narra j

Short Communication

Navigating the aftermath: Risk factors of recurrence following coronary bypass surgery in Indonesia

Adang Bachtiar[1], Cicilya Candi[1], Syarif R. Hasibuan[1,2*], Nisrina Widyasanti[2] and Dian Kusuma[3]

[1]Department of Health Administration and Policy, Faculty of Public Health, Universitas Indonesia, Depok, Indonesia; [2]Center for Health Administration and Policy Studies, Faculty of Public Health, Universitas Indonesia, Depok, Indonesia; [3]Department of Health Services Research and Management, School of Health and Psychological Sciences, City University of London, London, United Kingdom

*Corresponding author: syarif.rahman@ui.ac.id

Abstract

Coronary heart disease (CHD) remains a leading cause of mortality in Indonesia, and coronary artery bypass graft (CABG) surgery is frequently employed to manage arterial blockages. Despite its efficacy, the recurrence of heart disease post-surgery is a significant concern, highlighting the need for a deeper understanding of its influencing factors. The aim of this study was to examine the factors associated with the incidence of heart disease recurrence after coronary bypass surgery. This study employed a prospective observational design, analyzing hospital claim data from Indonesia's Social Security Agency for Health, known as *Badan Penyelenggara Jaminan Sosial* (BPJS) *Kesehatan*, from 2017 to 2022. The analysis included 5,947 patients who survived CABG surgery. Multivariable logistic regression was utilized to assess the relationship between patient demographics, comorbidities, socioeconomic status, and compliance with follow-up visits, as well as their impact on the recurrence of cardiovascular disease. The study found that 24.1% of patients experienced hospitalization recurrence. Patients with irregular follow-ups were less likely to experience recurrence (adjusted odds ratio (AOR): 0.63; 95%CI: 0.51–0.78). Other significant risk factors for recurrence included being self-employed (AOR: 2.09; 95%CI: 1.72–2.55), having comorbid conditions such as disorders of fluid, electrolyte, and acid-base balance (AOR: 3.55; 95%CI: 2.97–4.24), and experiencing cerebral infarction or stroke (AOR: 10.85; 95%CI: 8.24–14.29). In contrast, older age (AOR: 0.89; 95%CI: 0.88–0.91) and the presence of non-insulin-dependent diabetes mellitus (AOR: 0.35; 95%CI: 0.29–0.42) were associated with a lower risk of recurrence. Sex did not significantly influence the risk of recurrence (AOR: 1.18; 95%CI: 0.86–1.62). In conclusion, the study indicates a considerable rate of cardiovascular disease recurrence post-CABG in Indonesia, highlighting several key risk factors. Tailored postoperative management and strict adherence to follow-up protocols are essential for mitigating recurrence. These findings offer crucial insights for improving post-CABG health management strategies in Indonesia.

Keywords: Coronary artery bypass graft, recurrence, BPJS *Kesehatan*, Indonesian national health insurance, risk factors

Introduction

For decades, cardiovascular disease has been the leading cause of death globally. More than half a billion people worldwide are affected by cardiovascular disease, causing 20.5 million deaths in

https://narraj.org/

Received: June 10, 2024 - Accepted: October 2, 2024 - Published online: October 11, 2024

2021 [1]. Cardiovascular disease is a group of heart and blood vessel disorders that includes coronary heart disease, cerebrovascular disease, rheumatic heart disease, and other conditions. One of the most common types of heart disease is coronary heart disease (CHD) [2]. CHD is the second leading cause of death in Indonesia, contributing to 95.68 deaths per 100,000 Indonesian population or around 14.4% of total deaths in Indonesia [3]. Data from Indonesia *Riset Kesehatan Dasar* (RISKESDAS), known as Basic Health Research, shows an increasing trend in the incidence of heart disease, rising from 0.5% in 2013 to 1.5% in 2018 [4].

CHD is one of the heart function disorders caused by plaque buildup on the walls of the coronary blood vessels. This buildup leads to the narrowing or even blockage of the coronary arteries, resulting in a decreased blood supply to the heart [2]. When the heart lacks blood, people with this condition may experience symptoms of heart disease, such as chest pain and shortness of breath. In severe cases, this can even lead to a heart attack [5]. CHD is often caused by the accumulation of cholesterol in the lining of the coronary arteries, which forms plaque and blocks some or all of the blood flow in the large arteries of the heart. This condition is called atherosclerosis, which can be caused by lifestyle factors such as smoking and alcohol drinking [6]. Apart from being caused by lifestyle, there is a significant relationship between hypertension, diabetes mellitus, hypercholesterolemia, and the incidence of CHD [7].

