



JIMMA UNIVERSITY  
INSTITUTE OF HEALTH  
FACULTY OF MEDICINE

DEPARTMENT OF ANESTHESIOLOGY, CRITICAL CARE AND PAIN  
MEDICINE

**PROSPECTIVE CROSSECTIONAL STUDY ON PREVALENCE OF  
POST OPERATIVE ANEMIA AND ASSOCIATED FACTORS AMONG  
ADULT PATIENTS UNDERGOING MAJOIR ELECTIVE SURGERY  
AT JIMMA UNIVERSITY MEDICAL CENTER, 2022**

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## ACRONYMS

AOR Adjusted Odds Ratio

CI Confidence Interval

DBP Diastolic Blood Pressure

ETB Ethiopian Birr

JUMC Jimma university medical center

MOH Ministry of Health

NCD Non Communicable Disease

OR Odds Ratio

POA post-operative anemia

SD Standard Deviation

SOPs Standard operational procedures

SSA Sub Saharan Africa

ASA American society of anesthesiologist

RBL Relative blood loss

## SUMMARY

**Background:** Post-operative anemia is a condition seen on individuals passing under major elective surgery. It is an independent factor associated with perioperative stroke, heart failure, arrhythmias, renal impairment, and death in patients that undergone both cardiac and non-cardiac surgery. All of these negative impacts of post-operative anemia have huge cost implications especially for developing countries. This study will improve post-operative anemia management by fully addressing potential predictors. Additionally, it will play a significant role in helping physicians enhance safety of their patients. It will eventually act as a starting point or baseline for new studies on the area. So this study aims to assess overall prevalence of post-operative anemia and associated factors.

**Objective:** To assess prevalence of post-operative anemia and associated factors among adult major elective surgical patients in Jimma university medical center August 2022- February, 2023.

**Method:** A institution-based Cross sectional study was carried out from November 1 to December 30, 2022 at Jimma university medical center using a pretested semi-structured questionnaire adapted from different literatures through face-to-face interviews. Data was checked for its completeness, edited, cleaned, coded and entered in to EPI data version 4.6 and then exported to statistical package or the social science (SPSS window version 26) for analysis. Assumption of logistic regression and the result of assumption was checked. To find potential predictors, bi-variable logistic regression was used for each predictor and outcome variable. Those with  $P < 0.25$  was entered to multivariate logistic regression. A p value of  $< 0.05$  was considered as statistically significant and Hosmer-Lemeshow goodness of fit tests was used to evaluate the model's fitness. Finally findings presented using figures, AOR, percentage and summary table.

**Result;** The median age of participants was 42 years. Also, ninety five (51.1%) were females. Whereas, 67 (36%) can't read and write. 127 (68.3%) had a normal preoperative hemoglobin level. GA was used for 103 (55.4%). Likewise, 122 (65.6%) had an intraoperative blood loss of less than 500 ml. In the present study, 49 (26.3%) had comorbidity. In this study the prevalence of Post-Operative Anemia was 105 (56.5%). preoperative anemia,  $> 1000$ ml blood loss and duration of surgery  $> 4$ hours are associated with postoperative anemia.

## **Conclusion and recommendation**

This study revealed a higher level of postoperative anemia among adult major elective surgery patients in Jimma university medical center so early screening those with associated risk factors and early intervention is recommended

**Key words:** - post operative anemia, JUMC, Anesthesia



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## **CHAPTER ONE**

### **1. INTRODUCTION**

#### **1.1 Background**

Anemia is defined as a decreased blood cell hemoglobin concentration. It is one of the most common nutritional deficiency diseases observed globally and affects more than 1.62 billion (25%) people of the world's population, of which 56 million are pregnant women.(1,2 )

Anemia is a major public health problem affecting all ages of the world's population, its highest prevalence being among children aged <5 and Pregnant Women. Anemia is a common nutritional deficiency disorder and global public health problem which affects both developing and developed countries with major consequences for human health and their social and economic development (WHO 2019). According to WHO (2020) reports, one third of the global populations (over 2 billion) are anemic due to imbalance in their nutritious food intake [1-3].

There are several types and classifications of anemia. The occurrence of anaemia is due to the various red cell defects such as production defect (aplastic anaemia), maturation defect (megaloblastic anemia), defects in hemoglobin synthesis (iron deficiency anemia), genetic defects of hemoglobin maturation (thalassemia) or due to the synthesis of abnormal hemoglobin (haemoglobinopathies, sickle cell anaemia and thalassemia) and physical loss of red cells. This is a condition in which the body lacks the amount of red blood cells to keep up with the body's demand for oxygen. Understanding the different classifications can help to recognize the symptoms and also to avoid anaemia in the first place [2].

Iron is essential for the various activities of the human body especially in the hemoglobin synthesis. Iron deficiency anaemia is a condition in which the body has too little iron in the bloodstream. This form of anaemia is more common in adolescents and in women before menopause. Blood loss from heavy periods, internal bleeding from the gastrointestinal tract, or donating too much blood can all contribute to this disease [1, 4].

A low level of iron, leading to anaemia, can result from various causes. The causes of iron deficiency anemia are pregnancy or childhood growth spurts, Heavy menstrual periods, Poor

absorption of iron, Bleeding from the gut (intestines), dietary factors (iron poor or restricted diet), medication (aspirin, ibuprofen, naproxen and diclofenac), Lack of certain vitamins (folic acid and vitamin B12), Bleeding from the kidney, Hookworm infection, Red blood cell problems, Bone marrow problems. Symptoms of anemia include Tiredness, lethargy, feeling faint and becoming breathless easily, headaches, irregular heartbeats (palpitations), altered taste, sore mouth and ringing in the ears (tinnitus). Anaemia in pregnancy increases the risk of complications in both mother and baby such as low birth weight baby, preterm (premature) delivery and postnatal depression. Low iron reserves in the baby may also lead to anaemia in the newborn baby. In general, hospitalists may consider the more common and major causes of anemia in surgical patients: iron deficiency anemia, anemia of chronic disease, and macrocytic anemia (of which vitamin B12 and folate deficiencies account for more than 95% of cases, [5, 6]

**Post-operative anemia** is a condition seen on individuals passing under major elective surgery. It is an independent factor associated with perioperative stroke, heart failure, arrhythmias, renal impairment, and death in patients that undergone both cardiac and non-cardiac surgery. All of these negative impacts of post-operative anemia have huge cost implications especially for developing countries [4].

