all-cause mortality and rehospitalization in acute decompensated heart failure patients. Other information, including demographic and clinical characteristics, were presented as percentages for categorical variables and mean, median, and standard deviation for data with continuous variables.

Results

A total of 58 patients in this study showed a group of individuals with an average age of 55 years old and were dominated by male patients (n=34). Patients had a normal BMI (n=23) and obesity (n=23), most of the previous medical history was hypertension and diabetes mellitus (n=25), while the most common complaint was dyspnea (n=52). The most common treatment given was diuretics (n=57), and normal vital signs were obtained with the patient's average temperature of 36.4°C, average respiratory rate of 19, average heart rate of 81, average oxygen saturation of 98%, systolic blood pressure of 116 mmHg, and diastolic blood pressure of 72 mmHg.

Table 1. Characteristics of acute decompensated heart failure patients

Characteristics	Frequency, n (%)			p-value
	Total	Obese (n=23)	Non-Obese (n=35)	
Gender				
Men	34 (58.6%)	14 (60.9%)	20 (57.1%)	1.000
Women	24 (41.4%)	9 (39.1%)	15 (42.9%)	
Age*	55.46±12.11236	54.3913±12.18695	56.1714±12.1884	0.589
Body Mass Index*	24.88±3.92890	28.7722±3.29084	22.3306±1.39015	0.000
Previous Medical History				
Hypertension	25 (43.1%)	10 (43.5%)	15 (42.9%)	1.000
Diabetes mellitus	25 (43.1%)	9 (39.1%)	16 (45.7%)	0.787
Dyslipidaemia	3 (5.2%)	1 (4.3%)	2 (5.7%)	1.000
Coronary heart disease	13 (22.4%)	5 (21.7%)	8 (22.9%)	1.000
Peripheral arterial disease	3 (5.2%)	1 (4.3%)	2 (5.7%)	1.000
Smoking	5 (8.6%)	2 (8.7%)	3 (8.6%)	1.000
Stroke	5 (8.6%)	1 (4.3%)	4 (11.4%)	0.639
Others	17 (29.3%)	9 (39.1%)	8 (22.9%)	0.242
Vital Sign Measurement*				
Temperature	36.4171±0.20870	36.4043±0.20993	36.4257±0.21052	0.706
RR	19.8448±1.47258	19.9565±1.79591	19.7714±1.23873	0.644
HR	81.4138±13.32855	85.9565±17.64931	78.4286±8.55187	0.034
SpO_2	98.0862±0.84364	97.9130±0.90015	98.2±0.79705	0.208
SBP	116.2759±17.48763	116.5652±15.49142	116.0857±18.9028	0.920
DBP	72.6897±11.29385	71.8696±10.27045	73.2286±12.03447	0.658
Sign & Symptoms				
Peripheral edema	35 (60.3%)	16 (69.6%)	19 (54.3%)	0.283
Dyspnoea	52 (89.7%)	21 (91.3%)	31 (88.6%)	1.000
Orthopnea	20 (34.5%)	8 (34.8%)	12 (34.3%)	1.000
Paroxysmal nocturnal disease	16 (27.6%)	6 (26.1%)	10 (28.6%)	1.000
Fatigue	9 (15.5%)	3 (13%)	6 (17.1%)	1.000
Ronchi	3 (5.2%)	2 (8.7%)	1 (2.9%)	0.556
Chest pain	10 (17.2%)	3 (13%)	7 (20%)	0.725
Chest palpitations	10 (17.2%)	5 (21.7%)	5 (14.3%)	0.496
Edema pulmoner	8 (13.8%)	4 (17.4%)	4 (11.4%)	0.700
Cardiomegaly	43 (74.1%)	18 (78.3%)	25 (71.4%)	0.760
Bilateral pleural effusions	12 (20.7%)	4 (17.4%)	8 (22.9%)	0.746
Medications				
Beta-blocker	47 (81%)	20 (87%)	27 (77.1%)	0.499
ACE inhibitor	25 (43.1%)	14 (60.9%)	11 (31.4%)	0.033
Diuretics	57 (98.3%)	23 (100%)	34 (97.1%)	1.000
Nitrate	5 (8.6%)	2 (8.7%)	3 (8.6%)	1.000
Aspirin	6 (10.3%)	2 (8.7%)	4 (11.4%)	1.000
Statin	34 (58.6%)	10 (43.5%)	24 (68.6%)	0.101
Angiotensin receptor blocker	23 (39.7%)	5 (21.7%)	18 (51.4%)	0.030

