

**PREVALENCE AND DETERMINANTS OF ANEMIA AMONG
REPRODUCTIVE-AGE WOMEN WHO DELIVERED BY CESAREAN SECTION IN
UGANDA: EVIDENCE FROM THE 2022 UGANDA DEMOGRAPHIC AND
HEALTH SURVEY**

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**UGANDA CHRISTIAN
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DECLARATION

I, Martha Ithungu hereby declare that this study is original and has not been submitted for any other degree award to any other University before.

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APPROVAL

The dissertation “**Prevalence and Determinants of Anemia among Reproductive-Age Women Who Delivered by Cesarean Section in Uganda: Evidence from the 2022 Uganda Demographic and Health Survey**” has been done under my guidance and supervision.

Signature:  |

Date: 22/09/2025

SHALLON ATUHAIRE (Ph.D)

Supervisor

DEDICATION

I dedicate this master's thesis to my Mother Provia Turyamureeba, Kathryn Hill , Rev Canon John Mulindabigwi and the family of Rev Canon James Tummwesigye for their support throughout this course. May the Almighty God bless you abundantly.

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TABLE OF CONTENTS

DECLARATION	i
APPROVAL	Error! Bookmark not defined.
DEDICATION	iii
ACKNOWLEDGEMENTS	iv
TABLE OF CONTENTS	v
LIST OF TABLES	vii
LIST OF FIGURES	viii
LIST OF APPENDICES	ix
LIST OF ABBREVIATIONS AND ACRONYMS	x
ABSTRACT	xi
CHAPTER ONE: INTRODUCTION	1
1.0 Introduction	1
1.1 Background to the Study	1
1.1.1 Historical perspective	1
1.1.2 Theoretical Perspective.....	3
1.1.3 Conceptual Perspective.....	4
1.1.4 Contextual Perspective	5
1.2 Statement of the Problem	6
1.3 Objectives of the Study	7
1.3.1 Main Objective	7
1.3.2 Specific Objectives	7
1.4 Study hypotheses	7
1.5 Significance of the Study.....	8
1.6 Scope of the Study.....	8
1.7 Conceptual Framework	9
CHAPTER TWO: LITERATURE REVIEW	10
2.0 Introduction	10
2.1 Conceptual review	10
2.2 Theoretical review	10
2.3 Review of related literature	12
2.3.1 Socio-demographic factors associated with anemia	12
2.3.2 Relationship between obstetric and maternal factors and Anemia	15
2.3.3 Nutritional and Preventive Factors Associated with Anemia	18
2.4 Summary of literature review	19
CHAPTER THREE: METHODOLOGY	21
3.1 Introduction	21

3.2. Sampling design	21
3.2.1 Study population and inclusion criteria	21
3.2.2 Sample size	21
3.3 Data source and description.....	21
3.4 Description of the study variables	22
3.4.1 Dependent variable	22
3.4.2 Independent variables	22
3.5 Data quality control	24
3.6 Data management and analysis.....	25
3.6.1 Univariate analysis	25
3.6.2 Bivariate analysis.....	25
3.6.3 Multivariate analysis.....	25
3.6.4 Modified Poisson regression diagnostics.....	25
3.7 Ethical considerations in this study	26
CHAPTER FOUR: RESULTS PRESENTATION, INTERPRETATION AND ANALYSIS	27
4.1 Introduction	27
4.2 Univariate analysis	27
4.3 Bivariate analysis.....	29
4.4 Multivariate analysis	31
CHAPTER FIVE: DISCUSSION	34
5.1 Introduction	34
5.2 Socio-demographic determinants	34
5.3 Obstetric and maternal determinants	36
5.4 Nutritional and preventive factors	37
CHAPTER SIX: SUMMARY, CONCLUSION, AND RECOMMENDATIONS	39
6.1 Introduction	39
6.2 Summary of findings	39
6.3 Conclusion.....	40
6.4 Recommendations	40
6.4 Limitations of the study and areas of further research	41
References	42
Appendices	53

LIST OF TABLES

Table 3.1: Description of the different variables that were used.....	22
Table 4.1: Results of the distribution of characteristics of women that undergone a C-section.....	28
Table 4.2: Results of the association of anemia and independent variables in the exploratory unadjusted simple modified Poisson model.....	30
Table 4.3: Results of the Poisson regression model for Anemia.....	33

LIST OF FIGURES

Figure 1.1: Conceptual framework for risk factors associated with anemia.....	9
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LIST OF APPENDICES

Appendix I: Application for waiver of consent addressed to the chairperson UCU REC.....	54
Appendix II: Data collection tool.....	55
Appendix III: Authorization to use DHS data.....	58
Appendix IV: UCU Regular Supervision Report.....	59

LIST OF ABBREVIATIONS AND ACRONYMS

AIDS	Acquired Immunodeficiency Syndrome
ANC	Antenatal Care Visit
ATBUTH	Abubakar Tafawa Balewa University Teaching Hospital
BM	Biomedical Model
BMI	Body Mass Index
COVID-19	Coronavirus Disease of 2019
CSDH	Commission on Social Determinants of Health
C-sections	Cesarean sections
EAs	Enumeration Areas
HIV	Human Immunodeficiency Virus
ICF	International classification of Functioning
IUDs	Intrauterine Devices
LARCs	Long-Acting Reversible Contraceptives
LMICs	Low- and Middle-Income Countries
LR	Likelihood Ratio
MOH	Ministry of Health
NPHC	National Population and Housing Census
SDGs	Sustainable Development Goals
SDH	Social Determinants of Health
SSA	Sub-Saharan African
UCU-REC	Uganda Christian University Research Ethics Committee.
UDHS	Uganda Demographic and Health Survey
UNFPA	United Nations Population Fund
UNICEF	United Nations Children's Fund
WHO	World Health Organization

ABSTRACT

Anemia among women with previous C-section delivery significantly impacts on their health outcomes, particularly in countries like Uganda, where maternal healthcare disparities and food insecurity persist. This study examined the prevalence and determinants of this public health burden among C-section women age 15-49 years in Uganda, focusing on socio-demographic, obstetric, maternal, nutritional and preventive factors. While employing the modified Poisson regression model, the study utilized a cross-sectional secondary data of 1,066 women who had C-Section from the Uganda Demographic and Health Survey (UDHS) 2022 to examine the determinants of anemia among these women. The findings were reported as adjusted Risk Ratios (aRR) with the 95% Confidence Intervals (CI).

The results show that about one in ten women who had a C-section were affected by anemia. The multivariable modified Poisson regression identified significant associations between anemia and place of residence, household size, deworming treatment, and birth interval. Specifically, C-section women living in rural residents (aRR 0.957; 95% CI: 0.917 – 0.999), those in households with less than five people (aRR 0.961; 95% CI: 0.924 – 1), and women who did not deworm (aRR 0.947; 95% CI: 0.908 – 0.986) had lower risk while those with birth intervals of less than two years (aRR 1.040; 95% CI: 1.003 – 1.078) had a higher risk of being anaemia.

These findings indicated relatively high anemia among C-section women, underscoring the need for implementation of programs such as nutritional counseling, routine anemia screening, consistent supply of iron supplements to help replenish lost nutrients thus enhancing better health outcomes. Family planning initiatives may also help educate women on the value of adequate child spacing. The paradoxical finding that not taking deworming treatment lowers the risk of anemia, underscores the need for further research to explore this relationship.

CHAPTER ONE: INTRODUCTION

1.0 Introduction

This chapter presents the historical, theoretical, conceptual, contextual perspectives of the study background, problem statement, objectives and hypotheses of the study and the significance. Anemia is a significant public health concern, especially among women of reproductive age, as it is associated with serious maternal and fetal risks (Smith et al., 2019). The condition becomes particularly critical in women undergoing Cesarean sections (C-sections), a major surgical procedure that involves a higher risk of significant blood loss compared to vaginal deliveries (Shaikh et al., 2022). This blood loss can exacerbate pre-existing anemia, leading to severe complications such as increased risk of infection, delayed wound healing, prolonged hospital stays, and in extreme cases, maternal mortality (Shaikh et al., 2022). Moreover, maternal anemia during a C-section can adversely affect newborns, contributing to low birth weight, preterm delivery (Shah et al., 2022), and potential developmental challenges due to reduced oxygen supply during pregnancy. The combined impact of anemia and the surgical risks associated with C-sections underscores the importance of understanding this relationship to improve maternal and neonatal health outcomes.

1.1 Background to the Study

1.1.1 Historical perspective

Anemia, first discovered by Karl Vierordt in 1852 (Thompson et al., 2021), has long been recognized as a significant public health issue, with its impact on maternal and fetal health documented as far back as ancient civilizations. By the 19th century, anemia had already been identified as a major contributor to maternal and fetal morbidity (Guggenheim, 1995), with poor nutritional status (Brumberg, 1982) emerging as a key determinant of adverse pregnancy outcomes. Over time, global health initiatives, such as those led by the World Health Organization (WHO), aimed to reduce the prevalence of anemia, particularly in low-income countries (WHO, 1997), where maternal health interventions were minimal during the colonial era (Azevedo, 2017) and have only gradually improved since independence.

Caesarean section (C-section) has a long and complex history, rooted in both Western and non-Western traditions, dating back to ancient times. Although the term "caesarean" is commonly believed to originate from the birth of Julius Caesar, historical evidence suggests otherwise, as his mother, Aurelia Cotta, survived for many years after his birth (Todman, 2007). Initially, C-sections were performed only when the mother was dead or dying, with the sole aim of rescuing the fetus. This practice was consistent across various cultures until the introduction of anesthesia in the 19th century, which marked a turning point in the evolution of the procedure (Todman, 2007). From the late 19th

century onwards, advancements in surgical techniques significantly reduced the morbidity and mortality associated with C-sections. These developments allowed the procedure to transition from a last-resort measure to a safer and more controlled surgical option. In the modern era, the objectives of C-sections have expanded beyond merely saving the fetus or adhering to cultural and religious practices. The procedure now focuses on ensuring the safety of both the mother and child, while also accommodating the mother's preferences, reflecting a significant shift in obstetric care (Todman, 2007).

The evolution of obstetric care in the mid-20th century brought about a greater understanding of the risks associated with anemia in pregnancy, prompting the integration of routine anemia screening and management in prenatal care protocols (WHO, 2001). As the Cesarean section became more prevalent, it was noted that maternal anemia became a significantly public health concern. In a cross-sectional study, from 458 pregnancies among adolescent, (Pinho-Pompeu et al., 2017) found out that the majority (87.24%) received treatment with iron supplementation. (Janoušková et al., 2019) in their systematic review, revealed that anemia poses a greater risk during C-section, where blood loss exacerbates risk of complications. In the latter part of the 20th century, numerous studies (Siu, 2015; Villar et al., 2003; Yip, R., & Ramakrishnan, 2002) began to emphasize the need for targeted interventions to address anemia in pregnant women, with a specific focus on those undergoing C-sections (Siu, 2015; Villar et al., 2003). International health bodies like the World Health Organization (WHO) have continuously highlighted the importance of reducing anemia to improve maternal and neonatal outcomes (WHO, 2023).

Globally, anemia is a widespread health concern, affecting approximately 30% (539 million) of non-pregnant women and 37% (32 million) of pregnant women aged 15–49 years, as estimated in 2019 (WHO, 2023). The use of Cesarean sections continues to rise globally, now accounting for more than one in five (21%) of all childbirths, with nearly a third (29%) of all births likely to take place by Cesarean section by 2030, according to research findings (WHO, 2021). During this procedure, the risk of severe anemia increases due to potential substantial blood loss. According to studies by (Gari et al., 2022; Ragusa et al., 2024), women undergoing C-sections lose 500 to 1,000 ml of blood on average, compared to 300 to 500 ml in vaginal deliveries. The substantial blood loss not only reduces hemoglobin levels but also leads to severe complications such as postpartum hemorrhage (Shaikh et al., 2022).

According to WHO, (2019), in low- and middle-income countries, maternal deaths following Cesarean sections are 100 times higher than in high-income countries. Iron deficiency affects nearly 18% of pregnant women in the United States, with prevalence rising throughout the three trimesters of pregnancy, escalating from 6.9% to 14.3% to 28.4% (Wanda, 2024). Approximately 25% of

pregnant women in Australia have anemia Ebrahim et al. (2024), 52.5% in South and Southeast Asian countries of Bangladesh, Cambodia, India, Maldives, Myanmar, Nepal, and Timor-Leste (Sunuwar et al., 2020). In America and Europe, there exists a lower prevalence of anaemia, concentrated in 57% of most upper-middle- and high-income countries Araujo & Ayres-Silva (2023) with 15% in high-income countries and 23% in Central and eastern Europe in 2019 (Gretchen et al., 2022).

