DETERMINANTS OF ANAEMIA IN PREGNANCY AMONG WOMEN ATTENDING MOSORIOT SUB-COUNTY HOSPITAL, NANDI COUNTY, KENYA

BY

FREDRICK KIPKOSGEI MUTAI

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MOI UNIVERSITY

DECLARATION

DECLARATION BY THE CANDIDATE

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Signature……. Date……...…

Fredrick Kipkosgei Mutai

(SPH/PGH/01/17)

DECLARATION BY THE SUPERVISORS

This thesis has been submitted with our approval as the university supervisors

Signature……Date……

Dr. Samson Ndege

Senior Lecturer,

Department of Epidemiology and Medical Statistics,

School of Public Health,

College of Health Sciences,

Moi University

ELDORET - KENYA

Signature……Date……

Dr. Faith Yego Kosgei

Department of Health Policy, Management and Human Nutrition

School of Public Health,

College of Health Sciences,

Moi University.

ELDORET - KENYA.

DEDICATION

I dedicate this thesis to the Almighty God, my supervisors, family, classmates, and workmates.

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ABSTRACT

Background: The global prevalence of Anaemia in Pregnancy (AIP) stands on average at 41.8% and 61.8% in Africa contributing to 20% maternal deaths and increased risks of morbidity, stillbirths, foetal low-birth weight, and neonatal morbidity and deaths. Despite improvements in access and provision of free prenatal care, the prevalence of AIP in Kenya is at 57%. The research was to study several contributing factors to current anaemia levels and their identification to support the improvement in prenatal care and the promotion of positive birth outcomes in the sub-county hospital

Objectives: The objectives were to determine the prevalence of AIP; describe the socio-demographic and clinical factors of AIP; explore the commonly used interventional services for AIP and describe the birth outcomes of both mother and baby with AIP at Mosoriot Sub-County Hospital.

Methods: This was a retrospective review of medical records of women who had delivered at Mosoriot Sub-County Hospital in 2018. A total of 624 records with correctly recorded Hb levels was the study sample. Descriptive statistical data were analysed using measures of central tendency, mean and standard deviation for continuous variables and frequency for discrete variables. Chi-square inferential analytical statistic was used to measure the associations between the dependent and independent variables at a 95% level of confidence and 0.05 margin of error.

Results: A total of 400 records were reviewed and the prevalence of AIP was 64% during the study period. The mean Hb was 11.68 g/dl. The proportion of women aged 20 - 34 years was 35%. The age categories 25 – 29 and 40 – 44 years were significantly predisposed to AIP POR: 2.10 (CI 0.58-7.64) and 5.4 (0.03-3.6) respectively. There was a significant association between age and AIP; $X^2 = 5$, p=. 005. Logistic regression showed the following variables to be significantly associated with AIP: rural residence POR; 2.36 (CI 0.17-2.4), the primary and secondary level of education POR;1.86 (0.67-5.16) and 1.69 (CI 0.63-4.6) respectively. The proportion of women who had used iron or folic acid supplementation was 96% and those who used insecticide-treated mosquito nets were 22%. The common outcomes of women with AIP were normal deliveries (94%) and mild to severe blood loss (14%). Important foetal outcomes included underweight babies and birth asphyxia at five minutes (2.8%).

Conclusion: The prevalence of AIP was higher than the national and Nandi County average Most women who had mild anaemia were married, had achieved the primary level of education, were housewives with at least one child. Elderly women were more predisposed to AIP. There was significant use of mineral supplements among these women with few using mosquito nets. Under-weight and asphyxia were the major birth outcomes.

Recommendations: There was a need to scale up the awareness of the AIP contributing factors. The study advocates for use of specific recommended interventions and targeted support programs to reduce sociodemographic and health barriers that predispose pregnant women to AIP.

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ABBREVIATIONS AND ACRONYMS

AIC	Akaike Information Criterion
AIP	Anaemia in Pregnancy
ANC	Antenatal Care
ANOVA	Analysis of Variance
APGAR	Appearance, Pulse, Grimace, Activity, and Respiration
BMI	Basal Metabolic Index
CBC	Complete Blood Count
CDC	Centres for Disease Control and Prevention
DMOH	District Medical Officer of Health
FANC	Focused Antenatal Care
HB	Haemoglobin
HCT	Haematocrit
HIV	Human Immunodeficiency Virus
IDA	Iron Deficiency Anaemia
IREC	Institutional Research and Ethics Committee
KDHS	Kenya Demographic Health Survey
KNBS	Kenya National Bureau of Statistics
LBW	Low Birth Weight
MDGs	Millennium Development Goals
MOH	Ministry of Health
NACOSTI	National Commission for Science &Innovation
N.D	Not Dated
NICU	Neonatal Intensive Care Unit
PI	Principal Investigator
PNC	Post Natal Care
POR	Proportionate Odds Ratio
RA	Research Assistant
RBC	Red Blood Cells
SDG	Sustainable Development Goals
SSA	Sub Saharan Africa
TB	Tuberculosis
USA	United States of America
WHO	World Health Organization

DEFINITIONS OF TERMS

Age: The number of years a woman has during pregnancy.