Post-operative anemia after major non-cardiac surgeries may be due to worsening of pre-operative anemia, perioperative blood loss (intra-operative blood loss, coagulopathy, and phlebotomy), and post-operative reduced erythropoiesis due to surgery-associated inflammation. Inflammatory cytokines after surgery can lead to a cascade of effects where increased hepcidin degrades the iron exporter ferro-portein causing iron sequestration in macrophages. Active inflammation also leads to decreased iron uptake from the gastrointestinal tract and a diminished erythroid response to erythropoietin. This results in delayed recovery of hemoglobin post-operatively. Patients with cancer are at specially increased risk of bleeding due to multiple factors which include activation of pro-coagulant and anti-fibrinolysis pathways, effects of chemotherapy leading to anemia, thrombocytopenia and endothelial dysfunction, and, in some cases, close proximity or invasion into vasculature as well as hyper-vascularization of tumor itself. Other factors are hem dilution from excessive peri-operative fluids (which may exacerbate pre-existing anemia), nutritional deficiencies, and pharmacological interactions. Low pre-operative hemoglobin, female sex, and smaller body surface area have been identified as risk factors for the development of post-operative anemia and increased transfusion needs. Ongoing post-operative blood loss

can continue through drains or into traumatized tissue, or due to repeated phlebotomy during prolonged post-operative hospitalization. As such, peri-operative blood loss may result in acute or late post-operative anemia [6].

## 1.2. Statement of the problem

The commonest causes of post-operative anemia are worsening of pre-operative anemia, perioperative blood loss, and surgery-associated inflammation. The presence of anemia in surgical patients is associated with adverse clinical outcomes. It carries several post-operative risks including increased morbidity, mortality, and requirements of allogeneic blood transfusion, post-operative infections, delirium, intensive care unit admissions, lengthen of hospital stay, readmission and re-operation rates [6,7].

The economic loss of iron deficiency anemia alone was 4% of gross domestic product in these countries. Hence, early diagnosis and appropriate post-operative optimization of anemic surgical patients is very important [8].

The prevalence of post-operative anemia varies according to age, gender, anthropometric and nutritional factors, socioeconomic status, surgical conditions, recent prior surgery, comorbidities, medications and criteria used to define anemia [10].

The presence of wide ranges of results among previous studies, lack of well emerged evidences in the potential predictors for post-operative anemia in the study area and the country at large, the high prevalence of conditions that can exaggerate post-operative anemia such as malnutrition, chronic diseases, diseases of poor hygiene, and poor economic status in the study area had triggered us to conduct the current study and determine the magnitude of the problem and conditions that affect the problem [7, 8].

### **1.3 Significance of the study**

As it is known, one of the major concerns of different stakeholders all over the field is minimizing different risks that patients, especially those with surgical interventions, are suffering so far. Post-operative anemia is the major constraint which lengthens hospital stay of surgical patients by hindering wound healing.

Only few of previous studies have looked at the factors that influence the outcome in-depth. Consequently, the purpose of this study is to know the prevalence and identify factors that are predictive of post-operative Anemia among patients undergoing major elective surgery in Jimma university medical center.

This study will minimize post-operative anemia sufferings by major elective surgical patients through fully addressing potential predictors. Additionally, it will play a significant role in helping physicians enhance safety of their patients. It will eventually act as a starting point or baseline for new studies on the area.

The findings of this study will also serve as qualitative and quantitative teaching material for students in the field of health sciences in the future.

## CHAPTER TWO

### 2. Literature Review

According to World Health Organization (WHO) criteria, the global prevalence of anemia in 2020 was 32.9%, and in Ethiopia, it was around 23% in women and 10–26% in men. The predominant burden of anemia is found in low and middle income countries. WHO estimates that even among the South Asian countries, India has the highest prevalence of anemia. What is even more important is the fact that about half of the global maternal deaths due to anemia occur in South Asian countries; India contributes to about 80 per cent of the maternal deaths due to anemia in South Asia [3].

The previous studies have revealed wide ranges of the prevalence of anemia among surgical patients. Preoperative anemia was found in 5–78% of patients who were scheduled for surgical interventions, and in 30–60% of patients who were scheduled for major elective surgery. Even there is higher prevalence among colorectal cancer, gynecological and major orthopedic patients [10].

India has a high prevalence of post-operative anemia. About 30 to 40% of women are anemic. Similarly, a survey by the Indian Council of Medical Research showed that 35% of adolescent girls were anemic after surgery [10].

The prevalence of severe post-operative anemia among women is the highest in Rajasthan (2.5%), whereas it is the lowest in Bihar and Madhya Pradesh (0.9%). Prevalence of moderate post-operative anemia is found to be the highest in the state of Jharkhand and the lowest in Uttar Pradesh [11,13].

The overall prevalence of post-operative anemia among girls was 33.34%. Only 36.52% were normal, whereas 16.86% were mildly anemic, 39.32% were moderately anemic, and 7.30% were severely anemic in Raipur city, India [14].

The prevalence of post-operative anemia in south Egypt showed that 24% . The prevalence of anemia among 10- to 19-year-olds was 46.6%, where 23.8% were females and 22.8% males. The severity of anemia varied between sexes. Mild anemia is seen in about 98.3% in females and 88.5% in males and moderate anemia in about 11.5% in females and 1.7% in males [15].

The prevalence of post operative anemia in prospective multicentric observational CESARO-study in Germany shows 49 %(12).



According to a research done in USA, Different factors are associated to higher prevalence of post-operative anemia, The ACC guidelines also include consideration of patient-specific factors that may predispose to bleeding complications (like bleeding diathesis, platelet dysfunction, and antiplatelet medication). Following procedures with a low risk of post-procedural bleeding, therapeutic anticoagulation can generally be started within 24 h of surgery in collaboration with a proceduralists. However, following procedures with high bleeding risk, therapeutic parenteral anticoagulation or DOAC use should be delayed for at least 48–72 h after the procedure. Foregoing daily phlebotomy in stable patients decreases iatrogenic anemia and is not associated with increased readmissions or mortality. Every 100 mL of phlebotomy is associated with a hematocrit decrease of 1.9%. Combined with modern blood management protocols, acute normo-volemic hemo-dilution (ANH) and cell salvage are only beneficial in high bleeding risk (> 1000 mL) surgeries. ANH is the donation of whole blood immediately prior to surgery with the use of colloid or crystalloid fluids to maintain a hematocrit of around 20–30%. Subsequently, less blood is lost during surgery, and donated blood is returned to the patient at wound closure. Cell salvage involves the collection of shed blood during surgery and the return of washed or filtered blood to the patient [6].

