

Risk Factors for Declined Functional Status within 30 days After Elective Surgeries in Elderly Patients: A Prospective Cohort Study

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ABSTRACT

Background: Older adults are at risk of decreasing functional status due to their condition and many factors. Although many studies have been conducted about declining in functional status, based on the author's knowledge, only this study that has conducted about functional status changes in the elderly involving the frailty status which undergoing surgery in Indonesia. There are many factor was postulated, some of that was checked routine and applicable in clinical practice. Furthermore, identification of these risk factors can be used a basis for decision making to perform surgeries in older adults because poor functional status causes declining quality of life in the elderly patients. The aim of this research was to determine the risk factors for declined functional status within 30 days after elective surgeries in elderly patients. **Methods:** We conducted a prospective cohort study from July 2021 to December 2021 at Dr. Kariadi Hospital, Semarang, Indonesia. We included patients aged 60 or older who underwent elective surgery under general anesthesia. We excluded those who underwent emergency surgery, day care surgery, or were unwillingness to participate. The functional status were assessed using the ADL (Activity of Daily Living) Barthel index. To identify risk factors of declined ADL scores, a logistic regression analysis was performed on the age variable, gender, body mass index, frailty status, postoperative complications, as well as haemoglobin, and albumin levels. **Results:** This study included 191 participants, with 97 women (50.79%) and 94 men (42.21%). Declined in functional status within 30-days after surgery occurred in 54 participants (28.2%). There was a significant changed of functional status before and after surgery. Multivariate analysis showed that independently significant variables for declined functional status were male sex (OR 4.48, p value < 0.001), hypoalbuminemia (OR 2.59, p value 0.02), preoperative functional status (OR 2.37; p value 0.05), and postoperative complications (OR 24.885; p value < 0.001). **Conclusion:** Risk factors for declined functional status within 30 days after elective surgery in older patients are postoperative complications, preoperative functional status, hypoalbuminemia, and male gender.

Keywords: ADL, Barthel index, older adults, surgery.

INTRODUCTION

The growing number of older adults in a population is a public health concern, knowing that more older adults require surgical interventions.¹ According to the Indonesian Central Statistics Agency (BPS), life expectancy of Indonesian older population has increased from 70.1 years in 2010-2015 to 72.2 years in 2030-2035.² Increasing life expectancy rises several medical conditions that require surgeries in older patients such as arteriosclerosis, cancer, arthritis, prostatism, and fractures. Aging per se is a physiological process results in structural changes and decrement in functional capacities of organs over time.³ In older age, there is increased use of physiologic reserves just to maintain homeostasis. Immune competence decline with advancing age, include immunosenescence, decreased production of naïve T cell, and inflamaging. When the body is stressed, fewer reserves are available to meet the challenge.⁴

Surgical procedures are considered as stressors for older patients. Healthy older adults have sufficient reserves that are needed in normal circumstances. However, if they have to undergo surgeries, their bodies must compensate by maximizing their current reserves (homeostasis).⁵

Older people are at risk of decreasing functional status due to their condition and many factors, which one of them is iatrogenesis caused by drugs used in anesthesia during surgery or drugs given after surgery.^{6,7} Although many studies have been conducted about declining in functional status, based on the author's knowledge, only this study that has conducted about functional status changes in the older adults involving the frailty status which undergoing surgery in Indonesia. There are many factor was postulated, some of that was checked routine and applicable in clinical practice. Furthermore, identification of these risk factors can be used a basis for decision making to perform surgeries in the older patients because poor functional status causes declining quality of life in the older patients.⁸ We can optimize the patient's condition before surgery so that we get better functional status after surgery.

The aim of this research was to identify the

factors that affect declined functional status in older people after elective surgery.

METHODS

Study Participants

We conducted a prospective cohort study among 193 inpatients aged 60 years or older who underwent elective surgeries at Dr. Kariadi Hospital Semarang from June 2021 to December 2021. The sample was consecutively collected using inclusion criteria of age ≥ 60 years, admission for elective surgery, and being given general anesthesia. Subjects, who were given local anesthesia or regional anesthesia or who were unwilling to participate, were excluded from the study. Two patients were dropped out because they had psychological problems. There were 191 participants who completed the study. (Figure 1) Potential confounding factors were patient age and type of surgical.