One way to treat CHD is by creating a new pathway using a healthy blood vessel from another part of the body, such as a vein from the leg and an artery from the chest or wrist, so that blood flow does not bypass the blocked part of the coronary artery [8]. This procedure is known as coronary artery bypass graft (CABG), commonly referred to as bypass surgery. This surgery can restore blood supply to the heart muscle when non-surgical procedures have failed [8]. Coronary bypass surgery is an effective procedure for treating unstable angina, with a long-term survival rate extending up to 10 years [9]. A retrospective study of 5,549,700 CHD patients in the United States from 1988 to 2005 also reflected improvements in the quality and cost-effectiveness of CABG, reducing not only hospital costs but also the risk of death from surgery [10]. In addition, CABG is superior to a non-surgical procedure called percutaneous coronary intervention (PCI) for adults with heart disease who also suffer from diabetes. It is considered a better treatment option and can help doctors in preventing heart attacks, strokes, and death in this high-risk group [11]. Another study has shown that CABG is associated with lower mortality rates compared to PCI, especially in patients with diabetes, smokers, heart failure, or patients with peripheral arterial disorders [12].

Lifestyle after CABG will determine the patient's quality of life. The study demonstrated that CABG had a significant and lasting positive effect on physical and mental health up to five years after surgery and remained significantly improved up to 10 years after surgery in a sample of 585 patients [14]. However, having a good quality of life requires efforts to maintain a healthy lifestyle. Based on recommendations from the Stanford School of Medicine and New York University's Medical School, all patients should regularly take medication, be physically active, eat healthy foods, and stop smoking even when their post-operative condition is stable [13]. Furthermore, research shows that pain and depression often appear within 2–12 months after CABG and affect functional recovery after surgery [14]. Both pain and depression, as well as other causal factors, can be the driving force for cases of relapse in post-CABG patients.

A study conducted ten years post-CABG indicated that metabolic syndrome is associated with a heightened risk of myocardial infarction and recurrent congestive heart failure [15]. Another study conducted on long-term survival after CABG identified several predictors associated with mortality, including age, peripheral vascular disease, respiratory disease, reduced ejection fraction, renal dysfunction, arrhythmia, diabetes, hypercholesterolemia, cerebrovascular disease, hypertension, congestive heart failure, steroid use, and smoking. The effects of these predictors varied at different time intervals [16]. Peripheral vascular disease and congestive heart failure present at hospital admission were not significantly linked to mortality between 31 and 90 days but were associated with higher mortality rates in the subsequent period [16]. Hypertension was only associated with mortality three years after surgery. Diabetes, steroid use, and cerebrovascular disease were significant predictors of mortality between 1–3 years and beyond three years. Older age and smoking consistently showed a strong association with mortality across all time periods. Respiratory diseases, reduced ejection fraction, severe renal dysfunction, and

arrhythmia were significantly linked to mortality, although the hazard ratios decreased over time. Hypercholesterolemia was not significant during the first interval but became a protective factor after one year and onwards [16].

CHD is the second leading cause of death in Indonesia, with prevalence and mortality increasing significantly in recent years [3]. CABG has been proven to be effective in treating CHD, especially among patients with certain health conditions [11]. However, there are challenges to maintaining the quality of life for post-surgery patients [17]. Various studies have shown that several factors are associated with the recurrence of heart disease after coronary bypass surgery [12,15,16,18,19]. However, there is still a lack of understanding regarding the factors that potentially lead to recurrence. Therefore, the aim of this study was to determine the factors associated with the incidence of heart disease recurrence after coronary bypass surgery using data from Indonesia's Social Security Agency for Health, known as *Badan Penyelenggara Jaminan Sosial* (BPJS) *Kesehatan*.

For academic and research purposes, since 2018, BPJS *Kesehatan*, which administers of the National Health Insurance (*Jaminan Kesehatan Nasional*—JKN) program, has published public-domain sample data [20]. Research using this data is still limited, even among Indonesian scholars. Previous studies using BPJS *Kesehatan* sample data have primarily focused on service utilization. For instance, a study in 2022 examined the utilization of dental services under Indonesia National Health Insurance coverage [21]. In 2024, another study analyzed the utilization of hospitalization care for toddlers with pneumonia [22]. However, these studies did not delve into specific clinical outcomes, such as relapse rate. Our study builds on this foundation by providing a detailed analysis of relapse cases following coronary artery bypass graft surgery, offering new insights into the effectiveness and challenges of postoperative care within the Indonesia National Health Insurance Program.

