

# Manuscript\_Sri Haryuni\_FINAL rev

## 1.docx

*By sri haryuni*

***Systolic Blood Pressure, Blood Glucose and Mortality of Patients with Acute Coronary Syndrome***

Sri Haryuni<sup>1,3\*</sup>, Chatarina Umbul Wahyuni<sup>2</sup>, Moh Alimansur<sup>3</sup>, Jatmiko<sup>3</sup>, Kun Ika Nur Rahayu<sup>3</sup>

<sup>1</sup>*Doctoral Program of Public Health Student, Faculty of Public Health, Universitas Airlangga, Mulyorejo, Surabaya Indonesia;*

<sup>2</sup>*Department of Epidemiology, Faculty of Public Health, Universitas Airlangga, Mulyorejo, Surabaya Indonesia,*

<sup>3</sup>*Faculty of Health Science, Universitas Kadiri, Kediri Indonesia*

\*Corresponding author: [sri.haryuni-2020@fkm.unair.ac.id](mailto:sri.haryuni-2020@fkm.unair.ac.id)

**ABSTRAK**

**Latar belakang:** *Acute coronary syndrome* (ACS) merupakan penyakit kardiovaskular yang banyak menyebabkan kematian baik di Indonesia maupun di dunia. Tekanan darah sistolik dan kadar glukosa merupakan indikator yang penting dalam penentuan stratifikasi risiko dan informasi prognosis yang efektif. Tujuan penelitian ini adalah untuk mengidentifikasi tekanan darah dan glukosa darah sebagai salah satu faktor risiko untuk memprediksi mortalitas pada pasien sindroma koroner akut. **Metode:** Penelitian ini merupakan penelitian kuantitatif dengan pendekatan retrospektif yang menggunakan data sekunder RS Dr Iskak Tulungagung mulai januari sampai desember tahun 2020. Sampel yang digunakan berjumlah 110 responden yang diambil dengan menggunakan simple random sampling. Variabel independen nya adalah tekanan darah sistolik (X1), blood glucose (X2) dan variabel dependen adalah *mortality* pada pasien ACS (Y). **Hasil:** Hasil analisis multivariate menggunakan regresi logistik tekanan darah sistolik memiliki hubungan dengan mortalitas ( $p = 0,008$ ) dengan odds rasio 0,673. Glukosa darah sedikit lebih tinggi pada analisis multivariatnya dengan odds rasio 3,052 dan memiliki juga hubungan dengan mortalitas ( $p = 0,000$ ). **Kesimpulan:** Adanya tekanan darah sistolik yang rendah dan semakin tingginya glukosa darah maka semakin tinggi terjadinya mortalitas pada pasien ACS. Berdasarkan penelitian ini diharapkan lebih memonitor tekanan darah sistolik dan glukosa darah untuk pemberian perawatan yang lebih cepat dan akurat.

**Kata kunci:** sindroma koroner akut, glukosa darah, mortalitas, tekanan darah sistolik,

## ABSTRACT

**Background:** Acute coronary syndrome (ACS) is a cardiovascular disease causing a high number of patient mortality in the world as well as Indonesia. Systolic blood pressure (SBP) and blood glucose (BG) are suspected to be important indicators for determining the risk stratification and prognostic information of ACS. Therefore, this study aims to evaluate blood pressure and blood glucose alongside the mortality of patients with acute coronary syndrome.

**Methods:** This was a quantitative study conducted using a retrospective survey method and the secondary data used were obtained from the medical records in Dr. Iskak Hospital between January and December 2020. The study sample consists of 110 respondents selected with a simple random sampling. Meanwhile, the independent variables were systolic blood pressure (X1) and blood glucose (X2) while the dependent variable was mortality in ACS patients (Y).

**Results:** The multivariate analyses results with logistic regression show that systolic blood pressure is associated with mortality with a  $p$ -value of 0.008 and an odds ratio of 0.673. Furthermore, the blood glucose was slightly higher in the multivariate model which has an odds ratio of 3.052 and was associated with mortality having a  $p$ -value of 0.000.