## 2.2 Conceptual Framework

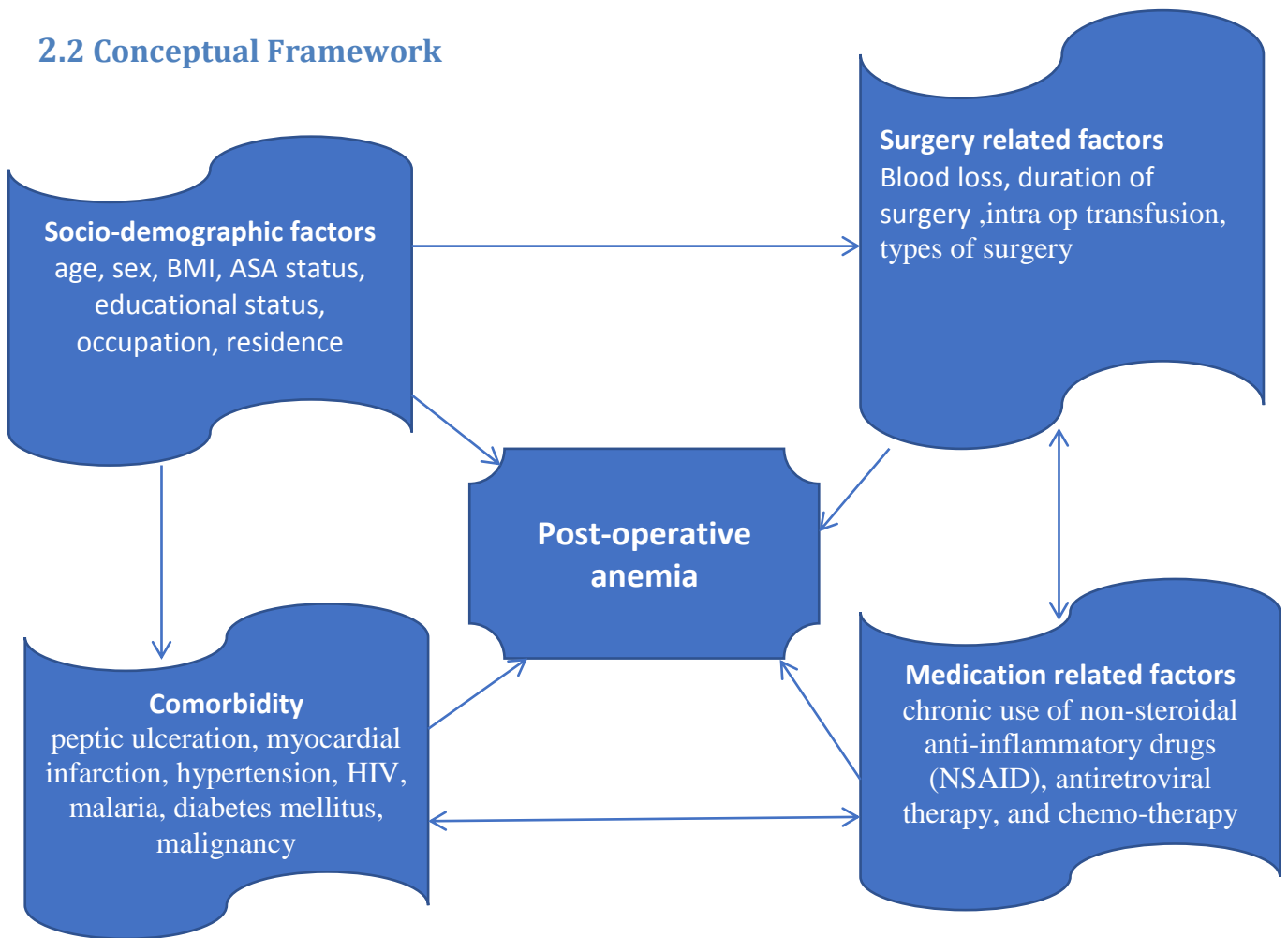


Figure 1: conceptual framework adapted after review of different literatures [2, 3, 5, 7, 10, 13].

## **CHAPTER THREE**

### **3. OBJECTIVES**

#### **3.1 General objective**

- To assess prevalence of Post-operative Anemia and associated factors among Adult major elective surgical patients in Jimma university medical center February, 2023 G.C

#### **3.2 Specific Objectives**

- To determine the overall prevalence of post-operative anemia among major elective surgery patients in Jimma university medical center February, 2023 G.C.
- To identify factors associated to post-operative anemia among major elective surgery patients in Jimma university medical center February, 2023 G.C.

## **CHAPTER FOUR**

### **4. METHODS AND MATERIALS**

#### **4.1 Study area and period**

This study was conducted at Jimma University Medical center (JUMC) between November 1 to December, 2023 G.C.

Jimma University medical center (JUMC) is the only teaching and referral hospital in southwestern part of the country providing services for over 15 million people.

There are around 12 OR tables of which 2 used for obstetrics, 2 ophthalmology, 1 emergency, 1 Orthopedics, 1 pediatrics, 1 neurosurgery, 1 for plastic and maxillofacial surgeries, 3 tables used for general surgery and gynecologic surgeries.

The estimated elective procedures done in a single month is around 180.

#### **4.2 Study Design**

Institutional based Prospective Crossectional study was conducted

#### **4.3 Populations**

##### **4.3.1 Source Population**

All patients admitted to JUMC for undergoing major surgery.

##### **4.3.2 Study Population**

Adult Patients undergoing major elective surgery during the study period.

#### **4.4 Eligibility criteria**

##### **4.4.1 Inclusion criteria**

Adult Patients come for major elective surgery in Jimma university Medical center during data collection period will be included.

##### **4.4.2 Exclusion Criteria**

Patients who are not willing to participate on the study will be excluded.