Methods

Research design and participation

This study used a cross-sectional observational design utilizing data from patients undergoing coronary bypass surgery between January 1, 2017 and December 31, 2022. The inclusion criteria in this study were: (1) patient aged ≥18 years; (2) minimum length of hospital stay of 24 hours; (3) have a claim code recorded as coronary bypass surgery from Indonesia Case Based Group (INA-CBG) and have a procedure recorded as coronary bypass surgery in the International Classification of Diseases, International Clinical Modification version (ICD-9 CM) version 2010 (tabular index to procedures 36.10–36.19 which is operations on vessels of heart with sub-group bypass anastomosis for heart revascularization); (4) the patient had to survive and be discharged alive from hospital after surgery; and (5) remained alive until December 2022. The membership status in the BPJS *Kesehatan* sample data, which includes categories such as active, inactive (due to non-payment of premiums), and deceased, was used to determine the inclusion criteria of the sample in this study up to December 2022. This allowed researchers to accurately identify whether the sample was still alive during the study period. The exclusion criteria in this study were patients who had missing data for the variables analyzed.

Data source and sampling of the sample data from BPJS *Kesehatan* from 2017 to 2022 was utilized. Several considerations were taken into account during data collection and analysis to ensure robust and reliable results [20]. The sample size was selected to be large and representative, providing a reliable basis for analysis. It had a sufficient distribution across different regions, allowing for analysis at national, provincial, and district/city levels. Each participant of BPJS *Kesehatan* is registered with a single primary healthcare provider (*Fasilitas Kesehatan Tingkat Pertama* or FKTP), which divides the entire population of BPJS *Kesehatan* participants [20]. Given that the utilization behavior of BPJS *Kesehatan* services is assumed to be highly correlated at the family level, with the family being the unit of registration, the sampling process used the family as the sampling unit rather than individual participants. To ensure adequate data on service utilization, over-sampling was conducted for participants who accessed services, as the number of participants utilizing services was lower compared to those who did

not [20]. This non-proportional sampling ensured a sufficient quantity of data related to service utilization behaviors.

BPJS *Kesehatan* has released sample data that includes participant and service data from 2015 to 2022, along with additional data for participants registered in 2022. To represent the most current conditions, the sample was supplemented with new participants who joined BPJS *Kesehatan* in 2022, as well as service data for these participants for that year. A more detailed description of the data collection and sampling methodology can be found at the official BPJS *Kesehatan* guidelines of the data sample method [20]. After weighting, a total of 7,896 patients underwent bypass surgery from 2017 to 2022, and 5,947 patients met the inclusion criteria.

Variable, outcome, and conceptual framework

The dependent variable of this study was recurrence incidence, which was examined from the incidence of hospitalization claims with a primary diagnosis of cardiovascular disease after the coronary bypass surgery. This study observed: (1) comorbidities seen based on International Classification of Diseases (ICD)-10 diagnosis codes recorded in claims data; (2) socioeconomic variables (age, gender, and social health insurance member segmentation); and (3) follow-up visit compliance as seen through the date of the outpatient visit to the cardiologist after coronary bypass surgery. Compliance with follow-up visits was categorized into (1) regular (at least did a follow-up visit once a year after coronary bypass surgery) and (2) not regular (have not had a follow-up visit after coronary bypass surgery in one year).

Data analysis

The statistical analysis was aimed to identify predictors of recurrence after coronary artery bypass surgery. A multivariate logistic regression analysis was performed to identify significant recurrence-associated factors and control for potential confounding factors. The independent variables included age, sex, comorbidities (such as diabetes mellitus and hypertension), social health insurance member segmentation, and compliance with follow-up visits. The dependent variable was the occurrence of recurrence after bypass surgery. The analysis was conducted prospectively, following patients who underwent coronary artery bypass surgery from January 1, 2017, through December 2022. Patients were monitored until December 31, 2022. The risk was calculated for odds ratios (OR) and adjusted OR (AOR) with 95% confidence intervals (CI) and *p*-values for each independent variable.