**Conclusion:** Based on the result, a low SBP and high BG lead to ACS patient mortality, consequently, serious attention is needed on the systolic blood pressure and blood sugar.

**Keywords:** Acute coronary syndrome, blood glucose, mortality, systolic blood pressure.

## INTRODUCTION

Cardiovascular disease cases are increasing daily and this is supported by the results of RISKESDAS 2018 which showed that approximately 1.5% of Indonesia's population (1.01729 million) is suffering from heart diseases caused by the change of behavior and lifestyle of the community<sup>1</sup>. Coronary heart disease

comes with many complications which are usually life-threatening such as the Acute Coronary Syndrome (ACS)<sup>2</sup>.

ACS is a non-communicable disease caused by pathological changes or abnormalities in the wall of the coronary arteries which leads to myocardial ischemia, unstable Angina Pectoris (STE), and Acute Myocardial

Infarction (AMI) such as non-ST-segment elevation MI (NSTEMI) and ST-segment elevation MI (STEMI)<sup>3</sup>. It is also caused by the sudden interruption of coronary blood flow to the myocardium due to atherosclerosis<sup>4</sup>.

ACS is a spectrum from STEAM, NSTEMI, STEMI with 90% of the cases is caused by the dissolution of atherosclerotic plaques leading to platelet aggregation and coronary thrombus formation<sup>3</sup>. However, the exact cause of ACS is unknown, although it is influenced by many risk factors which are categorized into two groups namely modifiable and not modifiable factors. The unmodifiable factors include age, gender, and family history while the modifiable factors are blood pressure, blood sugar level, cholesterol level, smoking and obesity<sup>5,6</sup>. Recently, blood pressure has been recognized as a high-risk factor for ACS alongside high blood glucose level which aggravates the condition<sup>6</sup>, hence, the presence of both condition increases the risk of acute coronary syndrome<sup>8</sup>.

Blood pressure is an important indicator for determining the prognosis of ACS and plays a huge role in the management of cardiovascular diseases<sup>9</sup>. Moreover, it is an element in the GRACE score used to determine patient mortality during hospitalization<sup>8,10</sup>. Meanwhile,

most studies show that low systolic blood pressure is associated with mortality<sup>9</sup> while some show a contribution of hypertension to mortality in ACS patients<sup>11</sup>. Blood glucose level also predicts mortality in hospitalized patients<sup>12</sup>. Therefore, this study aims to determine the relationship between systolic blood pressure, blood glucose level, and mortality in acute coronary syndrome patients.

## **METHODS**

This is a quantitative study conducted using a retrospective survey method and the population consists of 151 hospitalized patients confirmed with acute coronary syndrome (ACS) in the Intensive Care Unit (ICU) of Dr. Iskak Hospital. The study sample was 110 patients selected with a simple random sampling technique and the instrument used were notes designed by the researcher based on secondary data obtained from medical records of the hospital in March, 2020.

Subsequently, the independent variables were the systolic blood pressure and blood glucose level while the dependent variable was mortality. The data analysis was then conducted using descriptive and inferential analysis. The descriptive analysis was carried out with frequency distribution while the inferential used multivariate regression

analysis to determine the correlation between systolic blood pressure, blood glucose and ACS patient mortality. This

study was approved after an ethical review by RSUD Dr. Iskak with reference number 070/2417/407,206/2021.

## RESULTS

**Table.1 Characteristics of the study subjects**

Characteristics	n=110
Sex Categories, n (%)	
Male	73 (66.4)
Female	37 (33.6)
Age, n (%)	
Mature	9 (8.2)
Elderly	68 (61.8)
Old Elderly	33 (30.0)
Marital status, n (%)	
Married	83 (75.5)
Not married	9 (8.2)
Widow	12 (10.9)
Widower	6 (5.5)
Educational status, n (%)	
Primary school	66 (60.0)
Junior high school	19 (17.3)
High school	15 (13.6)
Bachelor	10 (9.1)
Job experience, n (%)	
Private Company	21 (19.1)
PNS (Government employees)	7 (6.4)
Farmer	32 (29.1)
Entrepreneur	13 (11.8)
Nonjob	37 (33.6)
Type of ACS, n (%)	
STEMI	73 (66.4)
N-STEMI	32 (29.1)
UAP	5 (4.5)

Sources: Secondary Data of Medical Records, 2021

Table 1 shows that most of the respondents were male which was 66.4% of the sample population and this agrees with previous study which showed that male patients are more prone to the

condition<sup>13-15</sup>. Majority of respondents were above 45 years (91.8%), married (75.5%), primary school (60%), unemployed (33.6%), and experienced STEMI (66.4%).