Data Collection

Data on the patient's age, gender, occupation, education, and marital status was obtained from the medical record. Concurrently, two investigators collected preoperative functional status data at the same time. Two internal medicine specialists assessed functional status evaluation before elective surgery using the Barthel index. The Barthel index measures functions status as a parameter of dependency on daily functions. The Barthel index measures ten important functions for being independent, including: eating, bathing, self-care, dressing, urinating, defecating, using the toilet, transferring, mobilizing, and stairs climbing. Patients were followed up within 30 days after surgeries, and their functional status were reassessed by WhatsApp or phone calls to their family or caregivers. Patients who deceased were assumed as patients with high dependency status. We analyzed data functional status before and after surgery with wilcoxon test.

Patients who had decline functional status were analyzed based on the variables of age, gender, body mass index, frailty status, preoperative functional status, surgical complications, haemoglobin levels and albumin levels. Frailty status is defined as a multi-dimensional state resulted from decreased physiological reserves

resulting in reduced resilience, loss of adaptive capacity, and increased vulnerability to stressors. In this study, we used the Clinical Frailty Scale instrument which consists of nine components, then we divide the patients into two groups. Patients that are very fit, well, and managing well grouped into the non-frail group, and patients that are vulnerable, mildly frail, moderately frail, severely frail, and very severely frail components into the frail group. Post-operative complications are defined as undesirable and unexpected consequences that arise after an operation.⁹ In this study, post operative complication was limited to whether or not complications that arose. Anemia is defined as a hemoglobin level below 11.1 G/dl, because in our laboratory we use a normal value of 11.1 G/dl and is based on the WHO definition that anemia is moderate if Hb < 11 G/dl in men or women.¹⁰

The ethical clearance of this study was approved by KEPK Dr. Kariadi Hospital Semarang (No. 842/EC/KEPK-RSDK/2021). Informed consents were obtained from patients who participated in this study. The confidentiality of patients was fully respected during data collection for manuscript preparation.

Statistical Analysis

Categorical variables are presented in numbers and percentages. Continuous variables

are represented as mean and standard deviation, or median and minimum-maximum in non-normally distributed data. We used either Chi Square or Fisher Test to perform bivariate analysis among who experienced decline functional status. The bivariate analysis was carried out on the variable age, sex, BMI (Body Mass Index), vulnerable status, surgical complications, haemoglobin level, and albumin level. The bivariate analysis results with p-value < 0.25 were then included in the multivariate analysis using logistic regression. Multicollinearity analysis and variant inflation factor (VIF) were performed on the independent variables. All statistical analysis were carried out using SPSS. The p value less than 0.05 was considered statistically significant.

RESULTS

Among 191 study participants, 33 (17.3%) of them deceased within thirty days after surgeries. Participants who deceased were assumed to have high dependencies status. We compare ADL scores of participants, before and thirty days after surgeries. The number of participants who had preserved, decreased, and increased ADL scores were 113, 54, and 24 participants respectively. It was show in flowchart on **Figure 1**.