Results

Patient characteristics

Of the total 5,947 patients included in the study, around 24.1% experienced a recurrence, while 75.9% did not have a recurrence after undergoing CABG. Regarding follow-up care compliance, 75.8% had regular post-surgery follow-up visits, whereas 24.2% had irregular follow-up visits (**Table 1**).

Table 1. Characteristics of post-coronary artery bypass graft (CABG) surgery patients (n=5,947)

Variable	n	%
Recurrence status		
Not recurrent	4,512	75.9
Recurrent	1,435	24.1
Follow-up care compliance		
Regularly	4,506	75.8
Not regularly	1,441	24.2
Sex		
Male	5,618	94.5
Female	329	5.5
Social health insurance member segmentation		
Dependent-employed	3,357	56.4
Self-employed	2,590	43.6
Atherosclerosis (ICD-10: I25)		
No	0	0
Yes	5947	100
Non-insulin-dependent diabetes mellitus (ICD-10: E11-E14)		

Variable	n	%
No	2,848	47.9
Yes	3,099	52.1
Other disorders of fluid, electrolyte, and acid-base balance (ICD-10: E87.1-E87.8)		
No	3.373	56.7
Yes	2,574	43.3
Hypertensive diseases (ICD-10: I10-I15)		
No	1,761	29.6
Yes	4,186	70.4
Heart failure (ICD-10: I50)		
No	2,105	35.4
Yes	3,842	64.6
Acute myocardial infarction (ICD-10: I21-I22)		
No	4,979	83.7
Yes	968	16.3
Cerebral infarction and stroke, not specified as hemorrhage or infarction (ICD-10: I63-I64)		
No	5,486	92.2
Yes	461	7.8
Diseases of the respiratory system (ICD-10: J00-J99)		
No	3,376	56.8
Yes	2,571	43.2
Age (in years)		
Median	60	
Maximum	76	
Minimum	39	

ICD-10: International Classification of Diseases, tenth version

In terms of sex, the majority of the sample was male (94.5%) and had dependent-employed insurance (56.4%). Upon Examining comorbid conditions, it was found that all patients had atherosclerosis, 52.1% had non-insulin-dependent diabetes mellitus, and 43.3% had other disorders of fluid, electrolyte, and acid-base balance. Hypertension affected 70.4% of the patients, while heart failure was present in 64.6% of patients. Acute myocardial infarction was reported in 16.3% of patients. Cerebral infarction and stroke, not specified as hemorrhage or infarction and respiratory system diseases, were presented in 7.8% and 43.2% of patients, respectively. The median age of the sample was 60 years.

The current findings contradict from conventional expectations, which suggest that patients who have regular follow-up care would exhibit lower recurrence rates. The current study reveals a contrasting finding that patients who had irregular follow-ups exhibit a significantly lower likelihood of recurrence compared to those who had regular follow-ups (AOR: 0.63; 95%CI: 0.51–0.78). Male and female patients showed no significant difference in recurrence risk (AOR: 1.18; 95%CI: 0.86–1.62). Self-employed patients had a higher risk of recurrence compared to dependent-employed patients (AOR: 2.09; 95%CI: 1.72–2.55). Patients with non-insulin-dependent diabetes mellitus had a lower risk of recurrence (AOR: 0.35; 95%CI: 0.29–0.42), while those with other disorders of fluid, electrolyte, and acid-base balance had a higher risk of recurrence (AOR: 3.55; 95%CI: 2.97–4.24). Hypertension and heart failure did not show a significant impact on recurrence. Patients with acute myocardial infarction did not show a significant difference in recurrence risk (AOR: 1.05; 95%CI: 0.84–1.31).

Patients with cerebral infarction and stroke had a significantly higher risk of recurrence (AOR: 10.85; 95%CI: 8.24–14.29). Those with respiratory system diseases also had a higher risk of recurrence (AOR: 1.62; 95%CI: 1.35–1.93). Increasing age was associated with a lower risk of recurrence (AOR: 0.89; 95%CI: 0.88–0.91), indicating that older patients were less likely to experience recurrence. The detailed multivariate analysis results are presented in **Table 2**. Among all variables analyzed, cerebral infarction and stroke were the most influential factors associated with the highest risk of recurrence. This indicates that patients with a history of cerebral infarction and stroke are significantly more likely to experience hospitalization recurrence compared to other factors.