**Table. 2 Characteristics of variable in the study**

Variables (n=110)	Result
Systolic blood pressure (mmHg), mean (SD)	124.48 (SD 32.482)
- Optimal (<119 mmHg) (n, %)	46 (40.7)
- Normal (120-129 mmHg) (n, %)	10 (8.8)
- Normal High (130 - 139 mmHg) (n, %)	21 (18.6)
- Hypertension Grade 1 (140-159 mmHg) (n, %)	24 (21.2)
- Hypertension Grade 2 (160-179 mmHg) (n, %)	4 (3.5)
- Hypertension Grade 3 (>=180 mmHg) (n, %)	8 (7.1)
Blood Glucose (mg/dL), mean (SD)	179.99 (SD 77.258)
- Ideal (80-144 mg/dl)	44 (38.9)
- Adequate (145-180 mg/dl)	27 (23.9)
- Poorly (>180 mg/dl)	42 (37.2)

Sources: Secondary Data of Medical Records, 2021

Table 2 shows that the mean systolic blood pressure was 124.48 mmHg and most of the values were less than 119 mmHg. Meanwhile, the average blood glucose level was 179.99 mg/dl,

and 37.2% of the patients had a poor glucose level.

**Table 3 Characteristics of systolic blood pressure and blood glucose with patient mortality**

Variable (n=110)	Mortality		Total	p-value
	Life	Death		
Systolic blood pressure (mmHg), (n, %)	32 (28,3)	81(71,7)	113(100)	0,009*
- Optimal (<119 mmHg) (n, %)	7(15,2)	39(84,8)	46(100)	
- Normal (120-129 mmHg) (n, %)	4(40)	6(60)	10(100)	
- Normal High (130 - 139 mmHg) (n, %)	4(19)	17(81)	21(100)	
- Hypertension Grade 1 (140-159 mmHg) (n, %)	9(37,5)	15(62,5)	24(100)	
- Hypertension Grade 2 (160-179 mmHg) (n, %)	3(75)	1(25)	4(100)	
- Hypertension Grade 3 (>=180 mmHg) (n, %)	5(62,5)	3(37,5)	8(100)	
Blood Glucose (mg/dL), (n, %)	32(28,3)	81(71,7)	113(100)	0,000*
- Ideal (80-144 mg/dl)	22(50)	22(50)	44(100)	
- Adequate (145-180 mg/dl)	6(22,2)	21(77,8)	27(100)	
- Poorly (>180 mg/dl)	4(9,5)	38(90,5)	42(100)	

\*Chi Square test

Table 3 shows the results of the chi square test carried out between systolic blood pressure and patient mortality, and a p-value of 0.009 (<0.05) was obtained, this indicates that there is a relationship between systolic blood pressure and patient mortality, hence, patients with blood pressure less than 119 mmHg (84.8%) died. Furthermore, the results of the chi square test carried out between

blood glucose levels and patient mortality shows a p-value of 0.000 (<0.05), this indicates that there is a relationship between blood glucose levels and patient mortality. Moreover, 90.5% of patients with poor glucose levels greater than 180 mg/dl died.

**Table 4 Effect of systolic blood pressure and blood glucose on mortality in acute coronary syndrome patients**

Variable (n=110)	$\beta$	p-value	Odds Ratio
Constant	1,450	0,951	1,043
Systolic blood pressure	-0,395	0,008	0,673
Blood Glucose	1.116	0.000	3.052

p-value and Odds Ratio, Logistic Regression

Table 4 shows that the systolic blood pressure has an effect on mortality in ACS patients with a p-value of 0.008 and adjusted odds ratio of 0.673. However, the blood glucose was slightly higher in the multivariate model which also has an effect on the mortality with a p-value of 0.000 and odds ratio of 3.052.