Anaemia in Pregnancy: Anaemia in pregnancy (AIP) was described as the Haemoglobin (Hb) level below 12g/dl in an expectant woman at sea level. It was considered severe anaemia when the Hb concentration was less than 7.0g/dl; moderate anaemia when the Hb level was between 7.0 - 9.9g/dl and mild anaemia when the Hb levels were between 10.0 - 11.9g/dl. The pregnancy Hb 11.0 - 11.9g/dl was classified as a mild anaemia level while addressing determinants of AIP. It is traditionally classified as normal, but due to its risk in the likelihood of inducing mild anaemia, it necessitates incorporation as an intersection of mild anaemia (WHO., 2014).

ANC Adherence: The extent to which pregnant mothers utilized antenatal services as prescribed by their health care provider. It included attending at least four ANC visits which were a MOH FANC requirement (MOH., 2004).

Anaemia Diagnosis: This was established through the automated figure output of Hb level estimation by laboratory tests (WHO., 2011).

Antenatal Care: This described a broad range of core care activities during pregnancy that involved curative, preventive, and promotive health services including detection and treatment of anaemia (MOH., 2004).

ANC Visits Number: The number of visits made by a pregnant woman to the ANC Clinic.

APGAR Score: This was a measure of the physical condition of a newborn. The score was obtained by adding scored birth points (2, 1, or 0) for heart rate, respiratory effort, muscle tone, response to stimulation, and skin colouration. A score of ten represented the best optimal foetal condition (Sabaratnam et al., 2004).

AIP Stakeholders: An individual, organizations or institutions that have a direct or indirect interest, or a role in AIP management.

Categorization of the Research Variables: The research variables were collected as numerical but categorized for analysis. Age of participants was categorized as (15 – 19, 20 - 24, 25 - 29, 30 - 34, 35 – 39, 40 - 44 and 45 – 49); trimester being first, second, third; parity (1, 2 - 3, 4^{+}), frequency of antenatal care visits (1, 2 - 3, and $4^{+)}$, the residence as rural, peri-urban and urban; occupational status as employed, self-employed, housewife or student; marital status as either married or single, and education level as primary, secondary, college or university.

Education Level: The level of education an expectant woman attained before her current pregnancy.

Employment: Being in an occupation where one earns a monthly income or daily wage.

Gestation at Birth: This was the duration of the pregnancy at delivery or abortion. Abortion was described as the expulsion of the foetus at less than 28 weeks, prematurity as birth between 28 - 35 weeks and a term birth as the delivery between 36 - 42 weeks of gestation (Sabaratnam et al., 2004).

Institutional Factors: These were the health care facility and policy issues that affected the uptake of pregnancy services. They were human resource capacity, facility working conditions, availability of medical supplies and equipment, and referral system among others.

Interventions of AIP: This was the process of intervening, interceding, or intercepting for pregnancy anaemia with the intent of improving the pregnancy outcome.

Levels of Normal Haemoglobin in Pregnancy: Normal haemoglobin was considered to be between 11 - 18 g/dl. However, factoring haemodilution (30 - 40%) in the second trimester and high probability of transcending to mild AIP, there was a need to classify the mild anaemia level from Hb 10 - 11.9 g/dl to safeguard this occurrence.

Marital Status: The state of being married or not during pregnancy.

Occupation: Type of profession an expectant woman is engaged in.

Outcomes of AIP: This referred to the results of AIP as measured by the maternal and foetal conditions at birth.

Parity: Number of pregnancies a woman has had.

Patterns of AIP: This described the geographical distribution of AIP in the classical epidemiological description in the triad of time, place, and person. It was also used to analyse the mix of lifestyle, environmental, and personal factors that influenced AIP and its distribution among expectant mothers.

Prevalence of AIP: Prevalence referred to the proportion of pregnant women who presented with AIP in Mosoriot in 2018. It comprised new and pre-existing cases of AIP. The numerator of the prevalence was n=400. The denominator for the prevalence was N=624.

Residence: Usual place of abode by an expectant woman.

The trend of AIP: Distribution of anaemia in pregnant women during the study period describing its occurrence, severity and geographical area extent in terms of residency.

CHAPTER ONE

INTRODUCTION

1.1 Background

The global pregnancy anaemia prevalence stood averagely at 41.8% (95%, CI: 33.5 - 42.6) and that for all non-pregnant women of reproductive age at 29.4% (95%, CI: 24.5 - 35.0) in 2011. There was a wide range of variation between countries and regions such that 5.7% in the USA, 18% in Europe, and 50.4% in Latin America; while the developing nations show an average range of between 23.8% in Asia and 61.8% in Africa (WHO., 2015, Nyamu et al., 2020, Stevens et al., 2013, Ayoya et al., 2006). Sub-Saharan Africa (SSA) stood at 57% (Haggaz et al., 2010).