Table 2. Multivariable logistic regression showing factors associated with recurrence incidence following coronary artery bypass graft (CABG)

Variables	Recurrent		Not recurrent		AOR (95%CI)
	n	%	n	%	
Follow-up visit					
Regularly	1,034	22.9	3,472	77.1	Ref
Not regularly	401	27.8	1,040	72.2	0.63 (0 51–0.78)*
Sex					
Male	135	22.7	459	77.3	Ref
Female	1,300	20.5	5,055	79.5	1.18 (0.86–1 .62)
Age (years)					0.89 (0.88–0.91)*
Social health insurance member segmentation					
Dependent-employed	671	25.9	1,919	74.1	Ref
Self-employed	764	22.8	2,593	77.2	2.09 (1.72–2.55)*
Non-insulin-dependent diabetes mellitus (ICD-10: E11-E14)					
No	975	34.2	1,873	65.8	Ref
Yes	460	14 .8	2,639	85.2	0.35 (0.29–0.42)*
Other disorders of fluid, electrolyte, and acid-base balance (ICD-10: E87.1-E87.8)					
No	483	14.3	2,890	85.7	Ref
Yes	952	37	1,622	63	3.55 (2.97–4.24)*
Hypertensive diseases (ICD-10: I10-I15)					
No	540	30.7	1,221	69.3	Ref
Yes	895	21.4	3,291	78.6	0.89 (0.73–1 .11)
Heart failure (ICD-10: I50)					
No	430	20.4	1,675	79.6	Ref
Yes	1,005	26.2	2,837	73.8	1.21 (0.98–1 .49)
Acute myocardial infarction (ICD-10: I21-I22)					
No	1,053	21.1	3,926	78.9	Ref
Yes	382	39.5	586	60.5	1.05 (0 .84–1 .31)
Cerebral infarction and Stroke, not specified as hemorrhage or infarction (ICD-10: I63-I64)					
No	1,100	20.1	4,386	79.9	Ref
Yes	335	72.7	126	27.3	10.85 (8.24–14.29)*
Diseases of the respiratory system (ICD-10: J00-J99)					
No	488	14.5	2,888	85.5	Ref
Yes	947	36.8	1,624	63.2	1.62 (1.35–1.93)*

The multivariate analysis was adjusted for age, sex, comorbidities (including non-insulin-dependent diabetes mellitus, other disorders of fluid, electrolyte, and acid-base balance, hypertensive diseases, heart failure, acute myocardial infarction, cerebral infarction and stroke, and diseases of the respiratory system), employment status, and follow-up care compliance. AOR: adjusted odds ratio; ICD-10: international classification of diseases, tenth version. *Statistically significant at $p<0.05$

Discussion

The findings from this present study offered valuable insights into the factors influencing recurrence after coronary bypass surgery, focusing on follow-up visit compliance, demographic factors, employment status, and comorbidities. The results revealed that patients who had irregular follow-ups were less likely to experience recurrence compared to those who had routine follow-up visits (AOR: 0.63, 95%CI: 0.51–0.78). A Previous study on recurrence following gastric cancer surgery revealed that patients who attended follow-ups consistently had a higher recurrence rate (17%) compared to those with less frequent follow-ups (11.4%) (p=0.041), likely due to earlier detection [23]. The regular or intensive follow-ups allowed for earlier detection of recurrence [24]. A study conducted in Canada in 2021 supports this finding and highlights the importance of regular follow-up visits in the early detection and effective management of complications [25]. Nevertheless, further analysis is required to confirm this, including an examination of the timing of recurrence (whether it occurred before or after routine follow-up), the type of patient visits (referrals or emergency unit admissions), and the role of early detection in patients who attend regular follow-ups.

The present study found no significant difference in recurrence risk between male and female patients, suggesting that gender may not be a major determinant of recurrence risk in this population. This finding was contrary to a previous study conducted in Italy in 2016, which indicated higher risks for men due to earlier onset of cardiovascular disease and different health behaviors [19]. The lack of association between gender and recurrence risk in this study could have been due to the homogeneous nature of the study population in terms of treatment and follow-up care; improved medical management and equitable healthcare access in recent years might have reduced gender disparities in recurrence risk [26]. Additionally, the sample size might have limited the statistical power to detect significant differences, particularly if the actual effect size was small [27]. Age and recurrence risk had a significant inverse association (OR: 0.89; 95%CI: 0.88–0.91). The unexpected result might be attributed to the intensive management and strict adherence to medical recommendations typically given to older patients, which often led to improved long-term outcomes [28]. Older patients tended to comply better with treatments and follow-up care, possibly due to heightened health awareness [29]. This finding might reflect a selection bias where healthier, more resilient older patients underwent surgery, contributing to their lower recurrence risk. Effective management of comorbid conditions like hypertension and diabetes further supported these outcomes [26].