## DISCUSSION

Systolic blood pressure is an important part of primary prevention in ACS patients and is also an element in cardiovascular management in hospitals, low values are associated with poor prognosis of the patients<sup>9</sup>. Furthermore, there is a negative correlation between systolic blood pressure and mortality in

ACS patients<sup>16</sup> because low systolic blood pressure leads to mortality. Therefore, it is an important predictor for the prognosis of ACS patients<sup>17</sup>.

A decrease in blood pressure indicates an imbalance between cardiac output and total peripheral retention caused by myocardial infarction which decreases the ventricular function due to loss of contractile power by the necrotic muscles and impaired contractility of ischemic muscles around it. Also, a decrease in blood pressure is an indicator of cardiogenic shock. The next phase is due to these compensatory mechanisms which lead to heart failure and weakening of contractions that lowers the blood

pressure, consequently, only the systolic pressure is observed. Usually, the heart rhythm becomes irregular and eventually causes cardiogenic shock which leads to death<sup>16</sup>.

Many studies assessing hypertension as the prognosis of ACS have inconsistent results<sup>11</sup>, this agrees with this study which shows that most of the hypertensive patients survived while some died, hence, this indicates inconsistency. Furthermore, the result shows that hypertension is not suitable as a predictor of mortality in ACS patients while others with a low systolic blood pressure all passed away and this indicates that it is a strong predictor.

Previous studies reported that high glucose levels are closely related to mortality in ACS patients<sup>2,12,18</sup> and as such an increase in glucose level in the first 24 hours of hospitalization is assumed to be a predictor of death within 30-180 days<sup>12</sup>. It is also described as an acute response to a hyperadrenergic state with an increased risk of thrombosis which worsens the condition of ACS patients and finally leads to death<sup>19</sup>. Meanwhile, hyperglycemia is a condition characterized by increased blood glucose due to increased gluconeogenesis, glycogenolysis, and hormone stress (adrenaline, cortisol, etc)<sup>20</sup>.

Hyperglycemia worsens the state of the myocardium and the prognosis of ACS patients due to induction of oxidative stress caused by free radicals which eventually leads to heart cells injury. It also increases cardiac contractility and reduces end-diastolic volume alongside the stroke volume to reduce oxygenation<sup>2,18</sup>.

#### **LIMITATIONS OF STUDY**

This study used a cross-sectional retrospective approach that collected data from medical records but no confirmation was carried out to ascertain that the data in the record were systolic blood pressure and blood glucose. Also, the care given to patients was uncontrollable and not all the risk factors were recorded.

#### **CONCLUSION**

This study shows that a low systolic blood pressure and high blood glucose are associated with ACS patient mortality.

#### **ACKNOWLEDGEMENT**

The authors are grateful for the financial support from the Faculty of Public Health, University of Airlangga, the Doctoral Program of Public Health Student, and the Faculty of Health, University of Kadiri. The authors are also



grateful to RSUD Dr. Iskak Tulungagung, Indonesia for the contribution towards the success of this study.