In Sub-Saharan African (SSA), anemia prevails at a rate of 43%, with the highest occurrence seen in the Western African region at 51%. Despite concerted efforts, progress to reduce the burden of anemia has been insufficient with Low- and Middle-Income Countries (LMICs), including those in SSA, not on track to meet the nutrition target of reducing anemia by 50% by 2030 (Mare, K. U., Aychiluhm, S. B., Sabo, K. G., Tadesse, A. W., Kase, B. F., Ebrahim, O. A., Tebeje, T. M., Mulaw, G. F., & Seifu, 2023). In many Sub-Saharan African nations, 15% of women undergo C-section deliveries Islam et al., (2022) and shockingly, approximately 50% of all maternal mortality resulting from pregnancy-related complications occurs in this heavily burdened region (Batist, 2019). A study conducted in Abubakar Tafawa Balewa University Teaching Hospital (ATBUTH), Bauchi, Nigeria, revealed that emergency Cesarean sections comprised 67.72% of all cases, while 81.39% were primary procedures (Atiku et al., 2023). The most frequently observed post-operative complication was anemia, affecting 13% of women who underwent Cesarean section deliveries. In Sudan, the prevalence of anemia among pregnant women is reported to be 53.0% Saeed et al. (2024), and this condition during pregnancy is linked with adverse maternal and perinatal outcomes. Among women in South Africa, 29% begin their pregnancies with anemia, with half of these cases attributed to iron deficiency anemia (Linström et al., 2024). A study showed that more than half of pregnant women in Tanzania had anemia at the end of their pregnancy (Konje et al., 2022).

In Uganda, according to the 2016 Uganda Demographic and Health Survey (UDHS), anemia affects close to 32% of women of reproductive age (Nankinga & Aguta, 2019). This high prevalence is exacerbated by inadequate prenatal care and nutritional deficiencies, leading to higher rates of severe anemia among C-section patients (Sivahikyako et al., 2021). The risk of maternal mortality in these cases is significantly elevated, with anemic women more likely to suffer severe postpartum complications compared to non-anemic women undergoing the same procedure (Mansukhani et al., 2023).

1.1.2 Theoretical Perspective

This study is grounded on two theories that the Biomedical Model (BM) and the theory of Social Determinants of Health (SDH). The Biomedical Model a foundational framework in medical science that emphasizes the biological and physiological determinants of health. Rudolf Virchow (1821–1902), often called the "father of modern pathology," played a pivotal role in this evolution,

emphasizing that diseases could be traced to disturbances at the cellular level (Lloyd, 2023). This laid the foundation for viewing health and illness primarily through the lens of biological processes. The biomedical model points out that intrinsic factors, such as genetic predispositions and physiological conditions, directly impact the risk of developing anemia (Bruns & Stalder, 2006). Factors such as blood loss during surgery, multiple pregnancies, and pre-existing medical conditions like HIV/AIDS or diabetes exacerbate the risk of anemia among these mothers (Ifeanyi, E.O, & Uzoma, 2024). These conditions affect the body's ability to produce or maintain healthy red blood cells, leading to increased susceptibility to anemia during pregnancy and after surgical procedures like C-sections (Andra et al., 2022). In Nepal, (Brunson, 2010) emphasizes that by focusing on these biological aspects, biomedical model allows for a targeted approach in identifying and managing women at higher risk, thus improving maternal health outcomes.

The SDH Theory, advanced by Marmot, (2005), underscores that health outcomes are deeply influenced by social and economic conditions rather than individual or biological factors alone. According to Marmot, (2005), social determinants such as poverty, nutrition, and access to healthcare services, sanitation and hygiene play a pivotal role in shaping health disparities. For instance, lower socio-economic status is often associated with reduced access to quality healthcare and nutrition, which can exacerbate conditions like anemia. Khatri et al., (2022) in a study in Nepal, among 1978 women aged 15–49 years who had live births notes that social determinants of health model allows for broader examination of how factors such as ethnicity, wealth index and birth order influence maternal health outcomes.

The Commission on Social Determinants of Health (CSDH), was established by (WHO, 2005), highlighting the importance of social factors in health outcomes and health inequities. The Commission emphasized that health is not merely the result of biological and genetic factors but is significantly influenced by the conditions in which people are born, grow, live, work, and age in. Integrating the Biomedical Model and the SDH Theory, allows for multidimensional framework that addresses both the immediate physiological causes of anemia and the broader socio-economic factors that influence health outcomes. This comprehensive approach enables the development of targeted, evidence-based interventions that may significantly reduce the prevalence of anemia among women undergoing C-sections, thereby improving maternal and fetal health outcomes in Uganda.

1.1.3 Conceptual Perspective

Anemia is operationally defined by a hemoglobin level of less than 11 g/dl, anemia is categorized into different severity levels: mild (10.0–10.9 g/dl), moderate (7–9.9 g/dl), and severe (below 7 g/dl) (Padhi et al., 2022; Tesema et al., 2021). Anchoring in the integration of the Biomedical Model and the Social Determinants of Health (SDH) Theory, provides a comprehensive framework to understand

the prevalence and determinants of anemia among women aged 15-49 years undergoing C-sections in Uganda. The Biomedical Model focuses on the intrinsic biological and physiological factors that directly impact anemia. This includes factors such as blood loss during surgery, multiple pregnancies, pre-existing conditions like HIV/AIDS or diabetes, and other obstetric complications that may impair the body's ability to produce or maintain healthy red blood cells (Andra et al., 2022). By emphasizing these biological determinants, the model highlights the importance of medical interventions, such as routine anemia screening and management during prenatal care, to reduce the risk of anemia in this vulnerable population (Bruns & Stalder, 2006; Ifeanyi, E.O., & Uzoma, 2024; Ruiz de Viñaspre-Hernández et al., 2021; Siu, 2015; Stapleton et al., 2019). This approach is crucial for developing clinical guidelines that target the specific medical needs of women undergoing C-sections, ensuring that they receive the necessary care to prevent and manage anemia effectively.

Incorporating the socio-economic and environmental factors that influence health outcomes, The SDH theory posits that health disparities are shaped by social determinants like poverty, nutrition, access to healthcare, and sanitation (Marmot, 2005). Factors such as socio-economic status, age, education level, residence, marital status, occupation, household size, geographic location, and access to healthcare services are critical in understanding the broader influences on maternal health. Lower socio-economic status for example reduces access to quality nutrition and healthcare, exacerbating the risk of anemia (Khatri et al., 2022). By integrating both the Biomedical Model and the SDH Theory, this study's framework not only addresses the immediate biological causes of anemia but also the underlying social determinants that contribute to its prevalence.

1.1.4 Contextual Perspective

Anemia remains a significant public health issue in Uganda, particularly among women of reproductive age (Bongomin et al., 2021). This health burden among pregnant women undergoing C-sections is of particular concern due to the compounded risks associated with surgical procedures and pre-existing anemia (Shaikh et al., 2022). Uganda's healthcare system, while making strides in improving maternal health services, continues to face challenges in accessibility, especially in rural and underserved regions. Many women in these areas experience limited access to quality prenatal care, which is critical for the early detection and management of anemia (MOH, 2020). Despite these efforts, anemia among women undergoing C-sections, particularly in rural and underserved regions where access to quality prenatal care is limited, remains a significant concern. This underscores the need to understand the biological, obstetric, and socio influences on this health burden among this vulnerable group, providing crucial insights for developing targeted interventions to improve maternal and neonatal health outcomes.

An analysis of the Uganda Demographic and Health Surveys conducted in 2006, 2011, and 2016 among 10,956 weighted cases of women age 15–49 by (Nankinga & Aguta, 2019) shows that 32% of women had anemia in 2016. The study found out that women in households without improved drinking water sources were at higher odds of being anemic. Furthermore, wealth index, regional variations, and age influenced anemia in women of child bearing age. However, this study ignores women undergoing C-section, yet they are at greater risk due to blood loss during surgical procedures (Shaikh et al., 2022). This study primarily focused on social factors and did not delve into the biological, obstetric and environmental factors that significantly contribute to anemia among this vulnerable group that may already be suffering from anemia prior to surgery.

Additionally, a cross-sectional study among pregnant women attending the antenatal care clinic of Kawempe National Referral Hospital, Kampala, Uganda by (Bongomin et al., 2021) revealed that anemia occurred in the second or third trimester of pregnancy and none were severe. This study focusing on the timing of anemia, and its outcomes failed to unveil the influencers of the disease especially in the context of C-section mother, which may provide insights into policy making to improve health outcomes for these women. Furthermore, through a systematic review of 17 published studies of anemia in pregnancy in Uganda between 1 January 2000 and 31 September 2020, the study revealed a prevalence of 30%. While (Khatri et al., 2022; Nankinga & Aguta, 2019) explored the socio determinants and (Bongomin et al., 2021) the prevalence which based on a smaller study area of Kawempe National Referral Hospital rather than Uganda as a whole, there is need to address the risk associated with C-section and understanding the broader obstetric, biological and environment influencers of this disease among these women in the national context.

1.2 Statement of the Problem

Anemia remains a critical public health challenge, affecting approximately 40% of pregnant women globally and contributing significantly to 115,000 maternal and 591,000 infant mortality (Abriha et al., 2014; Bongomin et al., 2021). In Uganda, while Cesarean section (C-section) rates have increased from 5.7% in 2011 to 14% in 2022 (UBOS, 2023), the prevalence of anemia among pregnant women aged 15-49 years persists at a concerning rate of 30% (Bongomin et al., 2021). This confluence of rising C-sections and high anemia prevalence underscores a pressing public health issue, as the increased blood loss associated with C-sections exacerbates anemia's detrimental effects on maternal and fetal health. Women undergoing C-sections are particularly vulnerable to severe anemia, which may lead to poor surgical outcomes, increased postpartum recovery time, and elevated risks of postpartum hemorrhage.

Whereas there is research evidence (Ahmed et al., 2021; Bongomin et al., 2021; Kare & Gujo, 2021; Medicine et al., 2021; Rumbidzai et al., 2022) on factors associated with anemia among pregnant women, little information is available specifically for those undergoing C-section in Uganda. This gap in the literature emphasizes the need for focused study to determine the precise prevalence and determinants of anemia in Ugandan among women having Cesarean sections. For the purpose of creating efficient interventions to enhance the health outcomes for mothers and newborns in this high-risk population, it is imperative to address this knowledge gap. This study will throw more light on the burden of anemia among women who undergo C-section in Uganda. Findings from the study are expected to contribute to the evidence-based design of policies and programming to address anemia among women undergoing C-sections. Ultimately, the findings will also inform the efforts to reduce maternal and neonatal mortality in line with the Sustainable Development Goal 3.

1.3 Objectives of the Study

1.3.1 Main Objective

The major objective of this research study was to examine the prevalence and determinants of anaemia among C-section women aged 15-49 years undergoing C-section in Uganda.

1.3.2 Specific Objectives

The specific objectives include the following:

- i. To determine the prevalence of anaemia among C-section women aged 15-49 years in Uganda.
- ii. To identify the socio-demographic factors associated with anaemia among C-section women aged 15-49 years in Uganda.
- iii. To examine the relationship between obstetric, maternal factors and anaemia among C-section women aged 15-49 years in Uganda.
- iv. To identify the nutritional and preventive factors associated with anaemia among C-section women aged 15-49 years in Uganda.

1.4 Study hypotheses

The study tested the following key hypotheses:

H₀₁: There is a positive association between socio-demographic factors and anaemia among C-section women.

H₀₂: There is a significant relationship between obstetric and maternal factors and anaemia among C-section women.

H₀₃: Nutrition and preventive factors are positively association with anaemia among C-section women.

1.5 Significance of the Study

Anemia in pregnant women, particularly those undergoing C-sections, poses a significant public health concern both globally and in Uganda. It remains one of the most prevalent risk factors during pregnancy, contributing to heightened risks of maternal and fetal morbidity and mortality. Tackling anemia is essential for improving the health of mothers and children and for advancing broader public health goals.

For healthcare professionals, such as obstetricians and midwives, the study's findings may enhance the ability to assess and manage anemia risks more effectively. By identifying socio-demographic, obstetric, maternal, and nutritional factors that contribute to anemia, medical practitioners may offer tailored interventions like targeted iron supplementation and close monitoring for at-risk women, helping to reduce complications for both mothers and infants.