Social health insurance member segmentation emerged as a significant factor, with self-employed patients exhibiting a higher risk of recurrence compared to dependent-employed patients (OR: 2.09; 95%CI: 1.72–2.55). The increased risk in the self-employed group could have been attributed to differences in access to healthcare services, variability in health insurance coverage, and the challenge of balancing work demands with health needs [18]. Self-employed individuals may have had less structured access to regular medical check-ups and support systems that were more readily available to dependent-employed individuals [26].

The presence of comorbid conditions significantly influenced recurrence risk. Patients with non-insulin-dependent diabetes mellitus had a lower risk of recurrence, possibly due to better management and close monitoring of their condition [30]. Patients with disorders of fluid, electrolyte, and acid-base balance faced a higher risk of recurrence, highlighting the complexity and severity of managing these conditions post-surgery [31]. Patients with cerebral infarction and stroke had a significantly higher risk of recurrence, underscoring the severe impact of cerebrovascular events on long-term outcomes after coronary bypass surgery [32]. Additionally, patients with diseases of the respiratory system also had a higher risk of recurrence. This finding suggested that respiratory comorbidities could exacerbate the overall burden of cardiovascular disease and complicate recovery post-surgery [29]. However, having comorbidities such as hypertensive diseases and heart failure did not show a significant impact on recurrence, suggesting that these conditions may have been well-managed in the studied population, thereby not contributing to an increased recurrence risk. Similarly, patients with acute myocardial infarction did not show a significant difference in recurrence risk, indicating that post-operative care protocols may have effectively mitigated the risks associated with this condition [33].

Although providing a large sample, the limitation of this study is that the data used in this research may not include detailed information about patient behavior, postoperative lifestyle management, and psychosocial factors that can have a major influence on the risk of recurrence [34,35]. Also, the limitation of information regarding the details of medical interventions or compliance with treatment recommendations may have also influenced the results. As an observational study, this research faced obstacles in establishing cause-and-effect relationships between variables. Although multivariable logistic regression analysis could identify associations, there was still the potential for confounding bias from variables that were unmeasured or not included in the model. For instance, lifestyle factors such as diet, physical activity, smoking status, and adherence to prescribed medications, which were not captured in this dataset, could have influenced the recurrence of cardiovascular events. Additionally, psychosocial factors such as stress levels and social support, which were also not measured, may confound the associations observed in this study. The results of this study may not be fully generalizable to other contexts or populations, especially in countries with different health systems, socioeconomic factors, and lifestyles, even across provinces and regions, districts or cities in Indonesia. This study may not fully reflect variations in clinical practice and medical decision-making affecting the management of patients following coronary bypass surgery, which can vary widely between healthcare providers. Although it highlighted the importance of postoperative lifestyle in determining patient quality of life, this study may not have sufficiently detailed data on patient quality of life, which is an important aspect in evaluating the long-term success of CABG interventions. Addressing limitations in this research, follow-up research could involve prospectively collected primary data, including details about postoperative management, direct measurements of adherence to medication and lifestyle, and study designs that allow a more robust assessment of causal relationships.

Conclusion

This study identifies several key risk factors for recurrence after coronary bypass surgery. Older patients who have irregular follow-up visits demonstrate a significantly lower likelihood of recurrence compared to younger patients and those with routine follow-up visits, highlighting an unexpected pattern in postoperative care outcomes. Self-employed patients and those with comorbidities are likely to experience recurrence after surgery. By identifying the key predictors of recurrence, healthcare providers can implement tailored post-operative strategies to reduce recurrence rates and improve long-term outcomes for CABG patients. While this study highlights significant predictors, it is essential to recognize that other unmeasured factors—such as lifestyle changes, medication adherence, or genetic predispositions—may also contribute to recurrence risk. By investigating these additional factors, researchers gain a more comprehensive view of the causes behind recurrence that enable healthcare providers to design more personalized treatment plans, ultimately improving post-CABG patient management and reducing the likelihood of recurrence.