Patient with undetermined preoperative hemoglobin will be excluded

Patient with undetermined postoperative hemoglobin will be excluded

## 4.5 Sample size determination and Sampling technique

### 4.5.1 Sample size determination

The sample size for cross sectional research was determined using the single population proportion formula using 95% level of confidence, 5% margin of error, proportion (P) of 50% (0.882) .

$$n = \frac{Z^2 p(1-p)}{d^2} \quad n = \frac{(1.96)^2(0.5)(1-0.5)}{(0.05)^2} = 384$$

Z=1.96 corresponding to 95% confidence interval

n=sample size

p=proportion of prevalence of postoperative pain

d=degree of precision with in (+ or -) 5% of the true value

After using correction formula the final sample size **n = 187**

### 4.5.2 Sampling Technique

A convenient sampling technique was used to select patients who undergone major elective surgery at JUMC. Then the sampled patients was selected consecutively

## 4.6 Data Collection Methods

5 qualified nurses and 1 laboratory technician who are employed outside Jimma university medical center gather the data. Face-to-face interviews was used to gather data using a pretested, structured questionnaire prepared by team members.

## 4.7 Study Variable

### 4.7.1 Dependent variable

Post-operative anemia status (Yes/No)

### 4.7.2 Independent Variables

#### **Socio-demographic variables**

-age, sex, BMI, ASA status, educational status, occupation, residence

#### **Surgical conditions and intraoperative factors**

-general surgery, urologic, orthopedic, neurosurgery, gynecologic, and recent prior surgery

-blood loss, duration of surgery, blood transfusion

#### **Comorbidity**

- peptic ulceration, myocardial infarction, hypertension, HIV, malaria, diabetes mellitus, malignancy, asthma, and renal disease

#### **Medications**

Chronic use of NSAID, antiplatelet drugs, anticoagulant drugs, antiretroviral therapy, and chemo-therapy drugs).

### 4.7.3 Measurements

Blood samples was used for Hemoglobin determination.

After 8 hours of surgical procedure a venous blood sample was taken, filled to micro cuvette, Wipe of excess blood from the outside of the micro cuvette tip, and then it was placed in the cuvette holder of the device for measuring hemoglobin concentration.

Blood sample will be taken from the study participants, a drop of blood was placed on new slide, and thin smear was prepared. After being air-dried, labeled with identification number, the smear of the slide was fixed with absolute methanol and the smear was stained with giemsa solution based on the standard operational procedures (SOPs) and examined at 10× and 100× microscopic objectives.

#### 4.8 Operational definitions and definition of terms

**Anemia:** hemoglobin level <12 g/dl for females and <13 g/dl for males [3].

**Mild anemia:** hemoglobin measurements between 10 – 11.9 g/dl for females and 10–12.9 g/dl for male [3].

**Moderate anemia:** hemoglobin measurements between 7–9.9 g/dl for [3].

**Severe anemia;** hemoglobin measurements less than 7 g/dl(3).

**Adult patient:** patient with the age of 15 years and above for both genders [15].

**Major surgery:** any invasive operative procedure in which mesenchyme barrier opened, anticipated surgical duration was more than 1 hour and more prone to serious perioperative complications and fatal outcomes. Major surgical operations among general and urologic surgery (thyroidectomy, mastectomy, gastro-intestinal and hepatic-biliary surgery, nephrectomy, prostatectomy...), gynecologic surgery (hysterectomy, oophorectomy, myomectomy...) and orthopedic surgery (nailing, plating, fixations...) were included in this study [14, 16].

**Recent prior surgery:** Postoperative anemia can be explained by acute blood loss and the inflammatory state induced by surgery itself, leading to altered erythropoiesis and iron metabolism which reduced availability of iron when the body attempts to compensate. So commonly it needs 1–2 month to be corrected satisfactorily [17].



#### **4.9 Data quality assurance**

The data was collected by trained data collectors and supervised every day. Based on the pretest, the questionnaire was contextualized for main study. Data was checked for completeness every day after collection.

#### **4.10 Data processing and analysis**

Data was checked for its completeness, edited, cleaned, coded and entered in to EPI data version 4.6 and was exported to statistical package or the social science (SPSS window version 26) for analysis. Assumption of logistic regression and the result of assumption was checked. To find potential predictors, bi-variable logistic regression was used for each predictor and outcome variable. Those with  $P < 0.25$  was entered to multivariate logistic regression. A p value of  $<0.05$  was considered as statistically significant and Hosmer-Lemeshow goodness of fit tests was used to evaluate the model's fitness. Finally findings was presented using figures, AOR, percentage and summary table.

#### **4.11 Ethical consideration**

The study protocol was examined and approved by the schools of postgraduate studies in health sciences. The research was permitted to be done ethically with the help of the school of public health. A written informed consent form was signed by study participants. Every stage of the study was maintain the results' confidentiality, and participants are free to leave at any time

#### **4.12 Plan for data dissemination**

The Department of post graduate studies of Jimma University will be given a presentation and be given a submission of the study's findings. The study's findings will be discussed at numerous conferences, get-togethers, and workshops and efforts will be made to have them published in peer-reviewed journals.

## CHAPTER 5

### 5.1 Result

#### *Socio-demographic characteristics*

The median age of participants was 42 years (Median, IQR) (42, 19.25) and 144 (77.4%) were above the age of 31 years. Also, ninety five (51.1%) were females. Whereas, 67 (36%) can't read and write. Regarding residency of respondents, 107 (57.5%) were from urban areas. The study also revealed 133 (71.5%) patients with ASA class of one. (See table given below).