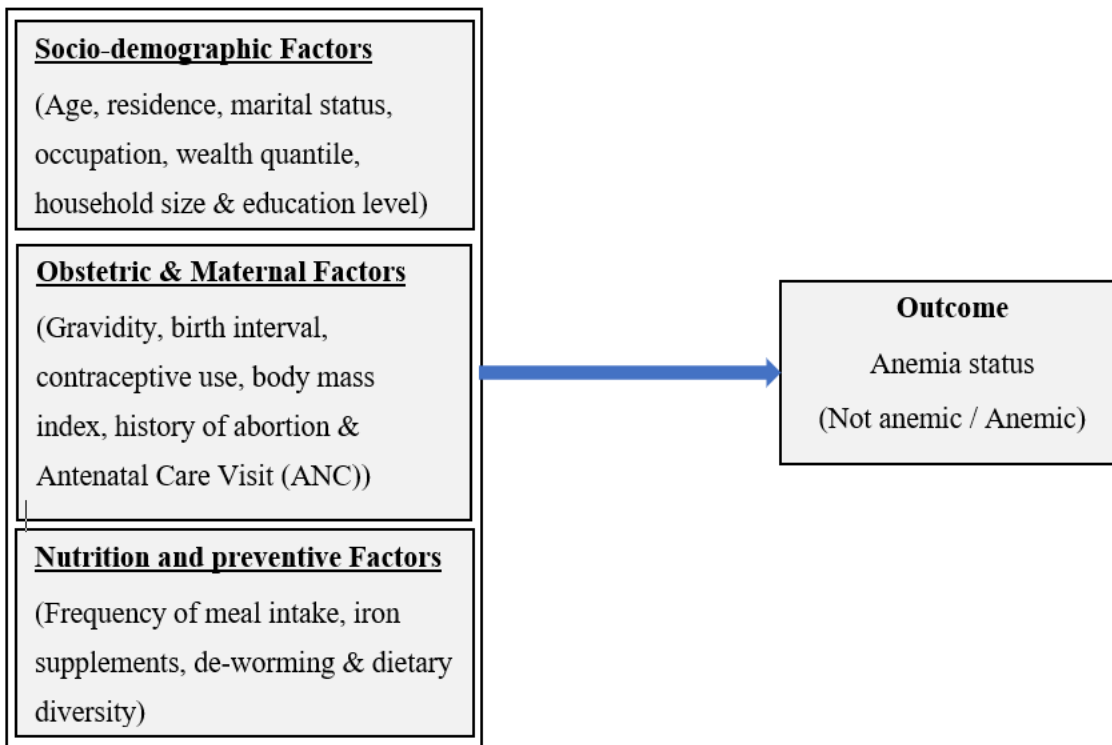
The study's outcomes may be pivotal in informing national guidelines on antenatal care and shaping how resources are allocated for maternal health services by policymakers and public health authorities. Targeted strategies to lower anemia rates may align with Sustainable Development Goal (SDG) 3, which promotes health and well-being for all. Pregnant women, particularly those having C-sections, may benefit from improved healthcare strategies, leading to better outcomes, fewer delivery complications, and enhanced postpartum recovery. Healthier pregnancies may, in turn, reduce maternal and infant mortality rates, benefiting families and communities at large.

1.6 Scope of the Study

This research was conducted in Uganda and involved a study group of pregnant women aged 15 to 49 who underwent a C-section and were effectively surveyed during the 2022 Uganda Demographic and Health Survey (UDHS). Anemia was the main focus for this study and females aged 15–49 years were the unit of analysis.

1.7 Conceptual Framework

Figure 1.1: Conceptual Framework for Risk Factors Associated with Anemia



Source: Adopted from (Khatri et al., 2022; Marmot, 2005) and modified by the researcher

The study examines anemia status as the outcome variable, categorized as "Not anemic" or "Anemic" based on hemoglobin levels. The independent variables are grouped into socio-demographic, obstetric and maternal, and nutritional and preventive factors. Socio-demographic factors include age, residence (urban or rural), marital status, education level, employment status, wealth quantile, and household size, all of which reflect the social and economic context of the women and their access to resources. Obstetric and maternal factors such as gravidity (number of pregnancies), birth interval, antenatal care visits, Body Mass Index (BMI), and abortion history capture reproductive health characteristics that may influence anemia risk. Nutritional and preventive factors like frequency of meal intake, iron supplement use during pregnancy, and de-worming highlight dietary practices and preventive healthcare measures critical to anemia prevention. These variables together provide a holistic understanding of the factors influencing anemia among women who have undergone C-sections.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

This chapter provides a comprehensive review of the determinants of anemia among c-section women 15-49 years. This review aimed to identify patterns, research gaps, and implications for interventions and policies to improve over-all health of mothers. By synthesizing the existing evidence, this review informs strategies that might enhance health and well-being, reduce maternal mortality and morbidity, improve pregnancy outcomes, and cognitive development in children.

2.1 Conceptual review

Anemia, particularly among pregnant women is a significant health concern that affects maternal and fetal health outcomes. According to WHO, (2024) defines anemia as hemoglobin concentration <110 g/L among pregnant women and 120 g/L among non-pregnant women. Other scholars (Araujo & Ayres-Silva, 2023; Linström et al., 2024) emphasize that anemia is related to iron deficiency, which affects oxygen transportation in the body, thus impacting both maternal and fetal health. This conditions is critical for pregnant women, especially those undergoing Cesarean sections, a surgical procedure of delivery a baby through an incision made in the mother's abdomen and uterus (Sung et al., 2024). Cesarean birth may involve the risk of significant blood loss which can worsen pre-existing anemia or exacerbate acute anemia. Shaikh et al. (2022) highlighted this surgical procedure, leads to blood loss compared to vaginal deliveries, intensifying anemia's risk and complications such as infections, delayed wound healing, in severs case, maternal mortality. Despite improvements in these procedures as lifesaving delivery of patient preference, the operation carries risks especially for already anemia pregnant women including those without pre-delivery anemia. Blood loos in c-section may reach 1000ml which is twice the average blood loss in vaginal deliveries (Ragusa et al., 2024). This substantial blood loss with pre-existing anemia imposes a greater risk of severe postpartum anemia if left un-treated.

2.2 Theoretical review

This study anchors in two primary theoretical frameworks; the biomedical model and social determinants of health theory. These theories consider both the physiological and socio-environmental factors that influence anemia in c-section mothers, enabling more effective interventions to address this health challenge. The biomedical model, a foundation in health sciences points out that biological and physiological determinants such as blood loss and iron deficiency influence health outcomes. Rooted in the work of Rudolf Virchow, (Lloyd, 2023) notes anemia is a direct consequence of biological disruption such as iron deficiency and blood loss during surgery

impairing the body's oxygen capacity as mentioned by Rudolf Virchow that disease can be traced to cellular disturbances.

Women with existing medical conditions such as hypertension, stroke, epilepsy or psychiatric disorder, as well as those who have had multiple pregnancies may be at higher risk being anemic (Guignard et al., 2021). These conditions may be intensified by significant blood loss during surgery, especially when hemorrhage exceeds 1000 ml, which is twice that of vaginal deliveries (Shaikh et al., 2022). Gestation and body mass index (BMI) also influence blood volume and iron levels Bongomin et al. (2021), as multiple pregnancies may increase iron demand while BMI affects the body's ability to store iron efficiently. Women with higher gestation may face increased anemia risk due to cumulative nutritional depletion from the body during these multiple pregnancies (Sivahikyako et al., 2021). Similarly, overweight and underweight women are shown to be at higher risk of complications in pregnancy, with anemia more prevalent among those with lower BMI due to inadequate iron stores that impair blood production and oxygen transportation (Koirala et al., 2022).

On the other hand, social determinants of health theory developed by (Marmot, 2005) posits that social, economic, and environmental conditions influence health disparities. Health outcomes may not be solely influenced by biological determinants, but also social determinants such as income, education, the environment in which people live in, access to healthcare, and social support systems. Women with lower socio-economic status may have limited access to nutritious food, iron supplements, and quality antenatal care, which increases the risk of anemia both during pregnancy and after c-section delivery (Khatri et al., 2022). Women engaged in physically demanding jobs with low income, may be more vulnerable to anemia due to inadequate nutrition and restricted healthcare access (Eshete et al., 2024). Residing in rural areas often limit access to quality healthcare facilities, and nutrition which may heighten the risk of anemia and complicates c-section recovery (Lakew et al., 2024). According to Sivahikyako et al. (2021), single or divorced women may lack family support which in turn leads to higher anemia risk post- surgery.

This integrated theoretical framework may support targeted interventions addressing both biological and social determinants to promote comprehensive health solutions. While biomedical model underscores the importance of physiological factors, such as blood loss and iron levels, the social determinants of health theory extends this view to socio-economic elements that shape health outcomes. These social determinants may worsen a woman's ability to access adequate prenatal care. Moreover, preventive factors such as iron intake are influenced by biological needs and limited socio-economic access to services in low resource settings which may contribute to anemia among c-section women.

2.3 Review of related literature

2.3.1 Socio-demographic factors associated with anemia

Pregnancy and the postpartum period pose unique challenges to iron metabolism, increasing the susceptibility to anemia among women, particularly those undergoing c-sections. Age is a significant factor influencing the prevalence and severity of anemia in this population, with older women often at higher risk due to physiological changes and cumulative health effects. Eleje et al. (2022) found out that significantly more women delivered through c-section at a later gestational age in their retrospective cross-sectional study in Nigeria among 627 women who had c-section. Prior to and during the COVID-19 pandemic, 46.8% and 40.0% of the women gave birth through c-section respectively. The results suggest that the rate of c-sections during the initial phase of the COVID-19 pandemic was notably reduced in comparison to the period before COVID-19, while instances of fetal distress, emergency situations, overdue deliveries, and postpartum anemia were notably higher during the same period compared to pre-COVID times.

In Germany, Schlothauer et al. (2024) in their cross-sectional study to examine the situation of obstetric care for women, who had fled their home country and reached Germany since the summer of 2015, compared to other immigrant women and non-immigrant women found out that immigrant women had a higher c-section rate of 36.6% while only 33.2% non-immigrant women underwent Cesarean birth. The study interviewed 3420 women who had delivered in the three hospitals of tertiary care in Berlin, concluding that irrespective of migration status and low degree of education, these women were at increased risk for anemia. Moreover, older women who have had multiple pregnancies had better physiological adaptations to the demands of pregnancy, leading to a lower risk of developing anemia compared to younger mothers, who may be experiencing pregnancy for the first time.

Urban areas generally have better access to healthcare facilities, nutritional resources, and antenatal care services, potentially reducing the risk of anemia among women undergoing c-sections. In contrast, women residing in rural areas may face challenges such as limited healthcare infrastructure, inadequate prenatal care, and poor dietary diversity, which could contribute to a higher prevalence of anemia following caesarean birth. A systematic review of four cross-sectional studies conducted in Ethiopia by Lakew et al. (2024) analysed data from several public health facilities to find the prevalence and associated factors of anemia and found that rural residence was significantly associated with a higher prevalence of anemia among postpartum women who underwent c-sections. This was attributed to limited access to healthcare services, inadequate antenatal care, and poor nutritional intake common in rural areas compared to urban settings. Rural women were found to have inadequate access to prenatal care and iron supplementation, which led to a higher prevalence

of moderate to severe anemia in these settings. This study, however, lacks detailed information about the effect of residence on anemia among C-section mothers in the context of Uganda despite incorporating several studies with adequate samples in the systematic review.

In consistency, residing in rural settings was significantly associated with high prevalence of anemia in South and Southeast Asia. Keya (2023) in their cross-sectional study to determine the prevalence and predictors of anaemia among 914,496 women of reproductive age found that in some countries like Maldives, a significant relationship existed between a woman's anaemia and her residential status and mode of delivery. The study highlighted that urban residence was protective against the risk of anaemia. Despite, this study focusing on women of reproductive age (15-49 years old), the generalization of this finding on both vaginal and caesarean birth limits comprehensive understanding of the risk of residence on anemia focusing on caesarean mothers. Furthermore, socio-demographic, economic and cultural factors in Uganda, might not be similar to that of countries in South and Southeast Asia.

