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Original Research

Ejection Fraction and Age as Predictors of Sleep Quality after Coronary Artery Bypass Graft (CABG) Surgery

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ABSTRACT

Background: *Coronary Artery Bypass Graft (CABG) requires a longer recovery and high risk of complication including sleep quality. This study aims to identify factors associated with sleep quality in patient post-CABG surgery.*

Methods: *This research used cross-sectional method and consecutive sampling with 100 respondents. The questionnaires used in this study were Pittsburgh Sleep Quality Index (PSQI), International Physical Activity Questionnaire (IPAQ), and Depression Anxiety Stress Scale (DASS).*

Results: *Prevalence of poor sleep quality (51%) was quite high compared to good sleep quality (49%). There was a significant correlation between ejection fraction (p 0,031 OR 4,718), age (p 0,039; OR 3,309), and sleep quality of post-CABG surgery. Results of logistic regression contained 4 variables related to sleep quality: ejection fraction (p 0,017 OR 5,520), age (p 0,026 OR 3,659), beta blockers (p 0,067 OR 8,544) and diabetes mellitus (p 0,145 OR 1,918).*

Conclusion: *Ejection fraction and age as a predictor of sleep quality. Nurses should assess the sleep quality of post-CABG surgery by considering these four variables: ejection fraction ≤ 40%, middle age, moderate-risk beta blockers and type 2 diabetes mellitus.*

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INTRODUCTION

The most common symptoms after CABG surgery were swollen legs (40.6%), sleep disturbances (24.7%), poor appetite (7.6%), dyspnea (21.2%), and chest pain (21.2%) (Oshvandi et al., 2020). Symptoms experienced by patients 2 weeks after CABG surgery were pain, acute sensitivity, limitation of exercise and physical activity, duration of use and side effects of drugs, irritability, anxiety, depression, the certainty of returning to work, and sleep problems. Difficulty maintaining sleep and low sleep efficiency existed common in the first week after cardiac surgery. Even though sleep quality improved over time, sleep disturbances persist until 6 months of recovery (Su & Wang, 2018).

Sleep disturbances following CABG surgery are a multifactorial condition. In addition to being influenced by the postoperative healing process, sleep quality can also be affected by physiological responses to surgery, pain, changes in the care environment, and psychological factors such as anxiety and stress. Persistent sleep disturbances can hinder the recovery process, reduce functional capacity, and diminish patients' quality of life following heart surgery (Franceschini et al., 2020).

The prevalence of poor sleep quality in post-CABG surgery patients was > 50%. Factors that influenced sleep quality 3 months after CABG surgery were the history of diabetes mellitus, body mass index, sedentary lifestyle, gender, degree of heart failure, preoperative anxiety, stress, and depression (Franceschini et al., 2020; Muthukrishnan et al., 2020). Poor sleep quality has harmful effects on postoperative patients, which causes a higher risk of delirium, increased sensitivity to pain, increased risk of cardiovascular disease, and poor recovery (Su & Wang, 2018).

Although various studies have identified factors associated with sleep quality following CABG surgery, existing research findings remain inconsistent, particularly regarding the influence of patients' clinical characteristics and the treatments they receive. Furthermore, most studies have been conducted in developed countries, so the results may not necessarily be generalizable to populations with different healthcare systems, cultures, and risk factors. Therefore, research is needed to evaluate the determinants of sleep quality in post-CABG patients within the context of local populations (Luo et al., 2020).

Postoperative sleep disturbances can weaken immunity and increase susceptibility to infection, high risk of cognitive impairment, increase the risk of cardiovascular and cerebrovascular disease, thereby affecting patient recovery (Luo et al., 2020). Several studies regarding sleep quality have been carried out, but ejection fraction, use of beta blockers, and stress factors are still rarely carried out. In addition to demographic factors and comorbidities, clinical parameters such as left ventricular ejection fraction, beta-blocker use, and stress levels have the potential to influence sleep quality through both physiological and psychological mechanisms. However, these three factors are still rarely analyzed together in a single research model, so the relative contribution of each factor to postoperative sleep quality cannot yet be comprehensively explained (Kumar et al., 2026).