*Table 1. Socio-demographic characteristics among adult major elective surgery patients in Jimma university medical center February, 2023 G.C.*

<b>Variables</b>	<b>Frequency(n=186)</b>	<b>Percentage (%)</b>
<b>Age group</b>		
15-19	8	4.3
20-25	16	8.6
26-30	18	9.7
>=31	144	77.4
<b>Sex</b>		
Male	91	48.9
Female	95	51.1
<b>Educational Status</b>		
cannot read and write	67	36.0
primary	57	30.6
secondary	50	26.9
college and university	12	6.5
<b>Residence</b>		
urban	79	42.5
rural	107	57.5
<b>Department</b>		
General Surgery	36	19.4
Orthopedics	44	23.7
GI surgery	16	8.6
Neurosurgery	10	5.4
maxilofacial surgery	11	5.9
gynecology	27	14.5
urosurgery	17	9.1
plastic	15	8.1
cardiothoracic	10	5.4
<b>Patient ASA class</b>		
1	133	71.5
2	47	25.3
3	6	3.2

## Surgical conditions and intraoperative factors

In this study, 24 (12.9%) had previous history of surgery. Of those who underwent surgery priorly, 16 (66.7%) undergone for surgery before 2 months. While, 127 (68.3%) had a normal preoperative hemoglobin level. GA was used for 103 (55.4%) and for these segment of participants their surgery took 2-4 hours. Likewise, 122 (65.6%) had an intraoperative blood loss of less than 500 ml and almost all i.e. 185 (99.5%) didn't encountered major vascular injury (See the table below).

*Table 1: Surgical conditions and intraoperative factors among adult major elective surgery patients in Jimma university medical center February, 2023 G.C.*

<b>Variables</b>	<b>Frequency(n=186)</b>	<b>Percentage (%)</b>
<b>Previous Surgery</b>		
Yes	24	12.9
No	162	87.1
<b>When was surgery Done</b>		
<1 week	1	4.2
1 week to 1 month	4	16.7
1-2 month	3	12.5
> 2 month	16	66.7
<b>Pre-operative Hemoglobin</b>		
mild anemia	51	27.4
moderate anemia	8	4.3
normal( not anemic)	127	68.3
<b>Type of anesthesia</b>		
G/A	103	55.4
spinal anesthesia	60	32.3
PNBs	23	12.4
<b>Duration of Surgery</b>		
1 hour	6	3.2
1-2 hours	61	32.8
2-4 hours	103	55.4
> 4 hours	16	8.6
<b>Major Vascular Injury</b>		
Yes	1	.5
No	185	99.5
<b>Intra-Operative Blood Loss</b>		
<500 ml	122	65.6
500-1000ml	49	26.3
1000-1500ml	10	5.4
>1500ml	5	2.7

### Comorbidity Related factors

In the present study, 49 (26.3%) had comorbidity. Of those who had co-morbidities, 22 (44.9%) of the causes were attributable to cardiovascular causes. (see figure 2 below).

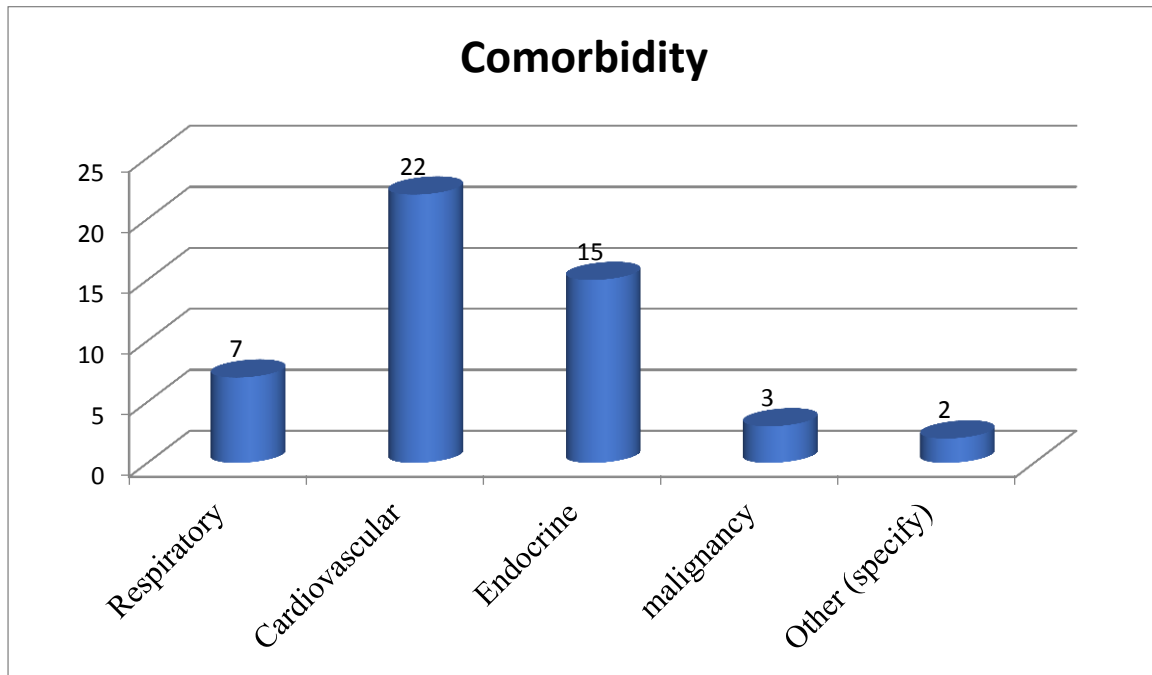


Figure 2. Co-morbidities among adult major elective surgery patients in Jimma university medical center February, 2023 G.C.

### Medications History of Patients

Fifty five (29.6%) had medication history. Of those who had medication history, 13 (23.6%) were on NSAID and 38 (69.1%) were on other types of medications (see table given below).

*Table 3: Medication history among adult major elective surgery patients in Jimma university medical center February, 2023 G.C.*

<b>Variables</b>	<b>Frequency(n=186)</b>	<b>Percentage (%)</b>
<b>Medication History</b>		
Yes	55	29.6
No	131	70.4
<b>Type of Medication used</b>		
NSAID	13	23.6
Anticoagulant	3	5.5
Chemotherapy	1	1.8
others (specify)	38	69.1

### Prevalence of Post-Operative Anemia

In this study the prevalence of Post-Operative Anemia was 105 (56.5%) 95% CI (53.4, 60.1)  
(See the figure below)