Ethics approval

The Research and Community Engagement Ethical Committee Faculty of Public Health Universitas Indonesia has proceeded with the ethical assessment procedure of this research and has been approved for implementation with ethical approval number 573/UN2.F10.D11/PPM.00.02/2024.

Acknowledgments

We acknowledge Universitas Indonesia for providing a supportive research environment and BPJS *Kesehatan* for data accessibility.

Competing interests

All the authors declare that there are no conflicts of interest.

Funding

Our research was funded by the Directorate of Research and Community Service, Universitas Indonesia (NKB-710/UN2.RST/HKP.05.00/2023). The funder had no role in the study design, data collection, analysis/interpretation, or preparation of the manuscript.

Underlying data

Derived data supporting the findings of this study are available from the corresponding author on request.

How to cite

Bachtiar A, Candi C, Hasibuan SR, *et al*. Navigating the aftermath: Risk factors of recurrence following coronary bypass surgery in Indonesia. Narra J 2024; 4 (3): e969 - http://doi.org/10.52225/narra.v4i3.969.

References

1. World Heart Federation. World Heart Report 2023: Confronting the world's number one killer 2023. Geneva: World Heart Federation; 2023.
2. Libby P. Braunwald's heart disease-E-book: A textbook of cardiovascular medicine. Amsterdam: Elsevier Health Sciences; 2021.
3. World Health Organization. Global health estimates: Leading causes of death 2000-2021. Available from: https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/ghe-leading-causes-of-death. Accessed: 4 February 2024.
4. Indonesia Ministry of Health. Laporan nasional riskesdas 2018. Available from: https://repository.badankebijakan.kemkes.go.id/id/eprint/3514/. Accessed: 4 February 2024.
5. Centers for Disease Control and Prevention. Coronary artery disease 2021. Available from: https://www.cdc.gov/heartdisease/coronary_ad.htm. Accessed: 4 February 2024.
6. NHS. Overview - Coronary heart disease 2024. Available from: https://www.nhs.uk/conditions/coronary-heart-disease/. Accessed: 2 April 2024.
7. Bachtiar L, Gustaman RA, Maywati S, *et al.* Faktor risiko yang berhubungan dengan kejadian penyakit jantung koroner (PJK) (Analisis Data Sekunder di Rumah Sakit Umum Daerah Kabupaten Subang). Available from: http://repositori.unsil.ac.id/7663/. Accessed: 2 April 2024.
8. John Hopkins Medicine. Coronary Artery Bypass Graft Surgery | Johns Hopkins Medicine. Available from: https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/coronary-artery-bypass-graft-surgery. Accessed: 10 July 2024.
9. Rahimtoola SH, Nunley D, Grunkemeier G, *et al.* Ten-year survival after coronary bypass surgery for unstable angina. N Engl J Med 1993;308(12):676-681.
10. Song HK, Diggs BS, Slater MS, *et al.* Improved quality and cost-effectiveness of coronary artery bypass grafting in the United States from 1988 to 2005. J Thorac Cardiovasc Surg 2009;137(1):65-69.
11. National Institutes of Health. Cardiac bypass surgery superior to non-surgical procedure for adults with diabetes and heart disease. National Institutes of Health (NIH). Available from: https://www.nih.gov/news-events/news-releases/cardiac-bypass-surgery-superior-non-surgical-procedure-adults-diabetes-heart-disease. Accessed: 2 April 2024.
12. Hlatky MA, Boothroyd DB, Baker L, *et al.* Comparative effectiveness of multivessel coronary bypass surgery and multivessel percutaneous coronary intervention: A cohort study mark. Ann Intern Med 2013;158(10):727-734.
13. White T. Stents, bypass surgery show no benefit in heart disease mortality rates among stable patients. News Center | Stanford Medicine. Available from: https://med.stanford.edu/news/all-news/2019/11/invasive-heart-treatments-not-always-needed.html. Accessed: 2 April 2024.
14. Morone NE, Weiner DK, Herbeck Belnap B, *et al.* The impact of pain and depression on recovery after coronary artery bypass grafting. Psychosom Med 2010;72(7):620-625.
15. Deo S V., Sundaram V, Wilson B, *et al.* Adverse events after coronary artery bypass grafting in patients with preoperative metabolic syndrome: A 10-year follow-up of the Veterans Affairs Database. J Thorac Cardiovasc Surg 2022;163(6):2096-2103.e3.