The East Africa region witnessed a mixed picture in the prevalence of AIP ranging from 24.3% in Ethiopia, 48% in Tanzania to 57% in Kenya. It is noted that most pregnant women were anaemic at the beginning of their conception, with an estimated average prevalence of 43% in non-pregnant women in developing countries and 12% in the developed economies (Nyamu et al., 2020, Naqash et al., n.d, as cited by Siddiqui et al., 2017, MOH, 2013, Nduhiu-Githinji, 2013, KNBS/ICF, 2010, McLean et al., 2009, WHO, 2015, The Lancet, 2011).

Studies done noted that AIP adversely affected the mother and the baby (Nokes et al., 1998, Horton & Ross, 2003, Polanska et al., 2017), & Naqash et al., n.d, as cited by Skroder., 2017). Maternal bad outcomes were found to be maternal fatigue, low productivity and increased risk of maternal postpartum anaemia, morbidity, and mortality. The neonates were found to encounter foetal anaemia, prematurity, low foetal birth weight, intrauterine growth retardation, postnatal morbidity and mortality, poor foetal cognitive and motor development.

The causes of AIP in developing countries are multifactorial. Approximately half of the cases relate to iron and micronutrient deficiencies associated with geographical variations. Major causes were acute and chronic infections and or infestations, for example, malaria, tuberculosis, hookworms, and HIV and AIDS. Minor causes comprised inherited and or acquired disorders that affect haemoglobin synthesis, poor red blood cell production, or low red blood cell survival such as haemoglobinopathies (Ononge et al., 2014, Makhoul et al., 2012, Okube et al., 2016, The Lancet., 2011). The risks and predisposing factors associated with AIP were both null and high parity; low socioeconomic status, teenage pregnancies, low education levels, short birth spacing, low family income, and cultural factors are contributors. All these factors are quite common in developing countries where AIP is also high (Dim & Onah., 2007 & Cüneyt et al., 2015).

From a global, regional, and national perspective, addressing the causes, risks and predisposing factors of AIP would greatly reduce its occurrence as it was manageable if detected on time. Effective management of AIP consisted of treatment of the underlying causes, management of the haemoglobin concentration to normal levels, prevention, and treatment of the complications. Preventive interventions for AIP comprise deworming, control of malaria, consumption of iron-rich foods, and iron supplementation. Besides, avoidance of alcohol, regular checking haemoglobin levels in especially women with heavy menses, controlling indigestion, and active physical activity are measures that have been shown to contribute to addressing this condition (MOH 216., 2016).

There is a need to address anaemia in pregnancy as early as possible through knowledge of determinants that contribute to its occurrence. The reason is that anaemia in pregnancy has far-reaching consequences. Mitigating against it has mostly been

addressed through planned and prioritized investment in healthcare by ensuring universal and quality health service. However, it was noted that not all pregnant women attended prenatal clinics for various reasons such as ignorance on benefits of early care, cultural beliefs, low economic empowerment, accessing the health care facilities and cost of health care. These vulnerabilities as found in Uasin Gishu and Western Kenya were likely to mirror in Mosoriot as they were neighbours (Riang'a et al., 2018, Mason et al., 2015).

1.2 Problem Statement

Chesumei Sub-County had experienced anaemia cases among its pregnant women with a mean Hb of 9.6g/dl and distributed as 17.5% severe, 53.8% moderate and 15% mild cases (K Nandi County., 2021). The disease burden at Mosoriot Sub-County Hospital serving the Sub-County had remained unknown and was likely to have contributed to poor maternal and foetal birth outcomes. There was a possibility that the pregnancy anaemia could have been higher or lower than the national and county prevalence which stood at 57%, and 55% respectively. The facility had been reported to have recorded a lower user rate of iron and folic acid supplementation (Nandi County Integrated Development Plan 2018-2022, WHO/CDC 2008). The hospital had no documented AIP prevalence rates in 2018. This was despite the presence of several AIP policy protocols in the access and provision of free prenatal care in the county. Lastly, the awareness and understanding of the AIP factors at Mosoriot Sub-County Hospital in Chesumei sub-county could not be ascertained at the time of research conceptualization and researchers became interested in uncovering the actual situation on the ground.

This thesis, therefore, endeavoured to address these gaps and provide evidence-based findings that will improve policy and practise guidelines to support the management of AIP in similar settings.

1.3 Justification

The research studied several determinants of AIP at Mosoriot Sub-County Hospital and their contribution to current anaemia levels. The study will contribute to the information on policy and practice for appropriate management, monitoring and evaluation of AIP. Identification of determinants of AIP will support the improvement in prenatal care and the promotion of positive birth outcomes in the sub-county hospital, the Nandi County and contribute to the overall progress of Kenya in achieving the vision 2030 goals and SDG 3 targets for women of reproductive age group (15 - 49 Years).

1.4 Research Question

What was the AIP magnitude, socio-demographic & health characteristics, commonly used interventions and birth outcomes at Mosoriot Sub-County Hospital in 2018?