Marital status serves as a proxy for social support, economic stability, and access to healthcare, all of which influence a woman's risk of developing anemia following childbirth. A cross-sectional study at Mbarara regional referral hospital targeting 427 women who underwent caesarean section revealed that those who were married had lower odds of severe anemia post c-section (Sivahikyako et al., 2021). This finding may be due to the increased likelihood of receiving family support for prenatal care, which includes adherence to iron and folic acid supplementation, and overall better health-seeking behaviours. The findings revealed that marital status was significantly associated with anemia outcomes, married women had better prenatal care attendance and nutritional intake, reducing their risk of severe anemia compared to their single or divorced counterparts. While the sample size was sufficient for statistical analysis, the study was limited to hospital-based populations, potentially excluding women who deliver at home or in smaller health facilities, where the risk of anemia might be different. Additionally, how different types of marital relationships (e.g., cohabiting vs. legally married) influence anemia particularly among women who have had c-section was not comprehensively explored.

Occupational factors such as physical demands, stress levels, access to healthcare, and socioeconomic status could all impact a woman's risk of developing anemia following a c-section delivery. A cross-sectional study in Shewarobit health facilities, Amhara, Ethiopia, analysed immediate postpartum anemia and its association with various factors, including occupation among 311 women (Eshete et al., 2024). It found that women of reproductive age working in labor-intensive jobs, particularly those in agricultural or manual labor, were more likely to experience anemia due to inadequate dietary intake and limited healthcare access. The results suggested that occupation, as a socioeconomic

indicator, plays a critical role in determining health outcomes. Although this study emphasized the need for targeted nutritional and healthcare interventions for women in these high-risk occupations, it focused on hospital settings ignoring mothers who might have given birth at home whose information might have not been captured. The UDHS, a national survey, however, captures records of all mothers available at the time of the survey at household levels.

Economic status of mothers and their families influence nutritional access, healthcare quality, and adherence to supplementation protocols. Women from lower wealth quantiles are more prone to anemia due to poorer nutritional intake and inadequate access to healthcare services. Despite government offering financial and technical support for the Anemia Mukht Bharat strategy's execution through the National health mission in India, anemia showed a significant public health burden to the population (Dutta et al., 2023). The authors while reviewing the obstacles and charting a path forward to tackling anemia in pregnant women in India found that from the 33 articles reviewed, women from the lowest wealth quintiles were more likely to be anemic. This findings may be due to limited access to prenatal care, inadequate iron supplementation, and poor dietary intake. Though this study, focused on strategies employed by government to tackle anemia in pregnancy which might be beneficial in the Ugandan context, different socio-demographic, economic and cultural factors may be affecting this population differently.

Larger households may experience increased competition for resources, limited access to nutritious foods, higher stress levels, and challenges in accessing healthcare services, all of which can contribute to a higher prevalence of anemia among women in such settings and vice versa. According to Sanjay & Shekhar (2024), the number of household members had a positive relationship with anaemia, which showed that more than 60% women living with a higher number of household members were more anemic than those living in smaller households. Among 44,225 ever married women of urban India, Sanjay & Shekhar (2024) using cross-sectional data from National Family Health Survey concluded their findings that maternal high-risk fertility behaviour which may lead to vaginal or c-section delivery is a significant factor in raising the chance of anaemia. The study also found that women who had vaginal deliveries were more anemic that those who had c-section birth, however, there is limited information on the dynamic interplay of household size and anemia among C-section mothers due to the study's generalizability.

Literature shows that there is disparity in findings on association between prevalence of anemia and level of education. Higher educational attainment is often associated with better health literacy, access to healthcare resources, and awareness of preventive measures against anemia (Sakai et al., 2024). Conversely, women with lower levels of education may face challenges in understanding and implementing strategies to prevent and manage anemia following C-section deliveries (Lakew et al.,

2024). In an observational cohort study that interviewed 3,420 women who delivered in three tertiary care hospitals in Berlin, Germany, immigrant women were found to have a higher c-section rate 36.6%. Schlothauer et al. (2024) pointed out that low level of education significantly increased the risk of anemia among these women. Women with lower educational attainment may have less access to information on proper nutrition, prenatal care, and anemia prevention. Additionally, limited education often correlates with lower socioeconomic status, which restricts access to healthcare services and a nutritious diet, further increasing the risk of anemia. Educational interventions targeted at improving health literacy among women of reproductive age may be crucial in reducing the prevalence of anemia, especially among immigrant populations.

2.3.2 Relationship between obstetric and maternal factors and Anemia

Gravidity serves as a marker of a woman's reproductive history and may impact her nutritional status, iron stores, and overall health, thereby influencing the likelihood of developing anemia following childbirth. Women with multiple pregnancies might be at a higher risk of anemia due to increased iron demands and potential depletion of iron stores with each successive pregnancy. This could lead to a cumulative effect on the risk of anemia post-surgery. A cross-sectional study conducted at the postnatal ward of Mbarara Regional Referral Hospital (MRRH) in Southwestern Uganda among 427 women found that women who underwent caesarean section and had multiple pregnancies were at a higher risk of severe postpartum anemia compared to those with fewer pregnancies (Sivahikyako et al., 2021). The study identified that multigravida women, who often face nutritional depletion due to repeated pregnancies and limited recovery time between pregnancies, showed a higher prevalence of severe anemia post-Cesarean section (6.79%). Cumulative maternal nutritional demands and inadequate prenatal care exacerbates anemia risk, particularly among women with higher gravida. While the study employed a cross-sectional design with adequate sample size, its generalizability to a tertiary hospital in Southwestern Uganda does not capture the experiences of women who had had caesarean birth in other settings of Uganda as a nation.

In a systematic review and meta-analysis of four studies conducted in Ethiopia in 2024 by Lakew et al., (2024), it is highlighted that among postpartum mothers in public health facilities, multigravida status was linked to increased risk factors for anemia. The study, utilizing a random-effects model with a 95% confidence interval across four reviewed cross-sectional studies, underscored the necessity for extended iron supplementation and tailored nutritional interventions for women with multiple pregnancies. It was observed that standard iron and folate supplementation during pregnancy might not adequately address depleted iron levels in high-parity women. While these cross-sectional studies provided substantial samples and focused on postpartum mothers, they predominantly considered Cesarean section as a determinant of anemia among these mothers. However, the socio-

demographic, obstetric, maternal, nutrition and preventive predictors of the severity of anemia specifically among mothers who underwent Cesarean deliveries were not extensively explored.

Short birth intervals may lead to inadequate recovery of maternal nutrient stores, including iron, increasing the risk of anemia post-delivery. Conversely, longer birth intervals may allow for better maternal nutritional replenishment, potentially reducing the risk of anemia in this population. At a district headquarters hospital Nankana Sahib, Ahmad et al. (2023) in their cross-sectional study, investigated the impact of short birth spacing on maternal anemia among 135 pregnant women and found out that among these women 18 – 40 years, there was a significant association between hemoglobin level and past histories of vaginal births followed by c-sections. Ahmad et al. (2023) noted that having a short inter-pregnancy gap was connected with increased risk of unfavorable outcomes for both the mother and the baby. The generalization of women who have had both vaginal and c-section delivery, limits the comprehensive analysis of the effects of such obstetric and maternal factors on maternal health. Additionally, this hospital-based study does not capture women who could have been grappling with anemia after traditional c-section birth.

There might be a potential link between certain contraceptive methods and an increased risk of anemia post c-section. For example, long-acting reversible contraceptives (LARCs) such as intrauterine devices (IUDs) may be associated with a higher incidence of anemia in this population due to factors such as menstrual irregularities and increased bleeding. The study by Mare et al. (2023) investigated the determinants of anemia among reproductive-age women in 29 Sub-Saharan African (SSA) countries using pooled data of 205627 reproductive age women from demographic and health surveys. The study identified several biological factors such as pregnancy status, use of contraceptives, and the presence of comorbid conditions like malaria and HIV contributing to varying anemia levels among women. Pregnant women were at a higher risk of anemia due to increased iron demands, while contraceptive use, particularly hormonal methods, was associated with reduced risk of anemia. However, the authors noted that in some contexts, contraceptives, especially intrauterine devices (IUDs), contributed to menstrual irregularities, exacerbating anemia. While the study addresses anemia in a broad range of countries with an adequate sample, it does not fully account for the significant heterogeneity within SSA in terms of dietary patterns, healthcare access, and public health policies. For instance, while some countries have implemented large-scale public health campaigns to combat anemia, others have not, leading to vast differences in prevalence and treatment outcomes.

The Body Mass Index (BMI) serves as a fundamental indicator of an individual's weight status and is widely used in clinical settings to assess health risks associated with weight. Elevated BMI levels, particularly in the overweight and obese categories, have implications in various health

complications, including anemia. In a hospital based cross-sectional study on maternal anemia and BMI as determinants of pregnancy outcomes comprised of laboring 101 women admitted for delivery in selected tertiary care hospital in South India, it was found that during 1st antenatal visit 58.4% had anemia, while 53.5% had mild anemia during the last antenatal visit (Koirala et al., 2022). The study concluded that underweight women (BMI <18.5) were significantly more likely to experience emergency c-section deliveries. Additionally, increasing BMI was linked to complications like preeclampsia and gestational diabetes. This study limited to South India, lacks applicability to diverse socio-economic and geographic regions, also while focusing on BMI, there is lack of comprehensive analysis on how BMI influences anemia in c-section women.

Women with a history of abortion may be at increased risk of anemia due to physiological impacts such as chronic iron deficiency resulting from previous blood loss, nutritional deficiencies, and reproductive health complications like uterine scarring. Psychological factors and inflammatory responses triggered by abortions may further exacerbate the risk of anemia in the postpartum period following a Cesarean section. While determining preoperative anemia in women undergoing Cesarean delivery at a comprehensive specialized referral hospital in Ethiopia, Hassen et al. (2023) in their cross-sectional study found that 28.3% of these women had preoperative anemia. The findings reveal that previous history of abortion and lack of iron supplementation, previous Cesarean section significantly associated with preoperative anemia among women awaiting Cesarean section. Being a hospital-based research, the study's limitation is lack of comprehensive analysis regarding women who have had previous Cesarean suffering from anemia in other settings besides Gondar comprehensive referral hospital.

Antenatal care visits are vital for monitoring maternal health, detecting and managing complications early, and promoting healthy pregnancy outcomes. Regular antenatal care visits are crucial as they facilitate the early detection of anemia during pregnancy, enabling timely interventions that potentially lessen the severity and its associated complications before delivery Ishag et al. (2023). Adequate antenatal care is linked to a reduced risk of anemia among women, a particularly vital consideration for those undergoing surgical procedures. These visits offer opportunities for monitoring hemoglobin levels, recommending iron supplements, and addressing anemia risk factors effectively. In a cross-sectional study on prevalence of post-partum anemia and associated factors among 424 women attending public primary health care facilities in Tanzanian, Mremi et al. (2022), noted that antenatal interventions provided for prevention of anemia, among participants who utilized insecticide treated nets helped to manage the conditions. The study results showed that more than half (57.6%) had three to four visits. The study is focused on Tanzania, which limits generalizability to

other nations like Uganda. Differences in healthcare access, socioeconomic conditions, and cultural practices might yield varying anemia outcomes in different geographical settings.

2.3.3 Nutritional and Preventive Factors Associated with Anemia

The frequency of meal intake is a crucial factor influencing anemia among women who have had c-sections. Regular meals support steady nutrient supply, aiding in iron absorption and preventing deficiencies. Stable blood sugar levels, a healthy metabolism, and optimal postoperative recovery are facilitated by consistent meal patterns, all contributing to a reduced risk of anemia and overall well-being. In Dire Dawas, Ethiopia, Beshir et al. (2024) in their cross-sectional study among 476 participants mentioned that frequent, balanced meals, including iron-rich foods, were associated with better hemoglobin levels. Meal frequency is critical for replenishing lost nutrients, particularly after surgical deliveries. Women who have more frequent meals with a variety of food groups meeting minimum dietary diversity have lower rates of anemia across all trimesters (Agbozo et al., 2020). At public hospitals in Dire Dawa, Eastern Ethiopia, Bireda et al. (2022) through a cross-sectional study among 476 study participants selected found out that insufficient meal intake hinders proper nutrient absorption, leading to lower iron levels and increased anemia risk among postpartum women, particularly those undergoing c-sections. However, the relationship between specific types of meals, quality of diet, and anemia remains unexplored in the study.