Source: Research data, processed
*Mean±standard deviation
RR: respiratory rate; HR: heart rate; SpO_2: normal oxygen saturation; SBP: systolic blood pressure; DBP: diabolic blood pressure; ACE inhibitor: angiotensin-converting enzyme inhibitors

According to Table 2, the average length of stay for obese patients was seven days, compared to six days for non-obese patients. These results showed that the average length of stay was longer in obese patients. Nevertheless, this was not statistically significant because the p-value obtained was 0.825, indicating that obesity had no bearing on length of stay. According to the statistical analysis, rehospitalization was likewise more likely in non-obese individuals, which yielded a significant value of 0.458, indicating that obesity did not affect rehospitalization rates. Additionally, the p-value for the association between obesity and all-cause mortality in this study was 0.673, indicating that obesity had no impact on all-cause mortality 30 days after discharge from the hospital.

Table 2. Bivariate analysis of the relationship of obesity to the length of stay, rehospitalization rate, and all-cause mortality rate within one month post-hospitalization

	Obesity (n=23)	Non-Obesity (n=35)	p-Value
Length of Stay (Days) (Mean±Standard Deviation)	7.9130 ± 5.72803	6.6571 ± 3.54752	0.825
Rehospitalization			
Yes	2	6	0.458
No	21	29	
Mortality			
Yes	3	3	0.673
No	20	32	

Source: Research data, processed

Discussion

This study indicated that the proportion of males was slightly more significant than females. This aligns with the study by Djaya, *et al*. (2015) of 331 heart failure patients treated in 2012, in which the most significant proportion was males (62.2%).[8] Conversely, this study found that patients with normal BMI were more likely females. This is similar to the study by Hermawan, *et al*. (2022).[9] The mean age of this study was 55.46 years old. This is also supported by the study conducted by Harikatang, *et al*. (2016), who found that the largest age group of heart failure respondents studied was 60-70 years old.[10] However, the results of this study differ from those of other studies abroad, where the average age of subjects treated for heart failure ranged from 67 to 80 years old.[11,12] This might be due to life expectancy in Indonesia (71.9 years old) being generally lower than that of other countries in the study. Moreover, in this study, patients with normal BMI were older, which is supported by Shah, *et al*. (2014).[13]

According to Asian nutritional status, BMI was divided into five categories: underweight (<18.5), normoweight (18.5-22.9), overweight (23-24.9), type I obesity (25-29.9), and type II obesity (≥30).[14] The classification results showed that most were patients with normal BMI (39.7%) and obesity (39.7%). Meanwhile, the average patient's BMI was 24.88. The average BMI in this study was not much different from the results of a study by Lestari, *et al*. (2017) in 59 heart failure patients at Dr. Soetomo General Academic Hospital, Surabaya, which found an average BMI of 26.1145.[15] However, Kenchaiah, *et al*. (2007) obtained a relatively higher average BMI of 28.3.[16] This difference was due to the higher BMI of patients with acute decompensated heart failure in Europe and America than in Asia.[13]