1.5. Study Objectives

1.5.1 Broad Objective

To describe the determinants of AIP among pregnant women attending Mosoriot Sub-County Hospital, Nandi County.

1.5.2 Specific Objectives

The specific objectives were to:

1. Determine the prevalence of AIP among the women attending Mosoriot Sub-County Hospital.
2. Describe the socio-demographic and clinical characteristics of pregnant women with anaemia attending Mosoriot Sub-County Hospital.
3. Explore the commonly used AIP intervention methods for anaemia among pregnant women attending Mosoriot Sub-County Hospital.
4. Determine the birth outcomes of pregnancy among women with anaemia attending Mosoriot Sub-County Hospital.

CHAPTER TWO

LITERATURE REVIEW

2.1 Epidemiology of Anaemia in Pregnancy

Anaemia in Pregnancy (AIP) is of public health prominence. Worldwide studies indicated the existence of variation in the prevalence of anaemia among pregnant women ranging from 5.7% - to 68.0%. The global trends and levels of AIP varied substantially across regions and countries in the period leading to 2011. High-income regions had the highest haemoglobin distributions with a mean haemoglobin concentration of 6 – 13g/dl while low-income regions had the lowest mean concentrations of Hb and the highest anaemia prevalence (WHO/CDC., 2008, The Lancet., 2011, Nduhiu-Githinji., 2013; Gebre & Mulugeta., 2015). Between 1995 and 2011, anaemia prevalence decreased by an average of 43%, while AIP prevalence declined by 9 - 10%. The estimated anaemia prevalence was translated to 32 million pregnant women with anaemia in 2011. Of these women, about half million to one million had severe anaemia (Gretchen et al 2013, Stevens et al., 2013 as cited by Vos et al., 2017) as illustrated in Figure 1.

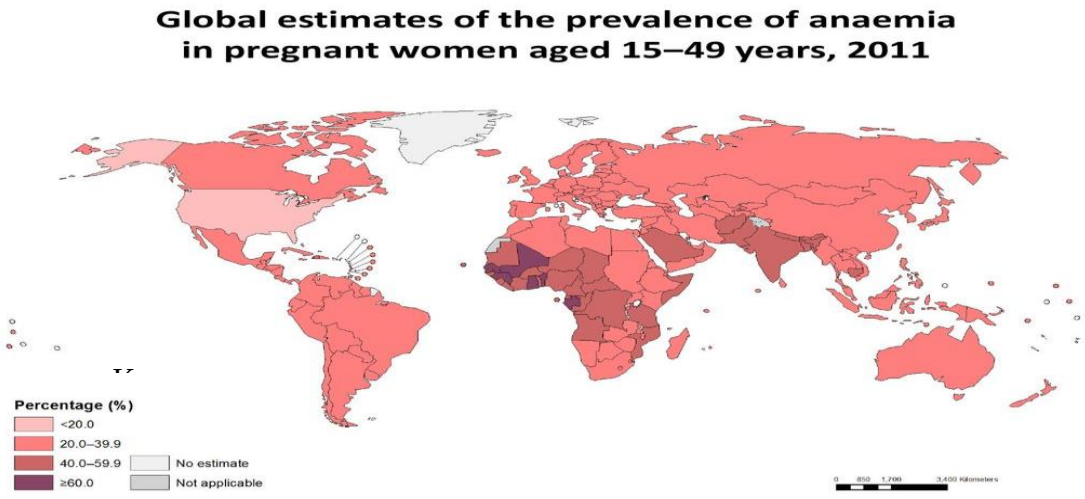

Figure 1: Global Estimates of the Prevalence of Anaemia in Pregnant Women Aged 15-49 Years in 2011 (The Lancet Global Health., 2011)

Zhao and collaborators in their five-year meta-analysis of the epidemiological prevalence of anaemia during pregnancy in China had found that the overall prevalence of anaemia during pregnancy was 19.9% with variation in categories such that mild, moderate and severe anaemia was 15.9%, 5.7%, and 1.3% respectively (Zhao et al., 2012 as cited by Xu et al., 2016). The African continent had a mixed picture of the magnitude. The northern and southern regions had low prevalence; while east and central regions were moderately affected. West Africa had the highest prevalence (The Lancet 2011).

A prospective, observational study in Africa (Baig-Ansari et al., 2008 as cited by Savera.,& Ali., 2020) among 1,369 pregnant women at gestational ages 20 - 26 weeks to determine the prevalence and risk factors had found that of all subjects, 90.5% had some anaemia, 75% were mildly anaemic, 14.8% moderately anaemic, and 0.7% had severe anaemia. It was observed to increase with advancing gestational weeks. The prevalence of anaemia at the first, second, and third trimester of pregnancy was 10.1%, 26.7%, and 28.1% respectively. Both degree and gestational week subgroup analysis showed a significant difference among groups. The study found no statistically significant differences among subgroups of cut-off year, region, residential area, age, education level, and parity. These findings were comparable to a retrospective study at Enugu, Nigeria by (Dim & Onah., 2007 as cited by. Onyekpa et al., 2021) among 530 normal pregnant women that found out that the prevalence of AIP was 40.4% of which 90.7% had a mild form, 9.3% had moderate, and no severe case.