The aim of this study was to determine the factors associated with the quality of sleep in patients after CABG surgery. This study is expected to provide stronger evidence regarding the factors that play the most significant role in determining patients' sleep quality after CABG surgery. The findings may serve as a basis for developing targeted nursing interventions and individualized postoperative care strategies to improve sleep quality and support optimal recovery following CABG surgery.

MATERIALS AND METHOD

The research method used is cross-sectional, the purpose of this study was to determine the factors associated with sleep quality in patients after CABG surgery. Determination of the sample using the sampling technique of consecutive sampling with a sample size of 100 respondents at the Harapan Kita National Heart Center Hospital polyclinic (RSPJNHK). Consecutive sampling is the determination of samples that meet research criteria within a certain time period until the number of samples is met.

The inclusion criteria for the study sample were age ≥ 18 years, 3 months after CABG surgery, and being able to communicate in Indonesian. Three months after CABG surgery is the time needed for recovery (Priscila et al., 2017), this study want to know whether sleep had recovered. Respondent with cognitive impairment, uncooperative and mental disorder are exclusion criteria because their answer bias and not due to the variables in this study.

Data collection uses 4 questionnaires: respondent demographic, Pittsburgh Sleep Quality Index (PSQI score ≤ 5 indicates good sleep quality), Depression, Anxiety, and Stress Scales (DASS, D score ≤ 9 is normal, A score ≤ 7 is normal, S score ≤ 14 is normal), and International Physical Activity Questionnaire (IPAQ score < 600 MET is low activity level). The demographic questionnaire consists of age, sex, weight, height, ejection fraction, date of CABG surgery, beta-blockers, and type 2 diabetes mellitus. PSQI measure sleep quality, reliability test with a score Cronbach's Alpha 0.79, and content validity test results 0.89 (Alim, 2015). DASS measure stress, anxiety, and depression, reliability test with scores Cronbach's Alpha 0.9483, and the results of the construction validity test r > 0.3 (Damanik, 2006). IPAQ measure physical activity, reliability test with value Cronbach's Alpha ≥ 0.767, and validity test results 0.395-0.635 (Abdurrasyid, 2018).

Data were analyzed using univariate (frequency), bivariate (chi-square), and multivariate (logistic regression). Logistic regression is used to analyze the correlation of one or several independent variables with the dependent variable with dichotomous categorical data (good-bad, obedient-disobedient, etc. (Hastono, 2016; Swarjana, 2016). This research has passed an ethical review from the Ethics Committee of the Faculty of Nursing, University of Indonesia after revising and adding input and suggestion from two reviewer (number: Ket-06/UN2.F12.D1.2.1/PPM.00.02/2022) and RSPJNHK (number: UM.01.05/2.2.2/055/2022) as well as a letter of research supervisor permission.