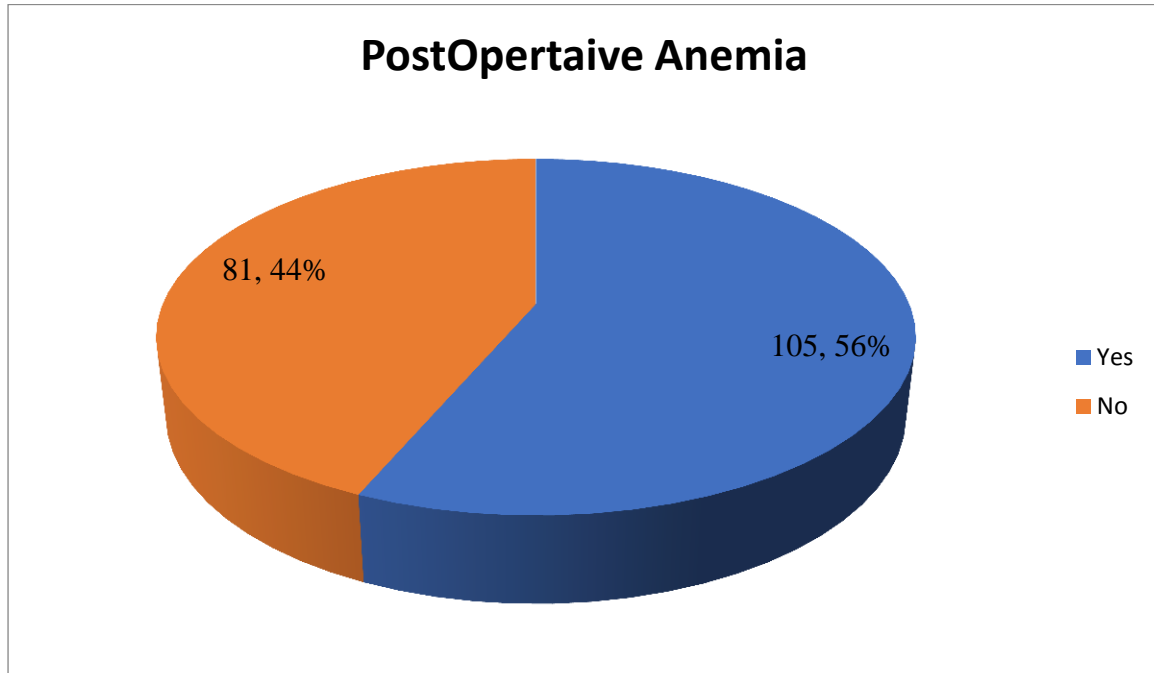


Figure 3: Prevalence of Post-operative anemia among adult major elective surgery patients in Jimma university medical center February, 2023 G.C.

## **Factors associated with postoperative anemia**

To identify factors associated with post-Operative Anemia both bivaribale and multivariable logistic regression analyses were done.

Accordingly, six variables were checked if they are candidate for the multivariable model. The candidates variables were selected based on a p-value and those having  $p < 0.25$  were taken to the multivariable logistic regression mode.

Then, three variables having p-value of less than 0.25 were taken to the multivariable model. Model fitness was checked by Hosmer-Lemeshow test of goodness of fit and revealed ( $P > 0.65$ ).

Finally, three variables prolonged duration of surgery, blood loss 1000- 1500ml, preoperative anemia were found to be statistically significantly associated with postoperative anemia.

Table 4. Bivariable and Multivariable Logistic Regression analyses of factors associated with Postoperative anemia among adult major elective surgery patients in Jimma university medical center August, 2022 G.C.

\* Candidate variables for final model i.e. Multivariable Logistic Regression at  $p < 0.25$

\*\* Variables statistically significant with Post-Operative Anemia at a  $p$ -value  $< 0.05$

Variables	Post-operative Anemia		COR(95%CI)	P-value	AOR(95%CI)
	Yes (1)	No (0)			
<b>Intra-operative Blood Transfusion</b>					
Yes	26(96.3%)	1(3.7%)	26.32(3.48,198.74)	0.412	2.20(0.134, 17.312)
No	79(49.7%)	80(50.3%)	1	1	1
<b>Patient ASA Class</b>					
1	71(53.4%)	62(46.6%)	1	1	
2	28(59.6%)	19(40.4%)	2.131 (0.38,2.984)	0.31	
3	6(100.0%)	0(0.0%)	4.32(0.72,5.74)	0.29	
<b>Pre-operative Hemoglobin</b>					
mild anemia	51(100%)	0(0%)	0.411 (0.38,1.212)	0.34	2.7(0.655, 10.411)
moderate anemia	8(100%)	0(0%)	1.611 (0.232,7.11)	0.18	2.63(2.411, 16.151)**
Normal (Not Anemic)	46(36.2%)	81(63.8%)	1	1	1
<b>Duration of Surgery</b>					
1 hour	2(33.3%)	4(66.7%)	1	1	1
1-2 hours	26(42.6%)	35(57.4%)	8.667(1.049, 71.56)	0.045*	4.734(0.374, 59.976)
2-4 hours	64(62.1%)	39(37.9%)	5.833(1.506, 22.59)	0.011*	3.137(0.535, 18.380)
>4 hours	13(81.3%)	3(18.8%)	2.641(0.708, 9.855)	0.148*	3.475(1.249, 15.28)**
<b>Intra-Operative Blood Loss</b>					
<500 ml	44(36.1%)	78(63.9%)	1	1	1
500-1000ml	46(93.9%)	3(6.1%)	3.11(0.238, 15.155)	0.171*	1.451(0.134, 9.512)
1000-1500ml	10(100.0%)	0(0.0%)	6.313(0.811, 25.85)	0.131*	2.98(2.541, 14.201)**
>1500ml	5(100%)	0(05%)	12.1401(0.41, 33.5)	0.231	3.92(0.712, 10.012)
<b>Department of Patient</b>					
General Surgery	20(55.6%)	14(44.4%)	1.867(0.415, 8.398)	0.41	0.750(0.114, 4.953)
Orthopedics	31(70.5%)	13(29.5%)	0.978(0.218, 4.383)	0.97	0.261(0.038, 1.776)
GI Surgery	12(75%)	4(25%)	0.778(0.133,4.536)	0.78	0.364(0.047, 2.850)
Neuro Surgery	6(60%)	4(40%)	1.556(0.244,9.913)		0.659(0.063, 6.860)
Maxio Facial Surgery	4(36.4%)	7(63.6%)	1	1	1
Gynecology	9(33.3%)	18(66.7%)	4.083(0.657,25.382)	0.131*	1.260(0.152, 10.446)
Uro-surgery	11(64.7%)	6(35.3%)	4.66(0.969, 22.464)	0.05*	2.818(0.369, 21.526)
Plastic Surgery	5(33.3%)	10(66.7%)	1.273(0.237, 6.821)	0.778	0.558(0.069, 4.529)
Cardiothoracic Surgery	7(70%)	3(30%)	4.667(0.830, 26.23)	0.08*	1.03(0 .124, 8.583)



## 5.2 Discussion

In this study, the prevalence of post-operative anemia was 56% 95% CI (53.4, 60.1).