In the East Africa region, (Meaza et al., 2017, Lebso et al., 2017) conducted a community-based cross-sectional study on the prevalence of AIP and its associated factors in Southern Ethiopia. The researchers established a prevalence rate of 23.2%. The associated factors for the anaemia were low socio-economic status, second and

third trimesters, gravidity three to five, and six and above children, not supplemented with iron, low dietary diversity score, and hookworm infection.

Additionally, a large facility-based cross-sectional study among 638 pregnant women attending antenatal care in public health centres in the central zone of the Tigray region, Northern Ethiopia in 2017 found the prevalence of AIP to be 16.88%. In this population, the leading associated factors were malaria, excessive menstrual bleeding, improper pregnancy planning, and meal frequency (Teklit et al., 2017, Grum et al., 2018). Some factors associated with the high prevalence were low socioeconomic conditions, poor nutritional intake, repeated infections, frequent pregnancies, and low health-seeking behaviours as quoted by Turkish and German investigators in a large study.

> "Prevalence and risk factors of anaemia among pregnant women attending a high-volume tertiary care centre for delivery" (Cüneyt et al., 2015).

In regions where anaemia was common, determining the magnitude and identifying factors that were associated with the disease was necessary for its control. These areas are located in developing countries where pregnant women are prone to anaemia.

There exists a gap identified in this area of study. Kenya's AIP prevalence is considered to be average (57%). Mapping its magnitude, as well as identification of the factors associated with the disease needs to be undertaken. Some of these factors were low socioeconomic conditions, inadequate nutritional intake, repeated infections, frequent pregnancies, and poor health-seeking behaviours.

An association between anaemia and nutritional deficiency in Africa was conducted in Ethiopia. The study that sampled 970 subjects observed a 29.4% prevalence of anaemia, 18% of which was due to iron deficiency. This signified that the causes of AIP are nutrition-related (Haider., 2009, Hubbard et al., 2009, Kowalski et al., 2014). These

findings were consistent with other studies such as in Ethiopia (Gebremedhin et al., 2014), Uganda (Ononge et al., 2014), Nigeria (Nwizu et al., 2011, as cited by Abdulqadir et al., 2019), and Vietnam (Aikawa et al., 2006, as cited by Ha et al., 2019) which indicated that the lack of ferrous supplementation was among the significant risk for developing anaemia during pregnancy. The odds of anaemia were found to rise as maternal age advanced. Expectant mothers aged above 31 were found to be significantly more anaemic compared to those mothers aged 18 - 24 years as observed by Okube et al., (2016) at Pumwani maternity hospital. Li Lin et al., (2018) had found that maternal anaemia was significantly associated with women older than 35 years, low family per capita monthly income, rural residence, and pre-pregnancy BMI < 18.5.

Residency and income tended to affect the trend of AIP. Geelhoed et al., (2006) in their rural Ghana research work had found that pregnant women in the low-income bracket were more anaemic than the high-income ones. A higher prevalence of anaemia was present among pregnant women from rural areas. The study also indicated that pre-pregnancy BMI < 18.5 was a predictor of anaemia, which was attributed to poor nutritional status at the gestational period. In Tanzania, researchers in 2011 established that the variance in anaemia during pregnancy depended on geographical location, dietary practice, and season. This is common in Sub-Saharan Africa, where the inadequate intake of diets rich in iron leads to aetiological factors of anaemia among pregnant women (Msuya et al., 2011 as cited by Stephen et al., 2018).

Tunkyi & Moodley., (2016) in their determination of the prevalence of anaemia at the initial antenatal visit and third trimester weeks gestational age and evaluation of perinatal and maternal outcomes longitudinal study found that the prevalence of anaemia was 42.7% at the first antenatal visit. 35% had mild anaemia. At the 32 – 34 gestational weeks visit, the prevalence of anaemia was 28.1%; and 19.3% for mild

anaemia. The prevalence of anaemia decreased from 42.7% at booking to 28.1% between 32 - 34 weeks. The prevalence of anaemia in HIV-infected women was higher than that in the non-infected cohort, and 47.2% of the study population was HIV infected (WHO 2012 as cited by Tunkyi & Moodley., 2017).

Alzaharani., (2012 as cited and reported by Nugdalla., 2018) found that the prevalence of anaemia was high in the third trimester (30.2%) compare to the first trimester (15%) and second trimester (14.8 %). This result was in agreement with the studies conducted in Kisumu District, Kenya, Ethiopia, Tanzania, and Egypt, which found that late pregnancy, increased the risk of developing anaemia. Further, AIP increased with rising parity and maternal age (Morsy & Alhady., 2014, Nyabuti., 2000 as cited by Zile et al., 2019).