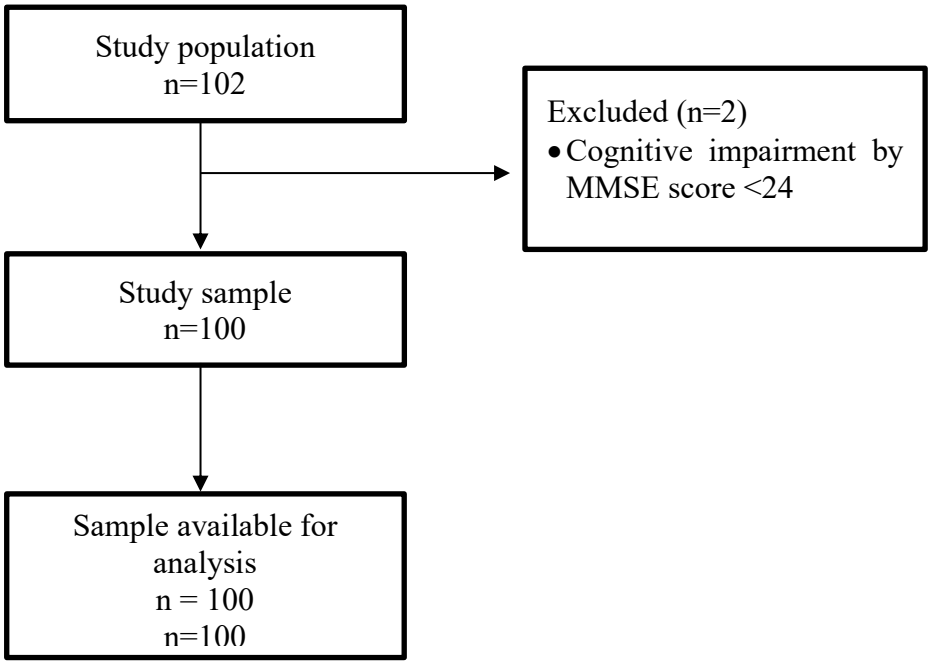

Figure 1. Flow diagram sampling

RESULTS

Table 1 shows data on the characteristics of respondents mostly in middle age 79%, male sex 85%, body mass index 44%, and no history of type 2 diabetes mellitus 58%. Most respondents with HFmrEF-HFpEF 85%, low-risk beta blocker drugs (bisoprolol and nebivolol) 94%, had moderate-high levels of physical activity 62%. The majority of respondents' stress, anxiety, and depression levels were at normal levels, namely 97%, 89%, and 95%.

Table 1. Demographic characteristics of respondents (n =100).

Variable	Category	n (%)
Age	Elderly	21 (21.0)
	Middle adulthood	79 (79.0)
Gender	Male	85 (85.0)
	Female	15 (15.0)
Body Mass Index	Normal	44 (44.0)
	Overweight	22 (22.0)
	Obesity	34 (34.0)
History of Diabetes Mellitus	No	58 (58.0)
	Yes	42 (42.0)
Ejection Fraction	HFmrEF–HFpEF	85 (85.0)
	HFrEF	15 (15.0)
Beta Blocker Risk	Low risk	94 (94.0)
	Moderate risk	6 (6.0)
Physical Activity	Low activity	38 (38.0)
	Moderate to high activity	62 (62.0)
Stress	Normal	97 (97.0)
	Mild to extremely severe	3 (3.0)
Anxiety	Normal	89 (89.0)
	Mild to extremely severe	11 (11.0)
Depression	Normal	95 (95.0)
	Mild to extremely severe	5 (5.0)

Table 2 provides an overview of the components of sleep quality, most of which are subjective sleep quality in the fairly good category of 83%, sleep latency of 16-30 minutes by 40%, duration of sleep 6-7 by 56%, sleep efficiency ≥ 85% by 72%, sleep disturbance with a score of 1-9 as much as 84%, never used sleeping pills 92%, and daytime dysfunction with a score of 1-2 as much as 60%. The overall prevalence of poor sleep quality is 51%. These findings indicate that despite generally favorable scores in several individual sleep components, more than half of the patients were still classified as having poor overall sleep quality following CABG surgery.

Table 2. Description of Sleep Quality Component after CABG Surgery (n=100)

Component	Category	n (%)
Subjective sleep quality	Very good	12 (12.0)
	Quite good	83 (83.0)
	Quite bad	5 (5.0)
	Very bad	0 (0.0)
Sleep latency	0–15 minutes	28 (28.0)
	16–30 minutes	40 (40.0)
	31–60 minutes	25 (25.0)
	>60 minutes	7 (7.0)
Sleep duration	>7 hours	19 (19.0)
	6–7 hours	56 (56.0)
	5–6 hours	20 (20.0)
	<5 hours	5 (5.0)
Sleep efficiency	≥85%	72 (72.0)
	75–84%	23 (23.0)
	65–74%	5 (5.0)
	<65%	0 (0.0)
Sleep disturbance	0	3 (3.0)
	1–9	84 (84.0)
	10–18	12 (12.0)
	19–27	1 (1.0)
Sleeping pills usage	Never	92 (92.0)
	<1 time a week	5 (5.0)
	1–2 times a week	2 (2.0)
	≥3 times a week	1 (1.0)
Daytime dysfunction	0	39 (39.0)
	1–2	60 (60.0)
	3–4	1 (1.0)
	5–6	0 (0.0)

Table 3 can be concluded that ejection fraction and age have a significant correlation to sleep quality after CABG surgery. The variables of diabetes mellitus and beta blockers were included in the multivariate modeling because p <0.25. Thus there are 4 variables analyzed in a multivariate manner.