Iron supplements are known to boost haemoglobin levels and improve iron stores in the body, thereby addressing the underlying iron deficiency that contributes to anemia following childbirth. Inadequate iron and folate levels in women may result in anemia, which makes women weary, dizzy, and more susceptible to infections. Uta et al. (2022) in a retrospective cohort study to examine the influence of nutritional supplementation for iron deficiency anemia on pregnancies associated with SARS-CoV-2 infection among 446 participants, all pregnant patients received a normal release iron supplement with a medium daily dose of iron between 30 mg and less than 60 mg elemental iron. The findings show that iron and folate was the optimal choice to normalize the weight at birth. Additionally, puerperal infection, emergency c-section, and small for gestational age were strongly associated with anemia in patients with COVID-19. However, the influence of iron supplements on anemia among women who underwent c-section was not comprehensively examined though the methodology shows high rigor with both treatment and control groups to examine the effect of these supplements on both maternal and child health.

De-worming enhances iron absorption, preventing nutrient competition, boosting immune function, reducing inflammation, and promoting overall health. De-worming treatments also help reduce the risk of anemia, leading to better health outcomes and aiding in post-C-section recovery. Women who

take deworming treatment during pregnancy have better perinatal outcomes, including lower rates of anemia, which is crucial for C-section deliveries. Women with infections may be more prone to anemia, which can increase risks during surgery. Revathi et al. (2024) in a cohort study among 650 women revealed that women who received deworming, had fewer complications related to blood loss, anemia, and prolonged recovery periods compared to those who were not dewormed. While the study includes C-section women, it does not focus specifically on how anemia-related risks impact this group compared to women who had vaginal deliveries. Additionally, the sample in the primarily consists of rural women, a more diverse sample across both urban and rural populations in Uganda provides more understand how healthcare access differs.

A diverse diet ensures the intake of essential nutrients like iron, folate, and vitamin B12, crucial for preventing anemia. Enhancing iron absorption through complementary food pairings and mitigating micronutrient deficiencies lowers the risk of anemia especially among pregnant women who have to undergo surgery during delivery (Bambo et al., 2023). Varied diet supports gut health, aiding in nutrient absorption and postoperative recovery following C-sections. Ensuring dietary diversity is essential for reducing anemia risk and supporting overall health outcomes in women undergoing C-sections (Beshir et al. 2024). Balcha et al. (2023) in a cross-sectional study among 420 pregnant women investigated factors contributing to anemia among pregnant women attending antenatal care in Pawi district, Northwest Ethiopia. The study revealed that 9% of the women underwent C-section deliveries. It also highlighted that poor dietary diversity defined as consuming fewer than three food groups was a significant risk factor for anemia. This dietary inadequacy, common among the women, makes them more susceptible to developing anemia during pregnancy. While this study may highlight dietary diversity and healthcare access, this research aims to delve deeper into other socio-economic, obstetric, maternal, nutrition and preventive factors influencing anemia specifically in C-section cases.

2.4 Summary of literature review

The literature review highlights that C-section women are at a higher risk of anemia due to increased blood loss, pre-existing conditions, and recovery complications. Numerous studies have explored the prevalence and determinants of anemia among pregnant women, with many of them focusing on regions outside Uganda and differences in sample sizes, methods, and data sources which limit the applicability of their findings to the Ugandan context. These studies conducted in countries with distinct healthcare systems and socio-economic conditions may not accurately reflect the challenges faced by c-section mothers in Uganda, where access to healthcare, socio-economic disparities, and cultural factors significantly influence maternal health outcomes. The methods used in these studies vary widely, with data source differences such as hospital based, community, and cohort-based

surveys, as well as variability in sample sizes, may influence the findings and generalizability of results. The majority of these studies do not specifically isolate c-section patients, grouping them with women who deliver vaginally, which may not capture the risks associated with surgical delivery in the Ugandan context. This study seeks to address these varying methodological gaps specially focusing on the prevalence and determinants of anemia among c-section women aged 15 – 49 in Uganda. The study aims to provide insights that are more relevant to the Uganda’s healthcare context, which may contribute the targeted interventions that improve maternal and neonatal health outcomes in this population at high risk.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This Chapter presents the methodology that was used in the study. It includes the data source and study design, sample size, description of the variables, data analysis, ethical considerations, and limitations of the study.

3.2. Study design

This study was a secondary data analysis on women aged 15-49 years and who had C-section prior to the Uganda Demographic Health Survey UDHS (2022). The UDHS is conducted every after five years by the Uganda Bureau of Statistics (UBOS), in collaboration with the Ministry of Health, the United Nations population Fund (UNFPA), the United Nations Children's Fund (UNICEF), the United Nations High Commission for Refugees (UNHCR) and World Bank implemented the survey. The main purpose of the 2022 UDHS was to provide current estimates of basic demographic and health indicators at the national level, which allows the calculation of key demographic indicators (UBOS,2023). The source of secondary data for this study was the data collected by UBOS for the purpose of UDHS (2022). The Uganda Bureau of Statistics follows rigorous procedures in sampling, data collection, verification and analysis.

3.2.1 Study population and inclusion criteria

The target population for this research study was all women that undergone a C-section of reproductive age 15-49 years successfully interviewed during the 2022 Uganda Demographic and Health Survey. These were women who were either permanent residents of the selected households or visitors who stayed in the household the night before the survey.

3.2.2 Sample size

In total, the 2022 Uganda Demographic and Health Survey (UDHS) reached a sample of 20,481 households resulting in 18,251 women being successfully interviewed, of which 1,066 underwent a C-section at the time of the survey. This sample size of 1,066 women was considered for this study.

3.3 Data source and description

This research study used secondary data from the survey entitled "Uganda Demographic and Health Survey (UDHS)," which was conducted by the Uganda Bureau of Statistics with support from the United Nations Children's Fund (UNICEF), and the United Nations Population Fund (UNFPA). ICF provided partial technical assistance through The DHS Program. The survey collected information

on a nationally representative sample of women of childbearing age (15-49). The survey questionnaires included questions on the household and respondent characteristics, fertility and family planning, infant and child health and mortality, maternal health and maternal and adult mortality, child and adult nutrition, malaria, HIV/AIDS, disability, road traffic accidents, child discipline, early childhood development, and domestic violence. The 2022 UDHS is a nationally representative survey designed as a follow-up to the previous (1988-89, 1995, 2000-01, 2006, 2011, and 2016 UDHS) surveys. The main purpose of the survey was to provide data needed to monitor and evaluate demographic and health indicators (Uganda Bureau of Statistics, 2023).

3.4 Description of the study variables

3.4.1 Dependent variable

The dependent variable for this study was anemia recoded as not anemic and anemic. It was delved from blood hemoglobin which was measured and recorded as a continuous variable in the 2022 UDHS dataset. A value of 1 was assigned to blood hemoglobin < 11g/dl, as recommended by the World Health Organization (WHO) to classify anemic pregnant and 0 otherwise (non-anemic).

3.4.2 Independent variables

The independent variables included age, residence, marital status, occupation, wealth quantile, education level, household size, gravidity, birth interval, body mass index, Antenatal Care Visit (ANC), history of abortion, frequency of meal intake, iron supplements, dietary diversity, and deworming. **Table 3.1** describes the different variables that were used.

Table 3.1: Description of the different variables that were used

Variable	Description	Codes/Values	Data type
Dependent variable			
anemia	Anemia status of the respondent	0-Not anemic 1-Anemic	Binary
Independent			
Age	Age of the woman	1-15-24 2-25-34 3-35-44 4-45 and above	Ordinal
Resd	Place of residence	1-Urban 2-Rural	Binary
mstat	Marital status	1-Never married 2-Married/co-habiting	Nominal

Variable	Description	Codes/Values	Data type
		3-Separated/widowed/ divorced	
employ	Employment status	1-Unemployed 2-Employed	Binary
income	Wealth index	1-Lowest 2-Second 3- Middle 4-Fourth 5-Highest	Ordinal
educ_level	Education level	1-No formal education 2-Primary education 3-Secondary education 4-Higher	Ordinal
HH_size	Household size	1=Less than 5 people 2=At least five people	Binary
gravidity	Gravidity	1=Primigravida 2=Multigravida	Binary
birth_interval	Birth interval	1 = Less than 2 years 2 = At least 2 years	Binary
BMI	Body mass index	1= Under-weight (less than 18.5kg/m ²) 2= Normal (18.8 kg/m ² -24.9 kg/m ²) 3=Overweight (25.0 kg/m ² - 29.9 kg/m ²) 4=Obese (at least 30 kg/m ²)	Ordinal
ANC	Number of ANC	1=Less than 4 visits 2=At least 4 visits	Binary
abortion	History of abortion	0-No 1-Yes	Binary
meal_freq	Frequency of meal intake	1=Less than 3 meals a day 2=At least 3 meals a day	Binary

Variable	Description	Codes/Values	Data type
iron_intake	Iron supplement intake during pregnancy	0-No 1-Yes	Binary
Diet_diversity	Dietary diversity	1=Less than 5 food groups a day 2=At least 5 food groups a day	Binary
de-worming	Drugs for intestinal parasites	0-No 1-Yes	Binary

Appendix II includes the relevant questions extracted from the 2022 UDHS Woman Questionnaire. These questions serve as a checklist to identify the variables in the dataset, ensuring that all necessary data points for this study such as anemia status, socio-demographic, obstetric, and nutritional factors are accurately captured and aligned with the study objectives.

3.5 Data quality control

The study utilizes secondary data from the 2022 Uganda Demographic and Health Survey (UDHS), a nationally representative dataset collected by the Uganda Bureau of Statistics (UBOS) in collaboration with other health stakeholders. To ensure high data quality, the UDHS follows rigorous procedures in sampling, data collection, and verification:

Sampling and Representativeness

All data collected by UBOS on women in the UDHS 2022 data set who met the criteria a night before the survey was selected for this study. There were 1,066 records in the UDHS 2022 data set who met the selection criteria

Standardized Data Collection Procedures

The UDHS data collection process involves trained field personnel who adhere to standardized protocols, reducing the risk of interviewer bias and errors. Comprehensive training and pre-testing of survey instruments are conducted to ensure accuracy and reliability in data collection.

Data Verification and Validation

The dataset undergoes multiple layers of quality checks and validation. Supervisors review and verify data throughout the collection process to identify and correct any inconsistencies. Additionally, the survey team uses electronic data collection devices that include built-in validation checks to minimize data entry errors.

3.6 Data management and analysis

Data was imported to Stata/SE 17 for management where recoding was done for various categorical variables. The analysis was done at mainly three stages of univariate, bivariate, and multivariable levels. It also involved diagnostic tests like model goodness-of-fit to data at the multivariate stage.

3.6.1 Univariate analysis

An assessment of the socio-demographic, obstetric & maternal, and nutrition & preventive characteristics of women that undergone a C-section was made using frequency for all the variables including the outcome.

3.6.2 Bivariate analysis

At this level of analysis, variable selection was done by fitting an exploratory simple modified Poisson regression model between each predictor variable (one at a time) and the outcome to establish their relationship and, in turn, identify potential predictors for further investigations. The level of significance was at 0.05, that is at a confidence interval of 95%. Also, all the predictor variables with a relatively small probability value of less than or equal to 0.1 from the exploratory simple modified Poisson regression model were considered for further investigation at the multivariate level.

3.6.3 Multivariate analysis

The modified Poisson regression model was fitted, adjusted for the independent variables selected from the bivariate level to examine the prevalence and determinants of anemia among C-section women aged 15-49 years in Uganda. At this level of analysis, a predictor variable was reported as having a significant effect on the outcome, if it is statistically significant at the 5 percent level of significance. The model according to Zou, (2004) is generally described as follows:

$$\log_e(\pi_i) = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \dots + \beta_{k-1} x_{i,k-1}$$

Where;

π_i = Probability of the i^{th} woman testing positive for anemia

β_0 = Intercept

$\beta_1, \beta_2, \dots, \beta_{k-1}$ = Slope coefficients of the covariates

$x_1, x_2, \dots, x_{i,k-1}$ = Covariates for the respective case

3.6.4 Modified Poisson regression diagnostics

Likelihood ratio Chi-square test

Model goodness-of-fit to data was assessed using the likelihood ratio (LR) Chi-square test to determine whether the model is a good representation of the data. This test helped to identify whether the predictor variables have an overall significant effect on the dependent variable. The null hypothesis is that the independent variables overall are not significantly related to the outcome variable. Any association resulting in a p -value less than or equal to 0.05, led to the rejection of the null hypothesis. The likelihood-ratio Chi-squared test statistic according to Harrell, (2015) is generally described as:

$$G_{df}^2 = -2 \log_e(\Lambda)$$

$$\text{Where } \Lambda = \frac{\max L(H_0)}{\max L(H_A)}$$

$\max L(H_0)$ = maximum of the likelihood when parameters satisfy H_0 (intercept only model)

$\max L(H_A)$ = maximum of the likelihood when parameters satisfy H_A (saturated model)

Degrees of freedom (df) = number of parameters specified (estimated) under the alternative model (hypothesis) minus the number of parameters estimated under the null model (hypothesis).