The finding on the prevalence of post-operative anemia in this study is comparable with the study done in Germany 50%(February 2020 G.C).

The justification for comparability of the result may be due to use of similar sample size and use of WHO standard definition of Anemia for diagnosis.

In the contrary, the finding of prevalence of post operative anemia in this study is higher than study done in India and Egypt 24% & 35% respectively.

The possible justification for this difference may be due to difference in exclusion criteria and Differences among international clinical practice guidelines on cut-off diagnostic hemoglobin levels.

Moreover, the sample size differences used in those studies versus the sample size used in the present study might overestimate the prevalence of anemia in the present study.

In other hand the finding of prevalence of post operative anemia in this study is lower than study done in Spain and multicenter analysis done in Europe 90% & 85.7% respectively .

This difference may be due to heterogeneity in populations i.e. differences in co-morbidity and related factors at the individual level and difference in timing of measurement of post operative hemoglobin.

In the present study, prolonged duration of surgery i.e. greater than 4 hours was a factor found to be statistically significantly associated with post-operative anemia.

Accordingly, the study revealed, those patients who stayed in surgery for greater than 4 hours had a 3.4795% CI (1.249, 15.28) times increased odds of developing postoperative anemia than those who stayed in surgery for 1 hour

This finding was supported by studies conducted in WHO 2021 report on global burden of anemia, USA and a brief review study on causes of post-operative anemia (3) (5) (6) respectively.

The justification for the concordance in the finding might be due to as duration of surgery increase amount of blood loss may increase proportionally and in addition to this with lengthy surgical procedure there will be an increase in release of inflammatory cytokine that can lead to a cascade of effects with the final result of reduction in hemoglobin concentration.

Likewise, the study revealed having a moderate level of preoperative anemia as a factor statistically significantly associated with post-operative anemia.

Accordingly the finding from the present study revealed patients with moderate level of preoperative anemia had a 2.63 95% CI (2.411, 16.151) times increased odds of developing postoperative anemia than those with normal hemoglobin count in the pre operative period.

This finding was in line with studies conducted in Spain, Germany and USA (20) (12),(5) respectively.

The reason for similarity of the prior studies from the present study is due to if patient had preoperative anemia it is expected for worsening of hemoglobin status due to associated blood loss and surgical stress [6, 7].

The other factor found to have an association with postoperative anemia in the present study is intraoperative blood loss of 1000-1500ml.

The finding from the present study signifies those who encountered an intra-operative blood loss of 1000 -1500ml had times 2.98 95% CI (2.541, 14.201) increased odds of developing post-operative anemia than those with an intra-operative blood loss of less than 500 ml

This finding is concordant with studies conducted by WHO 2021 report on global burden of anemia and USA, and a brief review study on causes of post-operative anemia respectively(3) (5) (6).

## **CHAPTER 6**

### **6. Strength and Limitation of the Study**

#### **6.1 Strength**

The strength of this study is that, it tried to uncover the magnitude of post-operative anemia among adult patients undergoing major surgery and identified factors supposed to have association with post-operative anemia this will fill the gap since there was no previous study on the study area.

#### **6.2 Limitation**

The draw backs of the present study is as this is cross sectional study, it cannot ascertain cause-effect relationship and some of the asked variables might be subjected to recall-bias. Also, the sample size used in the present study might hinder the degree of precision of the present study

## CHAPTER 7

### 7. Conclusion and recommendations

#### 7.1 CONCLUSION

**This study revealed a higher level of postoperative anemia among adult major elective surgery patients in Jimma university medical center and the factors associated with postoperative anemia were prolonged i.e. > 4hour duration of surgery, having moderate pre-operative anemia and intra-operative blood loss of greater than 1000ml.**

#### 7.2 Recommendation

##### To JUMC

- ✚ All patients who have undergone major surgery and whose surgery lasting > 4 hr.) Must be screened for postoperative anemia and a due interventional plan needs to planned ahead
- ✚ A due emphasis and corresponding intervention plan and care has to be employed for those patients undergoing major surgery so as to tackle the occurrence of post-operative anemia in JUMC.

##### For Anesthesiologist and Anesthetists:

- ✚ Give the higher risk of intra-operative blood loss to post-operative anemia, appropriate anemia management has to be employed so as to prevent post-operative anemia
- ✚ Since worsening of preoperative anemia is one of the factors associated with postoperative anemia we need to stabilize patient preoperative anemia status before proceeding with elective surgery .

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## Annex 1:

### Information sheet and consent form (English version)

A questionnaire for assessing prevalence of postoperative anemia and associated factors in Jimma University medical center

Good morning/good afternoon. My name-----; we come from Jimma University. We are working with an investigator, Gashaw Tadesse, doing his thesis for the partial fulfillment of specialty certificate of Anesthesiology, Critical Care and Pain Medicine. We are interviewing associated factors of post-operative anemia.. We are going to ask you some questions that are not difficult to answer. Your name will not be written in this format and never be used in connection with any of the information you are going to tell me. You are not obliged to answer any question that you do not want to answer and you may end this interview at any time you want to. However, your honest answers to these questions will help us to identify the main risk factors associated with postoperative anemia and helps to solve the identified problems in the future to control and prevent it. We would like to appreciate your help in responding to these questions, and the interview will not take more than 30 minutes.

#### Informed consent

I am the individual asked to be a study participant. Based on the information provided by the principal investigator, understand that it is not necessary to write my name, the information I tell to her/him will not to be used for other purpose and the information obtained from me will help to identify the main risk factors associated with postoperative anemia and helps to solve the identified problems in the future to control and prevent it in the future. So I agree to be a study participant.