16. Karim MN, Reid CM, Huq M, *et al.* Predicting long-term survival after coronary artery bypass graft surgery. Interact Cardiovasc Thorac Surg 2018;26(2):257-263.
17. Perrotti A, Ecarnot F, Monaco F, *et al.* Quality of life 10 years after cardiac surgery in adults: A long-term follow-up study. Health Qual Life Outcomes 2019;17(1):88.
18. Leviner DB, Zafrir B, Jaffe R, *et al.* Impact of modifiable risk factors on long-term outcomes after coronary artery bypass surgery. Thorac Cardiovasc Surg 2021;69(7):592-598.
19. Nicolini F, Vezzani A, Fortuna D, *et al.* Gender differences in outcomes following isolated coronary artery bypass grafting: Long-term results. J Cardiothorac Surg 2016;11(1):10-14.
20. Iwan Ariawan, Sartono B, Wahyuningsih W, *et al.* Data sampel BPJS kesehatan 2015-2022. Jakarta: BPJS Kesehatan; 2022.
21. Avionhela A, Hendrartini Y, Hanindriyo L. Tren dan determinan utilisasi perawatan gigi fasilitas kesehatan tingkat pertama oleh peserta jaminan kesehatan nasional (Analisis data sampel BPJS kesehatan 2015-2020). Yogyakarta: Universitas Gadjah Mada; 2022.
22. Tuti DT, Nurwahyuni A. Faktor-Faktor yang Berhubungan dengan Pemanfaatan Rawat Inap Tingkat Lanjut Pasien Balita dengan diagnosis Pneumonia: Analisis data sampel BPJS kesehatan tahun 2022. J Kesehat Tambusai 2024;5(2):5298-5308.
23. Park SH, Hyung WJ, Yang HK, *et al.* Standard follow-up after curative surgery for advanced gastric cancer: Secondary analysis of a multicentre randomized clinical trial (KLASS-02). Br J Surg 2023;110(4):449-455.
24. Ing TT, So BYJ. Value of intensive follow-up of patients after curative surgery for gastric carcinoma. J Surg Oncol 2007;96(6):503-506.
25. de Waard D, Fagan A, Minnaar C, *et al.* Management of patients after coronary artery bypass grafting surgery: A guide for primary care practitioners. CMAJ 2021;193(19):E689-E694.
26. Humphreys JM, Denson LA, Baker RA, *et al.* The importance of depression and alcohol use in coronary artery bypass graft surgery patients: Risk factors for delirium and poorer quality of life. J Geriatr Cardiol 2016;13(1):51-57.
27. Belle G van. Statistical rules of thumb. New Jersey: John Wiley & Sons; 2008.
28. Joris J, Hans G, Coimbra C, *et al.* Elderly patients over 70 years benefit from enhanced recovery programme after colorectal surgery as much as younger patients. J Visc Surg 2020;157(1):23-31.
29. Stenberg E, Marsk R, Sundbom M, *et al.* Remission, relapse, and risk of major cardiovascular events after metabolic surgery in persons with hypertension: A Swedish nationwide registry-based cohort study. PLoS Med 2021;18(11):1-15.
30. Lee MH, Lee WJ, Chong K, *et al.* Predictors of long-term diabetes remission after metabolic surgery. J Gastrointest Surg 2015;19(6):1015-1021.
31. Thorsteinsson K, Fonager K, Mérie C, *et al.* Age-dependent trends in postoperative mortality and preoperative comorbidity in isolated coronary artery bypass surgery: A nationwide study. Eur J Cardiothorac Surg 2016;49(2):391-397.
32. Kumar P, Casarett D, Corcoran A, *et al.* Utilization of supportive and palliative care services among oncology outpatients at one academic cancer center: determinants of use and barriers to access. J Palliat Med 2012;15(8):923-930.
33. Tseng HS, Chao ZH, Huang SK, *et al.* Utilization of emergency and hospitalization care after coronary artery bypass surgery for patients with ischemic heart disease. Int Heart J 2018;59(5):941-950.
34. Bikmoradi A, Masmouei B, Ghomeisi M, *et al.* Impact of Tele-nursing on adherence to treatment plan in discharged patients after coronary artery bypass graft surgery: A quasi-experimental study in Iran. Int J Med Inf 2016;86:43-48.
35. Hasandokht T, Salari A, Mirbolouk F, *et al.* Medication adherence and quality of life in coronary artery bypass grafting patients, results of retrospective cohort study. Anatol J Cardiol 2016;16(11):895.