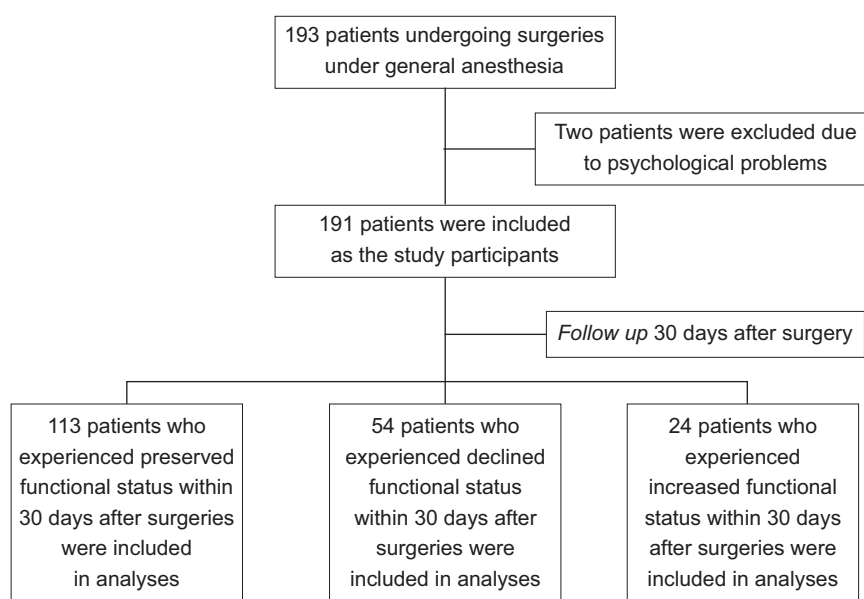


Figure 1. Flowchart from patient selection to analyses

There was a significant changed of functional status before surgery (high dependency 11 %; moderate dependency 14.1 %; mild dependency 15.2 %; independence 59.1 %) and after surgery

(high dependency 25.7 %; moderate dependency 7.9 %; mild dependency 11 %; independent 55.5 %). Data before and after surgery were analyzed with wilcoxon test (p value < 0.001).

Table 1. Baseline Characteristics of Study Participants.

Characteristics	(n=191)
Age	
median (min-max)	66 (60-87)
BMI	
median (min-max)	21.64 (12.64-42.97)
Gender (n, %)	
Men	94 (49.2)
Women	97 (50.8)
Ethnic Group (n, %)	
Java	174 (91.1)
Others	17 (8.9)
Marital Status (n, %)	
Married	161(84.3)
Widow or widower	30 (15.7)
Education (n,%)	
Higher education	15 (7.9)
Senior High School	61 (31.9)
Junior High School	18 (9.4)
Elementary School	76 (39.8)
Not graduated from elementary school	3 (1.6)
No formal education	18 (9.4)
Employment (n, %)	
Government employees	9 (4.7)
Private employees	128 (67)
Unemployedes	54 (28.3)
Type Surgery (n, %)	
Uncomplicated head and neck	51 (26.7)
Endoscopic	44 (23)
Intra-abdominal	32 (16.8)
Related orthopedic	24 (12.6)
Extensive intra-abdominal or intrathoracic with large fluid or blood loss	15 (7.9)
Hip	6 (3.1)
Prostate	5 (2.6)
superficial	5 (2.6)
Major or peripheral vascular	5 (2.6)
Thoracic	4 (2.1)
Comorbidity component (n,%)	
Solid tumor	95 (49,7)
Diabetes mellitus	41 (21,5)
Congestive heart disease	14 (7,3)
Liver disease	12 (6,3)
Myocardial infarction	8 (4,2)
Cerebrovascular disease	6 (3,2)
Chronic kidney disease	4 (2,1)
Hemiplegi	3 (1,6)
Chronic obstructive pulmonary disease	2 (1)
Peptic ulcer disease	2 (1)
Dementia	1 (0,5)
Peripheral vascular disease	1 (0,5)

Information: BMI (Body Mass Index); n, number of samples; min (minimum); max (maximum)

Table 2. Bivariate Analysis of the Variables Contributed to Declined Functional Status Participants