In this study, 25 patients (43.1%) had diabetes mellitus and hypertension as their most prevalent prior medical conditions. These findings did not appear to differ significantly from those of other studies, which revealed that patients with heart failure often had a prevalence of diabetes mellitus between 29 and 34%.[8,11,17,18] However, the prevalence of hypertension in this study was relatively lower compared to other studies, which had a prevalence of hypertension of around 52-57%.[8,11,17,18] Patients with normal weight were found to have a lower prevalence of obesity-related illnesses, such as diabetes, hypertension, and coronary artery disease.[13,16] This is in contrast to this study, which indicated that obesity-related illnesses were more prevalent in those with normal BMI. Nevertheless, the conclusion was not statistically significant, possibly due to the small sample size. Patients with heart failure worldwide frequently have vascular risk factors, including hypertension, diabetes, and dyslipidemia.[12] Although the pathophysiological mechanism behind the association between diabetes and heart failure is still not fully understood, it appears that hyperglycemia, insulin resistance, and hyperinsulinemia are the main risk factors for the development of the condition. Prolonged exposure to these three factors can lead to changes in vascular homeostasis through decreased nitric oxide and increased levels of reactive oxygen species, which activate proinflammatory factors. This leads to the development of atherothrombotic and myocardial dysfunction.[19] Meanwhile, pathological left ventricular hypertrophy and diastolic dysfunction brought on hypertension, leading to heart failure.[20]

This study showed that the most common complaint felt by patients was dyspnea (89.7%) in as many as 52 patients, followed by 35 patients (60.3%) complaining of peripheral edema. This study revealed that dyspnea was the most often reported ailment (89.7%), followed by peripheral edema (60.3%) in 35 patients. Patients with acute decompensated heart failure frequently exhibit congestion and fluid retention, such as weight gain, dyspnea on exertion, orthopnea, and edema compared to patients with pulmonary edema or cardiogenic shock.[21] According to a previous study, people with higher BMI were more likely to experience rest dyspnea, orthopnea, paroxysmal nocturnal dyspnea, and edema.[16]

Most drugs used were diuretics (98.3%) and beta-blockers (81%). The study by Tobing, *et al*. (2021) and Vollmert *et al*. (2020) supported these findings.[22,23] One recommendation for acute decompensated heart failure patients with evidence of volume overload is to be treated with intravenous diuretics. Beta-blocker pharmacologic therapy is one of the guidelines for heart failure with reduced ejection fraction (HFrEF).[24,25] Furthermore, using beta-blockers, diuretics, nitrate, aspirin, and statin was more frequent among normal BMI patients, but it was not statistically significant. This is contrary to the results of the study conducted by Shah, *et al*. (2014) and was likely due to the lack of sample size.[13] On the other hand, the use of ace inhibitor was more common in obese patients, as seen in the study by Hermawan, *et al*. (2022).[9]

The median length of stay in this study was six days with a seven-day average. These findings are consistent with the study conducted by Bueno, *et al*. (2000), which obtained an average length of stay of 6.32 days.[26] Bivariate analysis data with the Spearman test of the relationship between obesity and length of stay obtained a significance value or p-value of 0.825 (>0.050), meaning obesity did not affect the length of stay. The findings of this study are slightly different from the retrospective study conducted by Mughal, *et al.* (2021), which discovered that obese patients spent more time in the hospital (5 days) than non-obese patients (3 days).[27]

Acute decompensated heart failure patients who were discharged after being treated at the Integrated Cardiac Care Center at Dr. Soetomo General Academic Hospital, Surabaya, were followed up after 30 of hospital discharge. The results showed that as many as 8 patients (13.8%) with acute decompensated heart failure experienced rehospitalization within one month (30 days) after discharge due to all causes. The findings of this study are similar to the study by Reyes, *et al*. (2016), who found that the re-hospitalization rate ranged from 3% to 15%.[12] The findings of this study are also supported by Lestari, *et al*. (2017), where 11.9% of patients experienced rehospitalization.[15] Heart failure is associated with frequent hospitalization, but it remains a challenge to predict the

occurrence of re-hospitalization in heart failure patients. Many theories propose risk factors for re-hospitalization, including those associated with elevated filling pressures, such as orthopnea, jugular venous pressure, and echocardiographic filling patterns. Levels of cardiac biomarkers, such as cardiac troponin and natriuretic peptide, are also at risk for requiring readmission, particularly if levels are still high after discharge. Patients at risk may also be identified by signs of neurohormonal activation, such as elevated levels of circulating catecholamines and renin-angiotensin system metabolites or decreased serum sodium levels. A significant value or p-value of 0.458 (>0.050) based on the results of bivariate analysis data processing with the Fisher exact test indicated that obesity did not affect the rehospitalization rate 30 days after discharge. In other studies, it was also stated that the risk of hospitalization in heart failure patients was unaffected by BMI.[16,28]