Table 3. Description of Sleep Quality Component after CABG Surgery (n=100)

Variable	Sleep Quality				Total	%	OR (95% CI)	p *value*
	Bad		Good					
	n	%	n	%				
Age								
Middle Adulthood	45	57	34	43	79	100	3.309 (1.162-	**0.039***

Variable	Sleep Quality				Total	%	OR (95% CI)	p *value*
	Bad		Good					
	n	%	n	%				
Elderly	6	28.6	15	71.4	21	100	9.420)	
Gender								
Female	9	60	6	40	15	100	1.536	
Male	42	49.4	43	50.6	85	100	(0.503-4.693)	0.634
Body Mass Index								
Obesity	19	55.9	15	44.1	34	100		
Fat	10	45.5	12	54.5	22	100	-	0.736
Normal	22	50	22	50	44	100		
Diabetes Mellitus								
Exist	25	59.5	17	40.5	42	100	1.810	
None	26	44.8	32	55.2	58	100	(0.810-4.047)	0.212
Ejection Fraction								
HFrEF	12	80	3	20	15	100	4.718	
HFmrEF-HFpEF	39	45.9	46	54.1	85	100	(1.241-17.931)	**0.031***
Beta Blocker								
Moderate risk	5	83.3	1	16.7	6	100	5.217	
Low Risk	46	48.9	48	51.1	94	100	(0.587-46.376)	0.205
Physical Activity								
Moderate-High Activity	33	53.2	29	46.8	62	100	1.264	
Low Activity	18	47.4	20	52.6	38	100	(0.563-2.839)	0.717
Stress								
Mild-Extremely Severe	1	33.3	2	66.7	3	100	0.470 (0.041-5.356)	0.614
Normal	50	51.5	47	48.5	97	100		
Anxiety								
Mild-Extremely Severe	5	45.4	6	54.5	11	100	0.779 (0.222-2.739)	0.944
Normal	46	51.7	43	48.3	89	100		
Depression								
Mild-Extremely Severe	3	60	2	40	5	100	1.469 (0.235-9.191)	1.000
Normal	48	50.5	47	49.5	95	100		

Table 4 shows that there are 4 variables related to sleep quality after CABG surgery, namely ejection fraction, age, beta blocker, and diabetes mellitus. Independent variables included in multivariate analysis are those with bivariate test p-value < 0.25 (Hastono, 2016).The ejection fraction is the factor that is most significantly related to the quality of sleep after CABG surgery. Post-CABG surgery patients with HFrEF (EF ≤ 40%), middle age, moderate-risk beta blockers, and type 2 diabetes mellitus had a predictive ability of poor sleep quality 22% and the res is explained by the other variables.

Table 4. Multivariate Analysis

Variable	B	Wald	p *value*	OR	Nagelkerke R Square
Ejection Fraction	1.708	5.741	0.017	5.520	
Age	1.297	4.958	0.026	3.659	
Diabetes Mellitus	0.651	2.123	0.145	1.918	**22%**
Beta Blocker	2.145	3.363	0.067	8.544	
Constant	-7.415	12.328	0.000	0.001	

DISCUSSION

Gender and body mass index have no significant correlation to sleep quality, studies with similar results were conducted in Jordan, England and America (Toubasi et al., 2021). Male respondents was greater than women (85% vs 15%). Patients with low levels of education tend to ignore sleep problems and sleep sanitation which will reduce sleep quality. Patients prefer acute symptoms that are felt such as shortness of breath, fatigue, pain, and healing of surgical wounds and others (Toubasi et al., 2021).

Physical activity does not have a significant correlation to sleep quality, the results of this study are different from studies conducted in Italy and Brazil (Dubinina et al., 2021). Most of the respondents were in moderate activity, this was following the recovery period of surgery, which was 3 months. The patient has started doing his daily routine and trying to do homework according to his abilities. There is no significant correlation between diabetes mellitus and sleep quality.

Physical activity and diabetes mellitus variables can occur due to other factors, namely work. Patients who do not work tend to have short sleep duration, decreased sleep efficiency, and increased frequency of waking compared to patients who work. Unemployment affects poor quality in patients (Greissl et al., 2022). Stress, anxiety, and depression do not have a significant correlation to sleep quality.