Variables	Declined Functional Status, n (%)	Preserved Functional Status, n (%)	p-value	OR (95% CI)
Age				
≥ 80 years	5 (71.4)	2 (28.6)	0.031*	6.88 (1.294-36.665)
< 80 years	49 (26.6)	135 (73.4)		
Gender				
Men	37 (39.4)	57 (60.6)	0.001*	3.055 (1.567-5.953)
Women	17 (17.5)	80 (82.5)		
BMI				
Underweight	10 (31.3)	22 (68.8)	0.846*	1.188 (0.521-2.709)
Non Underweight	44 (27.7)	115 (72.3)		
Frailty Status				
Frail	33 (28.7)	82 (71.3)	1.000*	1.054 (0.553-2.009)
Fit or pre-frail	21 (27.6)	55 (72.4)		
Having Postoperative Complication				
Yes	24 (82.8)	5 (17.2)	0.00*	21.12 (7.451-59.86)
No	30 (18.5)	132 (81.5)		
Haemoglobin level				
Anemia (<11,1 G/dl)	30 (34.5)	57 (65.5)	0.114*	1.754 (0.929-3.311)
No Anemia (≥ 11,1 G/dl)	24 (23.1)	80 (76.9)		
Albumin level				
< 3,5 G/dl	38 (39.2)	59 (60.8)	0.001*	3,140 (1.599-6.166)
≥ 3,5 G/dl	16 (17.0)	78 (83.0)		
Preoperative ADL scores				
Dependency (0-49)	23 (47.9)	25 (52.1)	0.001*	3.324(1.664-6.640)
Not Dependency	31 (21.7)	112(78.3)		

*Chi-square test, BMI (Body Mass Index)

Table 2 describes the multivariate analysis of this study. Variables that have p-values <0.25 were included. They were age, gender, postoperative complications, haemoglobin levels, albumin levels, and preoperative ADL score. **Table 3** shows the results of the multivariate analysis of variables which contributed to the declined functional status, as presented by lower ADL score.

DISCUSSION

In this study, 17.3% of the study participants deceased. This proportion is higher than the study conducted by Amemiya et.al, with a

mortality rate of 0.4%. This disparity could be attributed to different characteristics of study participants, since Amemiya et.al conducted their study focused on inpatients with gastric and colorectal cancer, longer life expectancy in Japanese population than Indonesian, and there is a standard operating procedure for gastric and colorectal cancer surgery, namely resection of the primary tumor and involved lymphadenopathy in Japan.¹¹

In this study, the functional outcome was worsened in 54 participants (28.27%) and better in 24 participants (12.57%) 30 days after surgery. There was a significant changed

Table 3. Multivariate Analysis of Variables Contributing to Decline.

	Coefficient	S.E	Wald	df	p-value	OR	95% CI	
							minimum	maximum
Having postoperative complication	3.088	.575	28.878	1	.000*	21.398	7.113	67.664
Preoperative ADL scores	0.862	.439	3.857	1	.050	2.369	1.002	5.601
Albumin < 3.5 G/dL	0.953	.436	4.772	1	.029*	2.593	1.103	6.097
Hb < 11.1 G/dl	.766	.421	3.314	1	.069	2.151	.943	4.906
Male gender	1.500	.439	11.678	1	.001*	4.480	1.896	10.590
Constant	-3.533	.564	39.270	1	.000*	.029		

of functional status before and after surgery. This findings are in line with a study conducted by Kwon et.al which also found a significant decline in functional status. Declined functional status is common in older adults who undergo surgeries.¹² The expected general functional outcome in this study is better post-operative ADL score compared to preoperative ADL score, or a return to normal functional status before having illness. Good functional status, allows the patients to be more independent. Measurement of functional outcomes plays a significant role in the management of older patients. To date, measurement of functional status is not routinely assessed in older patients who will undergo a surgery.^{5,13}

In this study, preoperative ADL components were based on the Barthel index (eating, bathing, self-care, dressing, urinating, defecating, toileting, transferring, mobility, and stair climbing). One of the strengths of Barthel's Index compared to Katz's is that it describes disabilities more clearly and can detect functional changes in more detail.^{14,15} The Barthel index is also a recommended functional capacity test in older patients.¹⁶

In this study, patients who had declined ADL scores appeared to be older, than those who did not have declined ADL scores. Old age is a physiologic process where structure and functional capacity of organ and tissue progressively degenerate over time. The human body has the capability to compensate for age-related changes to some extent, but older people have a limited physiologic reserve that can become decline ADL on application of stressor.³ According to Hairi et al.'s research, old age is the variable associated with limitations in functional status. De Vasconcelos Torres' research also indicates an increase in dependency on ADL as one gets older.^{14,17,18}