Link specification test

The link specification test was carried out to assess the appropriateness of the Poisson log function. A non-significant result implied that the log link is correctly specified.

3.7 Ethical considerations in this study

This study used source secondary data from the 2022 Uganda Demographic and Health Survey (UDHS) which is accessible to all stakeholders. Permission to download and use this data was obtained through the DHS Program website (DHSprogram.com/Data) and the copy of the letter is attached in appendix III. Individual information from the subjects was kept confidential during and after the data analysis and any piece of communication concerning the research study was done only in line with the objectives of the study. The study also obtained clearance from Uganda Christian University Research Ethics Committee (UCU-REC) and a copy of the approval letter is shown in appendix I.

CHAPTER FOUR: RESULTS PRESENTATION, INTERPRETATION AND ANALYSIS

4.1 Introduction

This chapter discusses results from the three stages of analysis; the univariate stage, an assessment of the socio-demographic, obstetric and nutritional characteristics of C-Section women 15-49 years in Uganda were made using frequencies. This was followed by fitting an exploratory simple modified Poisson regression model to establish the relationship between each predictor and the outcome (anemia) and identify potential predictors for further investigations. At the multivariate stage, the multivariable modified Poisson regression model was fitted to examine the determinants of anemia among C-section women aged 15-49 years in Uganda.

4.2 Univariate analysis

This stage presents an assessment of the characteristics of women that underwent a C-section in Uganda presented in terms of frequencies (Table 4.1).

Table 4.1: Results of the distribution of characteristics of women that undergone a C-section

Characteristic	Frequency (n)	Percentage (%)
Anemia status		
Not anemic	962	90.2
Anemic	104	9.8
Age of the woman		
15-24	344	32.3
25-34	364	34.2
35-44	265	24.9
45 and above	93	8.7
Place of residence		
Urban	189	17.7
Rural	877	82.3
Marital status		
Never married	336	31.5
Married/co-habiting	582	54.6
Separated/widowed/ divorced	148	13.9
Employment status		
Employed	815	76.5
Unemployed	251	23.6
Wealth index		
Lowest	271	25.4
Second	350	32.8
Middle	234	22.0
Fourth	171	16.0
Highest	40	3.8

Education level		
No education	116	10.9
Primary	754	70.7
Secondary	155	14.5
Higher	41	3.9
Household size		
Less than 5 people	372	34.9
At least five people	694	65.1
Gravida		
Primigravida	946	88.7
Multigravida	120	11.3
Birth interval		
Less than 2 years	457	42.9
At least 2 years	609	57.1
Body mass index		
Under-weight	108	10.1
Normal	733	68.8
Overweight	179	16.8
Obese	46	4.3
Number of ANC		
Less than 4 visits	205	19.2
At least 4 visits	861	80.8
History of abortion		
No	801	75.1
Yes	265	24.9
Frequency of meal intake		
Less than 3 meals a day	1008	94.6
At least 3 meals a day	58	5.4
Iron supplement intake during pregnancy		
No	92	8.6
Yes	974	91.4
Dietary diversity		
Less than 5 food groups a day	1003	94.1
At least 5 food groups a day	63	5.9
Deworming		
No	367	34.4
Yes	699	65.6
Note. The analysis was based on all N = 1,066 respondents.		
Source: Generated by the author		

As shown in Table 4.1, out of the 1066 women who had C-Section, approximately 10% were anemic, with the majority (82.3%) in rural residence and the highest portion having low wealth index (59.2% in the lowest two quintiles) likely influencing anemia among these vulnerable mothers. Most (34.2%) women were aged 25-34, more than half (54.6%) were married or cohabiting, and the highest

proportion (76.5%) were employed despite the majority (70.7%) of them having attained only primary education, which may affect health literacy to enhance better maternal and infant health outcomes. Nutritional factors remain lacking as the highest percentage (94.6%) of these women consumed fewer than three meals daily, and 94.1% had inadequate dietary diversity, despite the majority (91.4%) reporting iron supplement intake. Although less than 50% had birth intervals under two years, this may impact maternal iron stores, and 11.3% being multigravida, increasing cumulative anemic risk. Despite, the majority (80.8%) reporting attending at least four ANC visits, only 65.6% received deworming treatment underscoring the need to improve implementation to enhance better health outcomes.

4.3 Bivariate analysis

The analysis at this stage was aimed at identifying potential explanatory variables of anemia for further analysis at the multivariate stage. The results of the association between anemia and each predictor variable in the unadjusted simple modified Poisson regression model are shown in Table 4.2.

Table 4.2: Results of the association of anemia and independent variables in the exploratory unadjusted simple modified Poisson model

Factor	Coef. ^a	Std. Error. ^b	p-value
Age of the woman			
15-24 ^s			
25-34	0.011	0.021	0.618
35-44	-0.020	0.025	0.419
45 and above	-0.036	0.038	0.345
Place of residence			
Urban ^s			
Rural	-0.054	0.019	0.005
Marital status			
Never married ^s			
Married/co-habiting	0.009	0.021	0.660
Separated/widowed/ divorced	0.033	0.027	0.231
Employment status			
Employed ^s			
Unemployed	-0.039	0.023	0.093
Wealth index			
Lowest ^s			
Second	-0.017	0.024	0.472
Middle	0.012	0.025	0.635
Fourth	-0.023	0.030	0.446
Highest	-0.061	0.059	0.298
Education level			

No education [‡]			
Primary	0.012	0.030	0.692
Secondary	-0.019	0.039	0.621
Higher	0.006	0.054	0.914
Household size			
Less than 5 people [‡]			
At least five people	0.036	0.020	0.072
Gravida			
Primigravida [‡]			
Multigravida	0.025	0.026	0.328
Birth interval			
Less than 2 years [‡]			
At least 2 years	0.029	0.018	0.040*
Body mass index			
Normal [‡]			
Under-weight	-0.033	0.033	0.317
Overweight	-0.030	0.026	0.253
Obese	-0.043	0.051	0.396
Number of ANC			
At least 4 visits [‡]			
Less than 4 visits	0.036	0.020	0.077
History of abortion			
No [‡]			
Yes	-0.036	0.023	0.048*
Frequency of meal intake			
At least 3 meals a day [‡]			
Less than 3 meals a day	-0.012	0.038	0.099
Iron supplement intake during pregnancy			
No [‡]			
Yes	-0.024	0.029	0.422
Dietary diversity			
At least 5 food groups a day [‡]			
Less than 5 food groups a day	-0.019	0.035	0.584
Deworming			
Yes [‡]			
No	-0.051	0.020	0.013*
Note 1. Significance: *p < 0.05			
Note 2. The analysis was based on all N = 1,066 respondents.			
Source: Generated by the author			
‡ Reference categories adopted in the analysis			
^a Coefficients			
^b Robust standard errors of coefficients			

Socio-demographic factors

Among the socio-demographic factors, place of residence had a statistically significant ($p < 0.05$) association with anemia, women in rural residence exhibited lower risk compared to those in the urban dwelling. While employment status and household size show a marginal relationship at ($p < 0.1$) with anemia, age, marital status, wealth index and education level show no significant relationship. Therefore, residence, employment status, and household size were considered for multivariate analysis.

Obstetric, maternal factors

From the obstetric and maternal factors considered in this study, it was found that birth interval and history of abortion was significantly ($p < 0.05$) associated with anemia among C-section women. Antenatal care reveals a marginal relationship ($p < 0.1$) while gravida, contraceptive use, and body mass index ($p > 0.05$) show no significant association and were therefore not considered at the final analysis.

Nutritional and preventive factors

The risk of being anemic shows a significant relationship with de-worming treatment ($p < 0.05$) and frequency of meal intake ($p < 0.1$) among the nutrition and preventive factors. The variables iron supplements, and dietary diversity were eliminated from the multivariate analysis since they did not substantially relate with the risk of being anemic.

4.4 Multivariate analysis

First, we assessed the model for goodness-of-fit to data using the Likelihood ratio chi-square test. We found a statistically significant result ($\chi^2(8) = 24.99, p = 0.002$) implying that the set of the selected predictor variables had a significant improvement over the null model. Second, the test for the correctness of the link function which involves the square of the estimated linear predictor as an extra covariate in the model indicated no statistical significance ($p = 0.071 > 0.05$), implying that the log link was correctly specified. These findings showed the appropriateness of using the modified Poisson regression model in explaining the data under investigation. Table 4.3 shows results of the socio-demographic, obstetric & maternal, and nutritional & preventive factors from the multivariable modified Poisson regression model.

Table 4.3: Results of the Poisson regression model for Anemia

Factor	aRR	Std. Err.	t-statistic	p-value	95%CI
Socio demographic factors					
Place of residence					
Urban [‡]					
Rural	0.957	0.021	-2.010	0.044*	0.917, 0.999
Employment status					
Employed [‡]					
Unemployed	0.961	0.022	-1.700	0.090	0.918, 1.006
Household size					
At least five people [‡]					
Less than 5 people	0.961	0.019	-1.960	0.048*	0.924, 1
Birth interval					
At least 2 years [‡]					
Less than 2 years	1.040	0.019	2.120	0.034*	1.003, 1.078
Obstetric and maternal factors					
Number of ANC					
At least 4 visits [‡]					
Less than 4 visits	1.023	0.024	0.970	0.332	0.977, 1.072
History of abortion					
No [‡]					
Yes	0.969	0.023	-1.370	0.172	0.925, 1.014
Nutritional and preventive factors					
Frequency of meal intake					
At least 3 meals a day [‡]					
Less than 3 meals a day	0.978	0.038	-0.590	0.557	0.906, 1.055
Deworming					
Yes [‡]					
No	0.947	0.020	-2.620	0.009*	0.908, 0.986
Constant	7.307	0.323	44.920	0.000*	6.700, 7.969
<p>Note 1. Significance: *p < 0.05 Note 2. The analysis was based on all N = 1,066 respondents. aRR-Adjusted Risk Ratio Std. Err. Robust standard errors of coefficients CI-Confidence interval [‡] Reference categories adopted in the analysis Source: Generated by the author</p>					

Socio-demographic factors

As shown in Table 4.3, C-section women living in rural areas (aRR=0.957; 95% CI: 0.917 – 0.999) have significantly lower risk of being anemic compared to their counter parts in the urban areas. This finding supports the hypothesis that location influences the risk of anemia among C-section women, suggesting that rural residence may provide protective benefits against anemia among this vulnerable

population. Households with less than five people was associated with a 3.9% lower risk of anemia (aRR=0.961; 95% CI: 0.924 – 1), suggesting that women living in households with fewer individuals are less likely to be anemic. This study accepts the null hypothesis that living in smaller households lower the risk of anemia. On the other hand, this finding fails to accept the hypothesis that employment status is significantly associated with anemia among C-section mothers given that its ($p > 0.05$).

Obstetric, maternal factors

Women with birth intervals of less than two years (aRR=1.040; 95% CI: 1.003 – 1.078) have an increased risk of anemia. This reveals that shorter intervals between birth are associated with higher likelihood of developing anemia compared to women who space their pregnancies further apart. This finding supports the hypothesis ($p < 0.05$) that birth interval is significantly associated with the risk of being anemic. On the contrary, the findings fail to accept the hypothesis that history of abortion and antenatal care visits have a relationship with anemia ($p > 0.05$).

Nutritional and preventive factors

Not deworming was associated with a 5.3% (aRR=0.947; 95% CI: 0.908 – 0.986) lower risk of anemia. This suggest that women who do not receive deworming may experience a reduced risk of anemia compared to those who do deworm. Accepting the hypothesis that deworming is associated with the risk of anemia, raising concern about the mechanisms that may influence anemia high prevalence among C-section mothers who take deworming treatment.

CHAPTER FIVE: DISCUSSION

5.1 Introduction

The prevalence of anemia among women who had undergone C-section was 9.8%. Though the prevalence is lower than national estimate (30%) for anemia among women of reproductive age, a significant proportion of those who had undergone C-section still faced this public health burden. The presence of anemia in nearly one in ten of these women highlights the need for continued maternal health interventions to prevent anemia related complications post-surgical recovery. Place of residence, household size, birth interval and deworming showed significant association with anemia among C-section women 15-49 years.