From the literature review, it was found that a gap in this area exists. The socio-economic, cultural prejudice, health provision systems and developmental levels differences in the world regions have been noted to contribute to the varied AIP prevalence rates. In Kenya, studies tailored to local conditions about these factors were not available, especially in Nandi County. And yet they were important when taken into account for the specific occurrence, severity, and trend of AIP in a given setting and population groups. These determinants were to be conjoined into the primary health care system for the implementation of prevention and treatment of pregnancy anaemia in existing programs.

2.2 Pregnancy

Pregnancy is the most significant physiological state for humankind since it assures the perpetuation of the species. The placenta forms the connection between the mother and the growing foetus and ensures their nutritional co-existence during the gestation

period. Many maternal and foetal changes occur during pregnancy. The maternal changes are the normal adaptations that a woman undergoes during pregnancy to better accommodate the growing embryo/foetus. These changes are both physiological and sociological (Milman., 2006, Norman., 2019).

Physiological changes are maximal late in the second trimester and then start to return to pre-pregnancy levels after delivery (Padayachi., 2004 as cited by Makhoul et al., 2012). The sociological changes are influenced by the socio-demographic and socio-clinical parameters that influence lifestyles, the region of abode, and occupation.

The reproductive organs of a woman become increasingly vascular and engorged with blood as the pregnancy progresses. Prodded by rising levels of oestrogen and progesterone, the breasts enlarge and engorge with blood. There is a progressive increase in uterine size during pregnancy filling most of the pelvic cavity by sixteen weeks. The anatomical changes give a general picture of the health of the expectant woman during the gestational period (Marieb & Hoehn., 2004 as cited by Bhatia & Chabra., 2018).

The total blood volume increases by nearly 40% - 50% above pre-pregnancy state levels. Plasma volume rises from the sixth week of gestation and stabilizes by the third trimester. The Red Blood Cell (RBC) mass increases early in the second trimester (Cunningham et al., 1993 as cited by Van Bogaert., 2006). The disproportionate rise in plasma volume compared with the RBC mass causes haemo-dilution, thus a decreased Haemoglobin (Hb) and Haematocrit (HCT) count leading to physiological fall in Hb (Sarah & Craig., 2001; Padayachi & Moodley., 2004 as cited by Marieb & Hoehn., 2004, Rogerson et al., 2007 and Zhang & Rawal., 2017). The oxygen-carrying capacity of blood was higher during pregnancy than in the pre-pregnant state (Riikonen et al., 1994

as cited by Zhao et al., 2021). Hb values below 12g/dl are found to be associated with poor foetal outcomes such as intrauterine growth retardation, low birth weight, and preterm birth (Milman., 2006, as cited by Kesavan & Devaskar., 2019).

Levels of progesterone and oestrogen rise continually throughout pregnancy, suppressing the hypothalamic axis and subsequently the menstrual cycle. Oestrogen produced by the placenta was associated with the foetus's well-being (Koller et al., 1979 as cited by Alonso et al., 2021).

The mother is the only provider of nourishment for the embryo/foetus and so her blood volume slowly increases during the pregnancy to accommodate this requirement. (Zhang & Rawal, 2017 & Koller et al., 1979 as cited by Alonso et al., 2021). Nausea and vomiting are among gastrointestinal changes that are occasionally experienced by women during pregnancy due to elevated Beta-Human Chorionic Gonadotropin (β HCG) and normally resolve by mid-trimester. The prolonged gastric emptying time decreased gastro-oesophageal sphincter tone leading to acid reflux and decreased colonic motility to amplified water absorption hence constipation (Alonso et al., 2021). This is potentially due to poor feeding and under-nourishment that predisposes to AIP.

Respiratory tidal volume surges markedly during pregnancy whilst respiratory rate remains unchanged, but there is a decline in residual volume. The increase in tidal volume is due to the mother's greater need for oxygen and the enhanced progesterone sensitivity of the modularly respiratory centre to carbon dioxide (Kassebaum et al., 2014, Skröder et al., 2017, & Marieb & Hoehn., 2004 as cited by Doig., & Zhang., 2017).

All these maternal changes are prominent in the presence of AIP leading to poor pregnancy outcomes.

The foetal changes are complex considering its growth and haematologic requirements. The maternal serum ferritin usually falls markedly in the second trimester of pregnancy because of iron utilization for expansion of the maternal red blood cell mass by the foetus (Thongperm et al., 2018, Unachukwu et al., 2018). By the third trimester, there is enhanced iron transfer corresponding to the time of peak efficiency of maternal iron absorption. The placental synthesis of ferritin facilitates the control of the absorption of excessive iron to the foetus. In this case, if this system is ineffective in maintaining iron transfer to the foetus, it reflects the occurrence of low maternal iron stores (Thongperm et al., 2018, Unachukwu et al., 2018). Understanding of the basic physiology of pregnancy is expected to impact positively the AIP stakeholders at Chesumei sub-county thus leading to informed support to the expectant mothers.