The results showed that 6 patients (10.3%) with acute decompensated heart failure died from all causes within one month (30 days) after hospitalization. These results are aligned with the study by Djaya, *et al*. (2015), which found that the mortality rate of heart failure patients at Dr. Cipto Mangunkusumo General Hospital, Jakarta, in 2012 was 10.3%.[8] According to Reyes, *et al*. (2016), the 30-day mortality rate ranged from 1% in Malaysia to 17% in Indonesia.[12] Fisher's exact test was used to conduct a bivariate analysis of the relationship between obesity and all-cause mortality rates during hospitalization and within 30 days of discharge. The results showed no relationship between obesity and all-cause mortality rates, with a significance value of 0.673 (>0.050). The findings of this study are consistent with the study of Shah, *et al*. (2014), which discovered that lower BMI results were linked to a higher mortality rate from acute decompensated heart failure.[13] Other studies also stated that patients with normal BMI or underweight had higher mortality than overweight or obese patients.[5,13,16,28] The results of this study are similar to the so-called obesity paradox, which contends that while obesity is a risk factor on its own for heart failure and increases its occurrence, it has the opposite effect on mortality.[29]

A worldwide epidemic, obesity is closely linked to the emergence of numerous cardiovascular conditions.[30] Heart failure can be brought on by obesity both directly and indirectly. Through several comorbidities, including insulin resistance, which decreases cardiac contractility, changes in lipid metabolism, which promote atherosclerosis, and the risk of ischemic cardiomyopathy, obesity has been demonstrated to increase the likelihood of heart failure. Myocardial lipid accumulation and increased fibrosis play a pathogenic role in cardiac arrhythmias that contribute to the development of heart failure. However, there is an "obesity paradox" theory where a higher BMI is reported to be protective against cardiovascular events, including heart failure.[13] Higher BMI may be associated with less cardiac sympathetic activity, weakened neurohormonal responses to stress, lower levels of proinflammatory cytokines, and lower levels of anabolic-catabolic imbalances. This, in turn, bodes a better prognosis. Another theory states that heart failure is a catabolic state, and obese patients have more energy reserves.[16] They have a better prognosis than patients with lower body weight.[16]

This study did not measure the patient's weight at discharge, which is the optimal weight without congestion. It also had a short follow-up period of 30 days after discharge. Hence, long-term mortality could not be analyzed. It had a small sample size, which affected the statistical analysis results. Therefore, future research is expected to expand the scope of research, especially research methods. For example, considering the difference in weight at the beginning of hospitalization and discharge, longer follow-up period, and selection of more subjects. Other variables that could affect the clinical course of acute decompensated heart failure could be avoided.

Strength and Limitations

This study has some limitations, including the relatively small sample size and brief follow-up period. Despite these limitations, only a few studies discussed the clinical outcomes of acute decompensated heart failure. The data is expected to help develop an excellent service system for acute decompensated heart failure patients at Dr. Soetomo General Academic Hospital, Surabaya.

Conclusion

Clinical outcomes in obese acute decompensated heart failure patients were observed to be shorter in the length of stay, lower rehospitalization rates, and lower all-cause mortality rates than in non-obese patients. However, it was not statistically significant. The findings of this study align with the obesity paradox, which states that obesity serves as an independent risk factor for the onset of heart failure but has an inverse relationship with mortality.

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Conflict of Interest

The authors declared there is no conflict of interest.

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Ethical Clearance

This study had received ethical clearance from the Ethical Committee for Health Research Dr. Soetomo General Academic Hospital, Surabaya (No. 0311/KEPK/XI/2021) on 24-10-2021.

Authors' Contributions

Designed the study, collected and analyzed the data, and drafted the manuscript: AAN. Supervised result and discussion: AA, SWM.

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