5.2 Socio-demographic determinants

This study accepts the hypothesis that place of residence is significantly associated with the risk of anemia, particularly, those residing in rural setting were found to be at a lower risk. Contrary to this finding, Lakew et al. (2024) in their systematic review conducted in Ethiopia found out that rural residence was associated with higher risk of anaemia among postpartum women who underwent C-section. Attributing this risk to limited access to healthcare services, prenatal care, inadequate antenatal care, poor nutritional intake, and iron supplementation. Similarly, Keya (2023) while determining the prevalence and predictors of anemia among women of reproductive age in South and Southeast Asia also found a high prevalence of anemia among those in rural settings. Noting that urban residence was protective against the risk of anaemia given better access to healthcare facilities, nutritional resources and antenatal care services, potentially reducing the risk of anaemia among C-section women. Carpenter et al. (2022) also found a very high prevalence of anaemia in a rural setting in Bangladesh where the majority delivered through C-section birth although most of them were at lower risk of low birth weight. Similarly, a rural setting in China reveals that the majority of women with post C-section complications such as anemia were given referrals to a Tertiary Care Hospital, attributing this to limited quality maternal care. Agreeing with this finding, elsewhere in Tanzania, Kalter et al. (2023) highlights that anaemia was commonly found among C-section mothers in urban centres. Women residing in town centres were more likely to deliver in a hospital through caesarean section due to complications associated with dwelling in these towns that place the lives of their babies at risk. This study suggests that rural women in Uganda probably engage in more physically active lifestyles and consume more iron rich fresh traditional diets offering benefits which contributes to lower risk of post C-section anaemia.

Employment was found to have no significant relationship with the risk of anemia, particularly, among those unemployed. Al-Rawashdeh et al. (2022) in Jordan agrees with this finding that

education has no impact on post C-section anemia. Though not directly relating education as a predictor of anemia among C-section mothers, they found out that education did not explain the disparities in C-section delivery, a procedure to avoid birth complications yet a risk factor for anemia. Similarly, Hassan et al. (2023) found no significant relationship between mother's employment status and choice of C-section associated with anemia. In the contrary, Eshete et al. (2024) found that housewives were more anemic, possibly due to financial constraints limiting access to iron rich foods and healthcare access. Shehwar et al. (2021) found out that women in Peshawar had reduced levels of hemoglobin after c-section delivery, with higher rates of Cesarean birth among the working class. Women who often conceive at late age influenced by the desire for economic independence, impacts on their chances of normal delivery, leading to caesarean birth. Aboushady et al. (2024) mentions that employed women mostly opt for C-section delivery to avoid complications during labor. Additionally, operative procedures come along with complications of anemia as a result of blood loss during and after the surgery. The finding of this study suggests that regardless of employment status, factors such as healthcare access, iron supplements with approximately 91% reporting taking them play a larger role in anemia prevalence than employment status. With more than half of these women being married or cohabiting, family support from their spouses may allow them to access adequate nutrition and healthcare services, offering protection against being anemic.

This study reveals that household size significantly influences anemia among women who have had C-section in Uganda, highlighting that women living in households with fewer members have lower risk of being anemic. The finding is similar with that of a study by Sanjay & Shekhar (2024) which showed that lower numbers of household members positively influence the risk of anaemia. In their study among 44,225 ever married women in India, the majority of those anaemic was found to be living in large sized households. The consequences of living in households with more members often affects the mother directly, as every member is competing for the limited resources within the family. Extended family members tend to influence the decision of C-section delivery (Temilola et al., 2025). Severe anemia and postpartum hemorrhage emerge as most common maternal complications associated with caesarean delivery. According to Sultana et al. (2022) most mothers have very little decision making autonomy about the choice of C-section delivery associated with the risk of blood loss, extended family members play a vital role in the decision making process. Contrary, Pandey et al. (2023) though didn't directly discuss family size as a predictors of anemia among C-section women, revealed a high prevalence of C-section among women from low sized families. In Mexico, although household size showed no significant relation with the C-section, these women suffered complications such as bleeding exposing them to greater risk of anaemia (Edelblute & Altman, 2021). In Uganda, smaller families often have adequate resources leading to better health management,

giving more protection against anemia as they are able to afford adequate frequent meals with iron rich foods, and medical care.

5.3 Obstetric and maternal determinants

This study showed that birth interval has a statistically significant relationship with the risk of being anemic, with women with shorter birth intervals at greater risk. In agreement, Ahmad et al. (2023) found a significant relationship between child birth and delivery whether vaginal or caesarean. Attributing this to hemoglobin levels changes from past histories of delivery among women with short birth spacing. Supporting this finding, Gele et al. (2022) mentioned that inadequate child spacing increases the risk of maternal depletion which worsens anemia due to limited time the mother has to recover from the previous birth. Aligning with this study, a case report by Sekar et al. (2023) mentions that child spacing of less than two years increases the risk of postpartum haemorrhage leaving these mothers more prone to severe anemia. Shorter birth intervals was found to be a risk of mortality among women undergoing C-section, attributing this to poverty and inadequate family planning (Abate et al., 2025). Failing to space pregnancies as recommended exposed mothers to C-section delivery which worsens pre-existing anemia. In Hawai, it was found that most mothers did not follow advise from their physicians (Delafield et al., 2020). Shorter intervals, not only increases the risk of morbidity, but also high mortality compared to mothers who have more than two years apart. Short child spacing depletes maternal iron stores which increases the risk of anemia. This finding suggests that, in Uganda, mothers closely spacing their children which exposes them to the risk of being anemia as the body has not fully recovered to regain the nutrients lost in the previous pregnancy and during delivery.

History of abortion shows no significant association with the risk of anemia among women who had undergone C-section. Consistent with this result, Sridhar et al. (2025) though did not directly discuss history of abortion as a determinant of anemia among C-section women, found out that abortion and history of caesarean delivery had no effect on preterm premature rupture of membranes which left more than half of the women anemic. In Fayoum University Hospital in Egypt Mohamed et al. (2024) revealed no significant association between history of abortion and peri-partum blood loss, suggesting that prior abortion may not directly contribute to anemia risk among C-section mothers. In the contrary, Hassen et al. (2023) in their cross-sectional study conducted in a specialized referral hospital in Ethiopia, it was found that preoperative anemia is associated with previous abortion putting these mothers at greater risk. This increased risk may be attributed to blood loss related with abortions, which depletes iron stores and elevate the body's iron during subsequent pregnancies. Similarly, Parikh et al. (2025) in their case report, mentioned that a woman with spontaneous abortion developed anemia during Cesarean section. Although, preventive surgery was carried out and completed without

complications, addressing the symptoms of anemia, the patients continue to struggle with the demand for iron as the body lost blood during abortion and surgery, ultimately delaying recovery time. Abnormal attachment of the placenta leads to excessive blood loss particularly during emergency surgery to save both the mother and the newborn (Askary et al., 2024). Previous curettage due to abortion exacerbates the risk of becoming anemia as the body lost a lot of blood. This study finding suggests that, high intake of iron supplements may have offset the long-term risk of anemia associated with abortions. Given that the majority reported not having done any abortions pre their C-section delivery, evidence of this no significant relationship between history of abortion and anemia among these mothers.

Antenatal care visits show no statistically significant relationship with anemia thus failing to accept the null hypothesis. In a tertiary Hospital in Southwestern Uganda, Sivahikyako et al. (2021) also found no relationship between antenatal care visit and anemia after caesarean. However, the majority of the women had attended at least four antenatal care visits before surgery. Contrary to this study finding, Mremi et al. (2022) mentioned that more antenatal visits helped to prevent anemia, particularly among those who used treated insecticide nets. Ishag et al. (2023) highlights that antenatal visits enhance early detection of anemia during pregnancy, which offers an opportunity to recommend iron supplements and nutritional counseling. According (Nankinga & Aguta, 2019) nutritional education during antenatal and postpartum care ensures that these mothers eat iron rich foods to help their body fight anemia. This helps to reduce the risk of anemia, particularly if the mother is considered for undergoing surgical procedures. Delayed antenatal care visits often result in poor compliance to anemia preventive strategies (Konje et al., 2022). Factors such as poor dietary intake and inadequate meal frequency may have overshadowed the potential benefits of antenatal visits in preventing anemia, given that the majority consumed less than the required food groups with few meals per day.

5.4 Nutritional and preventive factors

While this study shows no relationship between meal frequency and anemia among C-section women, eating frequently is essential for replenishing lost nutrients after delivery. Supporting this finding Misgina et al. (2021) showed no significant correlation between number of meals and gestational weight gain in their study where some participants had history of C-section. Due to food insecurity, these women often lack the opportunity to have frequent meals daily. Different from this study, Beshir et al. (2024) highlights that consuming nutritious meals frequently in addition to eating iron rich foods, greatly affects haemoglobin levels. Eating regular and diverse meals helps in maintaining a steady supply of nutrients essential for iron absorption and preventing deficiency. This promotes stable blood sugar levels, healthy metabolism and better recovery after surgery which lowers the risk

of being anaemic and enhances overall health (Agbozo et al., 2020). Balcha et al. (2023) found a high prevalence of anemia among women attending antenatal care in Ethiopia, attributing this to consuming less than the recommended number of meals with very few of them meeting the minimum dietary diversity. Eating fewer meals per day limits the chances of consuming iron rich foods which exposes the body to greater risk of anemia. Food shortages plays a critical role in the prevalence of anemia, particularly in low resource settings, where these women end up consuming less than the recommended meals per day (Araujo & Ayres-Silva, 2023). This study suggests that, while frequent meals are associated with better nutritional intake and improved iron levels, factors like dietary quality, and overall maternal health may influence the risk of anemia.

This study got a paradoxical finding that deworming is not a preventive measure against anemia, deworming reduces parasitic infections that interfere with iron absorption. The results show that those who did not take deworming treatment were at lower risk of becoming anemic. On the other hand, Revathi et al. (2024) mentioned that deworming during pregnancy helped reduce the risk of complications related to blood loss, anemia and prolonged recovery periods. In Mwanza city, Tanzania, Konje et al. (2022) studying high prevalence of anemia and poor compliance with preventive strategies, found out very low intake of deworming treatment among these women, although there was not statistically significant association. Deworming treatments reduces the risk of anemia particularly in high risk areas. Despite the majority taking mebendazole to prevent postpartum anemia at Mnazi Mmoja, Kigamboni and Magomeni Health care facilities, Mremi et al. (2022) reveals no significant relationship between deworming and anemia. Although (Balcha et al., 2023; Padhi et al., 2022) shows no evidence of association, deworming was pointed out as a prevention against the risk of developing anemia among pregnant mothers. This finding suggests that, intake of iron supplements might have played essential roles in boosting hemoglobin levels, thus lowering the risk of anemia, despite not taking deworming treatment. Women who took deworming treatment might have had complicated infections that required more specialized treatment putting them at greater risk.

CHAPTER SIX: SUMMARY, CONCLUSION, AND RECOMMENDATIONS

6.1 Introduction

Anemia increases the risk of postpartum complication and delayed recovery from Cesarean section, highlighting the need to examine factors associated with its prevalence in this population. Severe anemia not only weakens the body and delays recovery, but also increases the risk of death consequently affecting the health outcomes of the baby. This chapter presents the summary of findings, conclusion and recommendations for further investigations.

6.2 Summary of findings

This study examined the predictors of anemia among C-section women aged 15 – 49 in Uganda, focused on identifying the socio-demographic, obstetric and maternal factors, nutritional and preventive factors and the relationship between these factors and anemia among these vulnerable women. The findings reveal a prevalence of 9.8%, which is lower (30%) than the national prevalence to anemia among women of reproductive age in Uganda. The low prevalence may be attributed to improved hospital maternal care received by C-section mothers such as iron supplements and nutritional counselling. However, conditions such as food insecurity may exacerbate this risk among these vulnerable women, exposing more than one in every ten mothers, highlighting the need for sustained interventions to address post C-section challenge.

At the bivariate level of analysis, anemia was found to be significantly associated with socio-demographic, obstetric and maternal and nutritional and preventive factors at 5% level of significance using a simple modified Poisson regression model. An allowable probability value of 0.1 was also considered to qualify a variable for the final level of analysis, so as to have reasonable number of determinants. Among the socio-demographic factors, place of residence, employment status and household size were found to be significantly associated with the risk of anemia, while age, marital status, wealth quantile and education level showed no significant relationship. Birth interval, history of abortion and antenatal care revealed significant relationship while gravida, contraceptive use, and body mass index exhibited no association among obstetric and maternal factors. Lastly, in the category of nutritional and preventive factors, frequency of meals and deworming treatments were found to be significantly associated with anemia, while use of iron supplements, and dietary diversity showed no relationship.