2.3 Anaemia in Pregnancy

2.3.1 Description

Pregnancy anaemia is described as severe (Hb < 7.0g/dl), moderate (Hb 7.0 - 9.9g/dl), and mild (Hb 10.0 - 11.9g/dl) (WHO, 2014 & 2015). AIP is known to be one of the commonest and oldest women's disorders in the world, irrespective of the country’s political, socio-economic, socio-demographic, and cultural standards (WHO, 2014, K Nandi., 2021).

Some of the most common types of AIP include relative, absolute, physiological, and nutritional anaemia. Relative anaemia is characterized by little red blood cell mass disturbance in blood volume (Kassebaum et al., 2014). A profound decrease in red blood cell mass is a notable characteristic of absolute anaemia associated with autoimmune disorders that resulted in decreased production or increased destruction of red blood cells. This differentiation was a product of reticulocyte count leading to diagnostic criteria as morphologic or pathophysiologic parameters (Thomas et al., 1977

as cited by Kassebaum et al., 2014; & Ganguly et al., 2007 as cited by Chaparro & Suchdev., 2019). The presence of previous anaemic status further complicates AIP. It is notable that when the Hb is less than 10.4g/dl, then a true reduction in red blood cell mass is deemed as present (Chaparro & Suchdev., 2019).

Most researchers apply a cut–off Hb level of 10.0g/dl - 11.9 g/dl for the mild category of the AIP for the following reasons: Firstly, both the WHO and the Lancet showed that there was still an existence of a wide gap to be filled in the reduction of AIP (WHO., 2004 & The Lancet., 2011). Secondly, studies have established that blood loss during delivery would expose women to mild anaemia if the delivery threshold level of Hb was at 11 - 11.9g/dl who recommended that the haemoglobin value below 12g/dl be considered as mild anaemia (Greer et al., 2003, Seifedine et al., 2018). Thirdly, Kesavan & Devaskar., 2019, & Kadry et al., 2018 stipulated that Hb values below 12g/dl were associated with poor foetal and maternal outcomes. Fourthly, A study found that iron-deficient anaemic pregnant women had shorter pregnancies than non-anaemic or even anaemic but not iron deficient pregnant women (Milman et al., 2000 as cited by Kesavan., & Devaskar., 2019). Lastly, it was noted that the WHO and the MOH had not issued any recommendations on the use of different haemoglobin cut-off points for anaemia by trimester resulting from haemodilution but recognized that during the second trimester of pregnancy, haemoglobin concentrations diminished by approximately 0.5g/dl.

It was against this background that this research adopted the cut–off level of AIP to include the Hb 11.0 - 11.9g/dl as illustrated in Figure 2 adopted and modified from the Lancet Global Health and Nyakundi Patrick Nyamemba thesis (The LANCET Global Health., 2011, K Nandi., 2021).

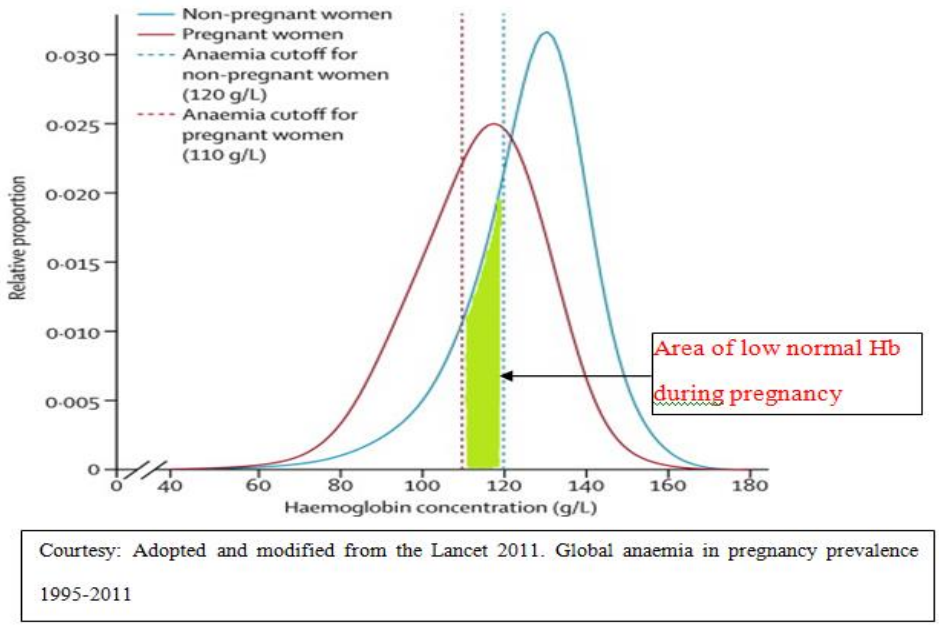

***Figure 2*: Anaemia Definition and Cut-off Hb Levels in Pregnant and Non-Pregnant Women** (The Lancet Global Health., 2011*)*

2.3.2 Causes

The causes of AIP have been documented as nutritional deficiencies, gastrointestinal bleeding, heavy menses, and infections leading to blood loss such as malaria and HIV (Kumar et al., 2009, Unisa et al., 2010 as cited by Sudha et al., 2018). The significant factors relating to iron that lead to increased prevalence of AIP were found to be poor uptake, poor absorption, increased utilization, and excessive loss (Goonewardene et al., 2012 as cited by Arora et at., 2019). Other causes include low Hb genetic traits and poor dietary availability of ferrous in diets that were low in ferrous, folic acid, or vitamin B12. This required oral iron supplementation as food alone could not provide enough amounts of iron (Kumar et al., 2013 &The Lancet., 2011).