The results of this study are different from studies conducted in Turkey and Australia (Caruana et al., 2018; Ekici, 2020). The frequency of stress, anxiety, and depression after CABG surgery is mostly at normal levels due to improved physical function and reduced complaints of chest pain, shortness of breath, fatigue, and others compared to before CABG surgery (Yan et al., 2024). Patients who have a poor perception of disease prognosis are at risk of experiencing poor sleep quality 4 times greater than patients who have a good perception of disease prognosis (Edmealem et al., 2020).

Beta blocker variable; 94% of respondents used bisoprolol and nebivolol, both of which are types of beta blockers with a low risk of decreasing sleep quality. Inhibitor drugs angiotensin converting enzyme (ACE) has a side effect of coughing (increased bradykinin), causing leg cramps and joint and muscle pain which can interfere with sleep quality. Antidiuretic drugs increase the frequency of urination thus patients need to be educated about the right time to take the drug thus it doesn't interfere with sleep quality (Tan et al., 2018).

Age has a significant correlation to sleep quality, studies with similar results were conducted in Germany, the Netherlands, and Ethiopia (Seid Tegegne & Fenta Alemnew, 2022; Tan et al., 2018). Middle adults are more at risk of experiencing poor sleep quality than the elderly because middle adults are of productive age, work, have busy schedules, high risk of stress, have light activities, and have unhealthy dietary behavior compared to the elderly (Tan et al., 2018). Middle adults tend to experience more

problems in the components of poor subjective sleep quality, less sleep duration, and long sleep latency.

The elderly tend to experience problems with sleep inefficiency components, sleep disturbances, and daytime dysfunction. Most of the elderly respondents have retired from work, flexible time, adjustment of activity types to energy levels, thus the elderly tend to feel undisturbed by the components of daytime dysfunction (Gadie et al., 2017). Ejection fraction has a significant correlation to sleep quality, the conclusion of the same research was conducted in Iran and China in patients with heart failure and coronary heart disease (Awotidebe et al., 2017; Cheng et al., 2021).

Patients with a low ejection fraction tend to have difficulty breathing during sleep which can reduce sleep quality (Cheng et al., 2021). Sleep disturbances and increased waking up at night in heart failure patients with EF <40% are the causes of poor sleep quality and poor health status (Awotidebe et al., 2017). Result of study by Hajj et al. (2020) showed that there was a significant relationship between NYHA fc III and poor sleep quality.

Research conducted by Mathews et al. (2021) in 47 patients with HFpEF had different results, namely, there was a significant correlation between sleep quality and cardiac dysfunction in patients with HFpEF. Abnormalities in cardiac structure (left ventricular mass) and diastolic function (higher E/e') have a significant association with poorer sleep quality. Social support obtained from spouses, family, closest people, and the environment, allows patients to share their surgical experiences (Karahan et al., 2024). Apart from that, it can also add information about treatment and increase patient motivation during treatment and recovery (Seid Tegegne & Fenta Alemnew, 2022).

The results of logistic regression found that the variables of ejection fraction, age, beta-blockers, and diabetes mellitus were associated with the quality of sleep of patients after CABG surgery. HFrEF (p 0.017; OR 5.520) and middle age (p 0.026; OR 3.659) variable are the predictors of sleep quality. This study facilitates nurses' assessment of patients at high risk for poor sleep quality and supports the provision of specific eduaction related to the causes of poor sleep quality after CABG surgery.

Limitation of this study are social desirability bias, respondents tended to answer question with answers they considered favorable and underreported socially undesirable answers, especially in stress, anxiety and depression variables. In addition, a larger sample size is needed and is carried out in several hospitals so the result can be generalized. These limitations should be considered when interpreting the findings, as they may affect the accuracy of self-reported psychological measures and limit the external validity of the study.

CONCLUSION

HFrEF and middle age are predictors of poor sleep quality in post-CABG surgery patients. Moderate risk beta blocker and a history of diabetes mellitus are the controlling variables. Nurses motivate and provide support to patients and families to routinely do exercise and exercise at home according to clinical conditions and recommendations from the Hospital to improve sleep quality. Early identification of patients at high risk for poor sleep quality may enable nurses to implement targeted interventions that optimize postoperative recovery and enhance patients' quality of life.

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