At multivariate level of analysis, the multivariable modified Poisson regression model was fitted to examine the determinants of anemia among C-section women aged 15-49 years undergoing C-section in Uganda at 95% confidence level. The results revealed that of the socio-demographic factors, place of residence and household size significantly influenced the risk of being anemic. Considering

obstetric and maternal, and nutritional and preventive factors birth interval and deworming respectively, revealed significant associations. Employment status, history of abortion, antenatal care, and frequency of meal intake did not significantly determine the risk of anemia among these women.

6.3 Conclusion

This study found that anemia is highly prevalent among women who have undergone C-section in Uganda, with approximately one in every ten women being anemic.

This finding indicates that socio-demographic characteristics such as place of residence and household size influence anemia prevalence in this population. Women from rural settings were found to be at lower risk compared to their counterparts in the urban dwelling. Living in a household with fewer members offered protective benefits against anemia. The limited competition for the available resources enhances better access to necessities such as food and medical care.

This study also established that there is a strong relationship between obstetric and maternal factors and anemia in the vulnerable population. Birth interval influenced the risk of being anemic with those having shorter child spacing at greater risk. Closely spacing pregnancies limits the body from replenishing the lost nutrients in the previous pregnancy which weakens the immune system. History of abortion, however, did not reveal any significant associated with the risk of becoming anemic.

The finding reveals response to deworming treatment, though associated with lower risk of anemia, deworming offers protection against anemia as it reduces parasitic infections that interferes with iron absorption. Meal frequency shows no significant relationship with the risk of getting anemia among this population.

6.4 Recommendations

This study recommends that government through the ministry of health should improve nutritional education programs within health facilities pre and post C-section to promote dietary diversity for these mothers. By encouraging consumption of affordable iron rich foods, these mothers are able to improve their dietary intake which protects against anemia. With one in every ten women being anemic, this may be exacerbated by food insecurity affecting meal frequency and dietary intake which affects the body's ability to replenish lost nutrients during pregnancy and delivery.

The study recommends that Maternal health policies need to strengthen routine anemia screening during antenatal and postnatal care, alongside consistent supply of iron and folate supplements to improve adherence among women. Additionally, family planning initiatives need to educate women on the benefits of child spacing to prevent nutrient depletion in closely spaced pregnancies. Moreso, community-based support programs through the village health teams may reinforce the importance

of postpartum care, nutritional intake, adherence to iron supplements and optimal birth spacing to allow maternal recovery.

Finally the finding that not taking deworming treatment lowers the risk of anemia, underscores the need for further research to explore this relationship. There is need for research in the effectiveness of various preventive strategies not only among postpartum but also expecting mothers

6.4 Limitations of the study and areas of further research

This study faced several limitations that may have influenced the findings. First, to attain the complete sample size of 1,066 caesarean section mothers, it was necessary to impute missing data. While imputation helped to minimize data loss and retain statistical power, it may have introduced some level of bias if the missing information was not completely random. Secondly, inability to include specific research questions, since the study relied on secondary data from the 2022 UDHS, it was not possible to ask additional questions tailored to this research focus. Lastly,

The UDHS data were collected in 2022, and certain social, economic, and health service delivery conditions may have changed since then, potentially affecting the relevance of the findings to the current situation. Despite these limitations, the study contributes valuable insights into the determinants of anemia among caesarean section mothers in Uganda and provides evidence that can inform public health interventions.

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Appendices

Appendix I: Research approval letter from UCU-REC.

 **UGANDA CHRISTIAN UNIVERSITY**
A Centre of Excellence in the Heart of Africa
Office of the Vice Chancellor
Research Ethics Committee UG-026



10th February, 2025

ITHUNGU MARTHA
Uganda Christian University
+256782834842
Email: ithungumarttha@gmail.com

UG-REC-026 APPROVAL NOTICE


To: Ithungu Martha, Principal Investigator

Re: UCU-REC Application titled: Prevalence and Determinants of Anemia among C-Section Women Aged 15-49 Years in Uganda.

Application Number: UCUREC-2025-1173

Version: 4.1

Type: INITIAL REVIEW
 Protocol Amendment
 Letter of Amendment (Loa)
 Continuing Review
 Material Transfer Agreement
 Other, Specify:



I am pleased to inform you that the UG-REC-026; UCUREC approved the above referenced application.
Approval of the research is for the period from 10th February, 2025, to 10th February, 2026
This research is considered minimal risk category.
As Principal Investigator of the research, you are responsible for fulfilling the following requirements of approval:

1. All co-investigators must be kept informed of the status of the research.
2. Changes, amendments, and additions to the protocol or the consent form must be submitted to the REC for re-review and approval **prior** to the activation of the changes. The REC application number assigned to the research should be cited in any correspondence.
3. Reports of unanticipated problems involving risks to participants or other must be submitted to the REC. New information that becomes available which could change the risk: benefit ratio must be submitted promptly for REC review.

1 of 2

Research and Ethics

P.O. Box 4, Mukono, Uganda, Plot 67-173, Bishop Tucker Road, Mukono Hill.
Tel: +256 (0) 312 350 885 Fax: +256 (0) 41 42 90 800 Email: rec@ucu.ac.ug Web: www.ucu.ac.ug
UCUREC is accredited by Uganda National Council for Science & Technology, FDA, and National Institutes for Health of the United States of America

Appendix II: Data collection tool

A compiled list of relevant questions from the 2022 Uganda Demographic and Health Survey (UDHS) Women's Questionnaire based on the variables in the study is shown below;

1. Outcome Variable: Anemia Status

- **Question on Anemia Testing:** "Was your hemoglobin level measured?"
- **Hemoglobin Level Results:** This question included anemia categorization, often with values that indicate anemia status (e.g., mild, moderate, or severe anemia).
- **Section:** Health or Biomarker Section

2. Target Population: Women Aged 15-49 Years Who Had a C-Section

- **Age:**
 - **Question:** "What is your age in completed years?"
 - **Section:** Respondent's Background
- **Pregnancy History (to identify C-Section):**
 - **Question on Mode of Delivery:** "What was the mode of delivery for your last birth?" (Options typically include vaginal delivery, C-section)
 - **Section:** Maternal Health or Reproductive Health

3. Socio-Demographic Factors

- **Age**
 - **Question:** "What is your age in completed years?"
 - **Section:** Respondent's Background
- **Residence**
 - **Question:** "What is your place of residence?" (Response options: urban or rural)
 - **Section:** Respondent's Background
- **Marital Status**
 - **Question:** "What is your current marital status?" (Options may include married, cohabiting, never married, divorced, or widowed)
 - **Section:** Marriage and Sexual Activity
- **Education Level**
 - **Question:** "What is the highest level of education you have attended/completed?" (Options typically include no education, primary, secondary, higher)
 - **Section:** Respondent's Background or Education
- **Employment Status**

- **Question:** "Have you been employed in the past 12 months?" or "What is your current employment status?"
- **Section:** Employment or Economic Activity
- **Wealth Index**
 - **Derived from:** Questions about household assets and amenities.
 - **Section:** Household and Living Conditions
- **Household Size**
 - **Question:** "How many people live in your household?"
 - **Section:** Household Composition

4. Obstetric and Maternal Factors

- **Gravidity (Number of Pregnancies)**
 - **Question:** "How many times have you been pregnant?"
 - **Section:** Reproductive History
- **Birth Interval**
 - **Question:** "What is the interval between your last two births?" (Typically measured in months or years)
 - **Section:** Birth History
- **Antenatal Care Visits (ANC)**
 - **Question:** "How many antenatal care visits did you have for your most recent pregnancy?"
 - **Section:** Maternal and Newborn Health
- **Contraceptive Use**
 - **Question:** "Have you used any contraceptive method?" (For past and current usage)
 - **Section:** Family Planning
- **Body Mass Index (BMI)**
 - **Derived from:** Height and weight measurements taken during the survey.
 - **Section:** Biomarker Section (Anthropometry)
- **History of Abortion**
 - **Question:** "Have you ever had a pregnancy that ended in an abortion or miscarriage?"
 - **Section:** Reproductive Health

5. Nutritional and Preventive Factors

- **Frequency of Meal Intake**
 - **Question:** "How many meals do you typically consume in a day?"

- **Section:** Nutrition or Dietary Intake
- **Iron Supplement Intake**
 - **Question:** "Did you take iron supplements during your last pregnancy?"
 - **Section:** Maternal and Newborn Health
- **De-Worming**
 - **Question:** "Did you take any de-worming medication during pregnancy?"
 - **Section:** Maternal and Newborn Health

END

Appendix III: Authorization to use DHS data



Dec 02, 2024

MARTHA ITHUNGU
UGANDA CHRISTIAN UNIVERSITY
Uganda
Request Date: 11/30/2024

Dear MARTHA ITHUNGU:

This is to confirm that you are approved to use the following Survey Datasets for your registered research paper titled: "PREVALENCE AND DETERMINANTS OF ANEMIA AMONG C-SECTION WOMEN AGED 15-49 YEARS IN UGANDA":

Uganda

For restricted surveys, you must also request special permission from the Implementing Agencies. If approved, the restricted datasets will be provided to you by FTP.

To access the datasets, please login at: https://www.dhsprogram.com/data/dataset_admin/login_main.cfm. The user name is the registered email address, and the password is the one selected during registration.

The IRB-approved procedures for DHS public-use datasets do not in any way allow respondents, households, or sample communities to be identified. There are no names of individuals or household addresses in the data files. The geographic identifiers only go down to the regional level (where regions are typically very large geographical areas encompassing several states/provinces). Each enumeration area (Primary Sampling Unit) has a PSU number in the data file, but the PSU numbers do not have any labels to indicate their names or locations. In surveys that collect GIS coordinates in the field, the coordinates are only for the enumeration area (EA) as a whole, and not for individual households, and the measured coordinates are randomly displaced within a large geographic area so that specific enumeration areas cannot be identified.

The DHS Data may be used only for the purpose of statistical reporting and analysis, and only for your registered research. To use the data for another purpose, a new research project must be registered. All DHS data should be treated as confidential, and no effort should be made to identify any household or individual respondent interviewed in the survey. Also, be aware that re-distribution of any DHS micro-level data, either directly or within any tool/dashboard, is not permitted. Please reference the complete terms of use at: <https://dhsprogram.com/Data/terms-of-use.cfm>.

The data must not be passed on to other researchers without the written consent of DHS. However, if you have coresearchers registered in your account for this research paper, you are authorized to share the data with them. All data users are required to submit an electronic copy (pdf) of any reports/publications resulting from using the DHS data files to: references@dhsprogram.com.

Sincerely,

Bridgette Wellington

Bridgette Wellington
Data Archivist
The Demographic and Health Surveys (DHS) Program

Appendix IV: UCU Regular Supervision Report



UGANDA CHRISTIAN UNIVERSITY

School for Research and Postgraduate Studies

"A Centre of Excellence in the Heart of Africa"

REGULAR SUPERVISION REPORT

Supervisor's Name: SHALLON ATUHAIRE

Student's Name: MARTHA ITHUNGU Reg No: **RJ23M21/019**

Date of Submission of Work to Supervisor: 22/09/2025

Date of Meeting that Discussed the Work: 22/09/2025

SUPERVISORS COMMENTS ON STUDENT'S WORK AND RECOMMENDATION FOR ACTION

1. A number of comments had been raised during proposal development and all were addressed before filedwork.
2. The research report is generally well written.
3. Ensure that all your work is justify aligned /indented particularly from Chapter 3 onwards
4. There is a blank gape on page 25 which needs deletion.
5. Your work needs proof reading for grammatical errors. There are so many combined words without gaps, some end with commas instead of full stops, others have full stops in the middle. Take time off to read through your work word for word if possible together with another person at the same time.
6. Identify a journal and follow its authors' guidelines to transform your work into manuscripts for publication. You can get at least wo journal articles from this work.

STUDENT'S SIGNATURE

Handwritten signature of Martha Ithungu in blue ink.

SUPERVISOR'S SIGNATURE

Handwritten signature of Shallon Atuhaire in blue ink.

Cc Head of Department
Cc Co-supervisor (if there is one)