1. Yes\_\_\_\_\_ If yes go to next section

2. No\_\_\_\_\_ If no go to next participant

Name of data collector\_\_\_\_\_ signature\_\_\_\_\_

## **Annex 1: Informed consent from Afaan Oromo version**

**Walii galitee**

**Ani Obboo/addee/Dr \_\_\_\_\_ , miseensa garee qorannoo irra.**

**Qorannoo kun kan inni irratti xiyeefatee, waa'ee yaalamtota kutaa namoota gar malee dhibamaniitti ciisani kessa yaalamanirratti.**

**kanaafuu qorannoo kana irrattii wantaisin irraa eegamu akka nuufgotan kabajaan isin gaafanna. Kunis ammoo fayyaayaalamtota garmalee dhukkubsatan irratti fayidaa fijijjiirama guddaa ni fida.**

**Waliigaltee fi eyyama kessaniin malee icciti kessan nama biraaf yookin ammoo waajira tokkoofuu akkadabarsinee hinkenninee waadaa isiniif galla.**

**Yoo qorannoo kana irratti hirmachuu kessan waliigallee, gaaffii waliigalaa irraa isiniif jaliqabna. Deebii kessan kan dhugaa irratti hundahee yoo kennitan fayidaajijjiirama fayyaatif nuf gargaara.**

**Qorannoon kun karaa univarsitii Jimma irraa fudhatama argatee jira.**

**Kanafuu qorannookanarratti hirmaachuuf fedhii qabduu?**

**1. nanqaba ..... Deebiin nanqaba yoo jette gaaffii itti anutti fufi.**

**2. Hinqabu ..... deebiin hinqabu yoo jette , galatooma jedhiiti gaaffii addaan kuti.**

**Fedhii qorannoo adeemsisuuf yaada namarraa kan fuudhu.**

**Maqaa..... Guyaa..../..../.... Mallattoo .....**

**guyyaa gaaffii itti gaafatame ...../...../..... mallattoo.....**

**Hordofa isaatin mirkana'u kanmuli'isu**

የ መጠይቅ ፈቃድ

ጂማዩ ኒ ቨርሲቲ ጠፍ ሳይንስ ኮሌጅ ፣ ህክምና ትምህርት ቤት፣ የአንስቴዥሎጂ ትምህርት ክፍል  
የ መጠይቅ ፈቃደኛነት ቅጽ

ስሜ \_\_\_\_\_ ይባላል፡፡ እኔ በጂማዩ ኒ ቨርሲቲ በአንስቴዥሎጂ  
ትምህርት ክፍል የምርምር ቡድን ወስጥ አንድ አባል ነኝ፡፡ የዚህ መጠይቅ አላማ

ከቀዶ ጥገና በኋላ የሚመጣ የደም ማስ እና ተያያዥነት ገሮችን ለመቆየት የሚደረግ ምርምር/ጥናት /መረጃ  
መስጠት ነው፡፡

እርስዎ አንድ የጥናቱ ክፍል አድርጌ ስመጥ አስፈላጊ የሆኑ መረጃዎችን እንደሚሰጡ በመጠየቅ ነው፡፡

በጥናቱ ለመስተፍ ፈቃደኛ ከሆኑ ከእርስዎ የሚገኘው ማንኛውም መረጃ በሚሰጥ ይጠበቃል፡፡ ለዚህም ሲባል

የእርስዎ ሥም እና አድራሻ አይገለጽም፡፡ እንዲሁም ከጥናቱ በኋላም በቀዶ ህክምና ክፍል የሚደረገውን

ክትትል እና ተያያዥነት ገሮችን ለመቆየት ይረዳል፡፡

የቃል ሥምምነት

የዚህ ጥናት ዓላማው ጠቅላላ በጥናቱ ለመሳተፍ

ሀ. ፈቃደኛ ሆኛለሁ ለ. ፈቃደኛ አይደለሁም

በጥናቱ ለመስተፍ ፈቃደኛ ከሆኑ ቃለ መጠይቁን መቀጠል ይቻላል፡፡

ፈቃደኛ ከሆኑ የ መጠይቁ መላያ ቁጥር \_\_\_\_\_ መጠይቁ የተካሄደበት ቀን \_\_\_\_\_

የጠያቂው ስም \_\_\_\_\_

የሱፐርቫይዘር ስም \_\_\_\_\_ ጥናቱን በተመለከተ ማንኛውም አይነት ጥያቄ ካላችሁ

የሚከተለውን አድራሻ ተጠቅሙ



**Annex 2:**  
**Questionnaire** (English version)

**Questionnaires on prevalence and associated factors of post-operative anemia in major adult elective surgical patient at JUMC**

**Questioner Code** \_\_\_\_\_

**I Socio-demographic characteristics and observed pre-operative documentations.**

1. ID \_\_\_\_\_

2. Age/year \_\_\_\_\_

3. Sex

a. Male      b. Female

4. Educational status

a. cannot read and write      c. Secondary  
b. primary      d. college or university

5. Residency

a. urban      b. rural

6. BMI

a. <18.5      c. 25-29.9  
b. 18.5-24.9      d. >30

7. Unit (department) of the surgical procedure

a. Otorhinolaryngology      f. Ophthalmology  
b. General surgery      g. Neurosurgery  
c. Orthopedics      h. Maxillofacial Surgery  
d. Plastic surgery      i. Other (specify \_\_\_\_\_)



- |   |                        |
|---|------------------------|
| a. G/A  | c. Epidural anesthesia |
| b. spinal anesthesia  | d. PNBs                |
| 17. Duration of surgery   |                        |
| a <1 hour   | c.2-4 hours            |
| b. 1-2 hours  | d.>4 hours             |
| 18. Major vascular injury   |                        |
| a. yes  | b. no                  |
| 19. Intraoperative estimated blood loss                           |                        |
| a. < 500 ml   | c.1000-1500ml          |
| b. 500-1000ml   | d.>1500 ml             |
| 20. Relative blood loss   |                        |
| a. <10%   | c.20-30%               |
| b .10-20%   | d.>30%                 |
| 21. Intraoperative blood transfusion                              |                        |
| a. yes  | b.no                   |
| 22. If yes to question 21, specify                                |                        |
| a.1 unit  | c.3 units              |
| b.2 unit  | d.>3 units             |
| 23. post-operative anemia   |                        |
| a. yes  | b. no                  |
| 24.if yes to question 23, specify post-operative hemoglobin level |                        |
| a.<7  | c.10-12                |
| b.7-10  | d.> 12                 |