Data on the characteristics of participants showed women are less likely to have decreased ADL score compared to men participants (p-value <0.001). This might be caused by beneficial immunomodulatory effect of estrogen. Estrogen has been proved to regulate neutrophil number and function, and the production of chemokines such as monocyte chemoattractant

protein (MCP)-a and cytokines including tumor necrosis factor (TNF)- α , interleukin (IL)-6 and IL-1 β .^{19,20} This aligns with research conducted by Nicole Veronese and friends regarding research to find association between gender and frailty in older patients.²¹

In this study, we found that male gender, hypoalbuminemia, anemia, postoperative complications, and dependence preoperative functional level are all variables that contribute to the declined functional status after surgery. In Kwon's study, male sex was likewise associated with declined functional status within one month after surgery, with an OR of 3.05 (95% CI 1.41-6.58).¹² Albumin level less than 3.5 g/dl has an effect on declined functional status after surgery with OR 2.59 (95% CI: 1.103-6.097) and p-value = 0.029. Research conducted by Hsu et.al also found that albumin level was associated with to functional status after surgery with p<0.001.²² This study found that anemia affected the decline in functional status after surgery with OR 2.151 (95% CI 0.943-4.906). This is in accordance with a study conducted by Pennix et.al which showed that the decline in physical performance was higher in older patients with anemia compared to those without anemia, 2.3% vs 1.4% respectively (p=0.003).^{23,24} Surgical complications were one of the causes of declined functional status with OR 21.39 (95% CI 7.113-67.664, p<0.001). The results are accordance with a study conducted by Zhang et.al on the decline in functional status thirty days after surgery, especially postoperative delirium with OR 2.20 (95% CI 1.60-3.02, P<0.001).²⁵ Preoperative ADL score lowered postoperative ADL score by OR 3.324 (95% CI 1.664-6.640, p<0.001). These findings are remarkably similar to those of Finlayson's study in older patients undergoing colon cancer surgery, which found that preoperative functional status affected postoperative functional status. (ARR: 1.21, 95% CI 1.11-1.32).²⁶ Greer's study yielded the same results, with an RR of 0.55 (95% CI 0.36-0.74).²⁷

Hypoalbumin plays important role in decreasing functional status after surgery because it is an indicator of malnutrition which plays a direct protective role through several biological mechanisms (such as molecular transport and the

main contributor in regulating colloid osmotic oncotic pressure), and plays an important role in the physiology of homeostasis.^{28,29} Preoperative anemia plays a role in decreasing functional status through their influence on increasing cardiac events, infectious complications, respiratory failure, kidneys, and central nervous system including the incidence of delirium.^{10,30} In this study, frailty was not significantly associated with decreased functional status. The possible explanation is frailty measured in an acute setting, so that the frailty score obtained may be higher due to effects that precede the disease (such as infection, new drugs).³¹

The age variable was significant in the bivariate analysis, but it was not significant in the multivariate analysis. There was no collinearity in the independent variables based on the tolerance test results for each variable which was larger than 0.4, and the VIF value was less than 10. Surgical complications are the most significant risk factor for declined ADL. This finding emphasizes the importance of joint action between geriatricians with the surgeons to identify the risk factors for surgical complications, improve the modifiable risk factors before surgeries, and warn the surgeons to perform the surgeries carefully to avoid these complications. The limitations of this study did not conduct analysis post-operative complications based on the severity of the complications and did not determine the time of decline in functional status. Future research needed to analyze the time in declining functional status which can be used in survival analysis (Cox regression).

CONCLUSION

Functional status is a parameter that can be used in patients undergoing surgery. Patients who have independent or mild dependent status may be advised to undergo surgery, whereas patients with moderate and severely dependent functional status may be advised to choose palliative treatment. Before surgery, the optimization of albumin and haemoglobin levels was necessary in older patients. Coordination with surgeons who will perform surgeries in older patients is crucial in identifying and correcting risk factors

for post-surgical complications and improving good surgical techniques to reduce the incidence of complications.

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DISCLOSURE STATEMENTS

The authors declare no conflict of interest.

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