## BIBLIOGRAPHY

1. Kemenkes RI. Laporan\_Nasional\_RKD2018\_FIN AL.pdf. *Badan Penelitian dan Pengembangan Kesehatan* 198 (2018).
2. Benamer, S. *et al.* Association of hyperglycemia with in-hospital mortality and morbidity in Libyan patients with diabetes and acute coronary syndromes. *Oman Med. J.* **30**, 326–330 (2015).
3. Smith, J. N., Negrelli, J. M., Manek, M. B., Hawes, E. M. & Viera, A. J. Diagnosis and Management of Acute Coronary Syndrome : An Evidence-Based Update. *JABFM* **28**, 283–293 (2015).
4. Suling, F., Patricia, M. & Suling, T. Prevalence and Risk Factors of Patient with Acute Coronary Syndrome at Universitas Kristen Indonesia General Hospital. **XXXIV**, (2018).
5. Mirza, A. J., Taha, A. Y. & Khdir, B. R. Risk factors for acute coronary syndrome in patients below the age of 40 years. *Egypt. Hear. J.* **70**, 233–235 (2018).
6. Varghese, T. . & Kumar, A. . Predisposing risk factors of Acute Coronary Syndrome (ACS): A mini review. *J. Pharm. Sci. Res.* **11**, 1999–2002 (2019).
7. Ralapanawa, U. *et al.* Epidemiology and risk factors of patients with types of acute coronary syndrome presenting to a tertiary care hospital in Sri Lanka. *BMC Cardiovasc. Disord.* **19**, 1–9 (2019).
8. Kumar, D. *et al.* Prognostic value of GRACE score for in-hospital and 6 months outcomes after non-ST elevation acute coronary syndrome. *Egypt. Hear. J.* **73**, (2021).
9. Mouhat, B. *et al.* Low Systolic Blood Pressure and Mortality in Elderly Patients After. *J. Am. Heart Assoc.* **9**, 1–9 (2020).
10. PERKI. *Pedoman Tata Laksana Sindrom Koroner Akut 2018. Perhimpunan Dokter Spesialis Kardiovaskular Indonesia* (2018).
11. Ma, W. *et al.* Impact of Admission Systolic Blood Pressure and Antecedent Hypertension on Short-Term Outcomes after ST-Segment Elevation Myocardial Infarction.

- Med. (United States)* **94**, e1446 (2015).
12. Deedwania, P. *et al.* Hyperglycemia and acute coronary syndrome: A scientific statement from the american heart association diabetes committee of the council on nutrition, physical activity, and metabolism. *Circulation* **117**, 1610–1619 (2008).
  13. Roohafza, H., Talaei, M., Pourmoghaddas, Z., Rajabi, F. & Sadeghi, M. Association of social support and coping strategies with acute coronary syndrome: A case-control study. *J. Cardiol.* **59**, 154–159 (2012).
  14. Wahyuni, I., Wijaya, I. P., Sukrisman, L., Nasution, S. A. & Rumende, C. M. Diagnostic Accuracy of Platelet / Lymphocyte Ratio for Screening Complex Coronary Lesion in Different Age Group of Patients with Acute Coronary Syndrome. **50**, 185–192 (2018).
  15. Dinakrisma, A. A., Wijaya, I. P., Nasution, S. A. & Dewiasty, E. The Role of Fragmented QRS (fQRS) As A Predictor of Major Adverse Cardiac Event within 30 days in Acute Coronary Syndrome Patients: A Retrospective Cohort Study. *Acta Med. Indones.* **51**, 3–9 (2019).
  16. Shlomain, G., Kopel, E., Goldenberg, I. & Grossman, E. The association between elevated admission systolic blood pressure in patients with acute coronary syndrome and favorable early and late outcomes. *J. Am. Soc. Hypertens.* **9**, 97–103 (2015).
  17. Razzolini, R. & Iannaccone, G. Systolic, mean and pulse pressure values in patients with acute coronary syndrome. *Minerva Cardiol. Angiol.* **69**, 277–279 (2021).
  18. Jneid, H. & Michael Lincoff, A. Acute coronary syndromes. *Clevel. Clin. Found. Intensive Rev. Intern. Med. Sixth Ed.* **298**, 341–342 (2014).
  19. Ayhan, H. *et al.* The relationship between acute coronary syndrome and stress hyperglycemia. *Exp. Clin. Endocrinol. Diabetes* **122**, 222–226 (2014).
  20. Ertorer, M. E. *et al.* Newly diagnosed hyperglycemia and stress hyperglycemia in a coronary intensive care unit. *Diabetes Res. Clin. Pract.* **90**, 8–14 (2010).

# Manuscript\_Sri Haryuni\_FINAL rev 1.docx

---

ORIGINALITY REPORT

---

# 19%

SIMILARITY INDEX

---

MATCH ALL SOURCES (ONLY SELECTED SOURCE PRINTED)

---

★"Acute Cardiovascular Care 2016", European Heart Journal: Acute Cardiovascular Care, 2016 5%

Crossref

---

EXCLUDE QUOTES ON

EXCLUDE MATCHES OFF

EXCLUDE BIBLIOGRAPHY ON