2.3.3 Presentation

Iron Deficiency Anaemia (IDA) was found to be common during the antepartum, intrapartum, and postpartum periods and could lead to serious maternal and foetal complications. Women with mild or moderate anaemia commonly present

asymptomatically and are only detected during screening. However, as the disease advances, the symptoms become more apparent and recognizable. The common symptoms of anaemia include fatigue, weakness, and reduced cognitive performance (WHO., 2016, Goonewardene et al., 2012 as cited by Tardy et al., 2020, WHO., 1992 & 2015, Makhoul et al., 2012 as cited by Pathan et al., 2021).

Therefore, adequate knowledge and awareness of these AIP factors are necessary as they motivate perinatal caregivers toward early detection and prompt management of AIP. This was found to be a gap that the research sought to address.

2.3.4 Diagnosis

AIP is diagnosed through venous blood Hb level. The lower threshold value in pregnant women was less than 12g/dl for diagnosis of anaemia during the trimesters (Tardy et al., 2020, Olus et al., 2015, Api et al., 2015, Ononge et al., 2014 & Pasricha et al., 2010 as cited by Larson et al., 2021).

2.3.5 Management

The correction of gestational iron deficiency involves the intake of iron-rich diets and oral augmentation. Daily oral ferrous (60mg) and folate (4mg) are started as soon as was possible after conception augmented by behaviour and lifestyle change. This continues up to six months after delivery. Parenteral iron is required for those women who have an intolerance to oral iron or who need rapid correction of anaemia. This comprises those with severe anaemia during the last month of pregnancy and those who experienced oral therapy difficulties (Apouey et al., 2017).

Blood transfusion became necessary when a patient decompensated following a drop in haemoglobin concentration and needed a more rapid rise in haemoglobin. Packed red cell transfusion administration was initiated for those pregnant women with had severe

anaemia (Hb of 6g/dl or less) close to the expected delivery date or less than 8g/dl if there was an increased risk of blood loss at delivery. This Hb was an emergency carrying a risk of congestive cardiac failure, sepsis, and death (Stolfus & Dreyfuss in WHO /INACG 2003/1998 as cited by Apouey et al., 2017 & Kumar et al., 2013

2.3.6 Prognosis

The symptoms of AIP ranged from fatigue to reduced cognitive performance if it was not treated. Older pregnant women had increased hospitalization and mortality rates compared to younger mothers (Lisonkova et al 2017 & Ojo., 1965 as cited by Fadare et al., 2021).

2.3.7 Prevention

A suitable way of managing AIP was pre-pregnancy counselling where dietary behavioural change advice and therapy were very important for ensuring better pregnancy results. It was recommended that full blood estimation be checked at the booking visit in pregnancy and Hb repeated at 28 weeks for anaemia screening. In high-risk mothers and multiple gestations, an additional haemoglobin check was recommended as delivery approached. Dietary advice to all mothers for improvement of intake and absorption of iron from food products became necessary. Rich sources of iron included iron in animal proteins, plant proteins, fruits, and iron-fortified cereals. Taking iron with vitamin C improved its intake and absorption (Stolfus & Dreyfuss in WHO /INACG 2003/1998 as cited by Apouey et al., 2017). Increased intake of iron and treatment of underlying conditions like deworming was an important preventive measure (Stolfus & Dreyfuss in WHO /INACG 2003/1998 as cited by Apouey et al., 2017). Routine Hb checking and administration of iron and folic acid for all menstruating women, including adolescents, especially in communities where IDA was a health concern was advocated.

2.4 Routine Laboratory Investigation during Pregnancy

The WHO requires that a pregnant woman receive a range of standard prenatal tests during the first and subsequent visits to the antenatal clinic or when the need arose. Those tests picked up any illnesses or other possible health problems early in pregnancy, such as anaemia. The identified health problems were projected to receive prompt management during pregnancy or immediately after birth, thus allowing good pregnancy outcomes. The tests commonly undertaken were complete haemogram, check Hb or Red Blood Count (RBC), Haematocrit (HCT), Packed Cell Volume (PCV), blood group, syphilis, HIV, urinalysis, and glucose level (Ononge et al., 2014, Fadare et al.,2021, Mitchel et al., 2003, Tagbor et al., 2010 as cited by Aberese-Ako et al., 2019 &Tahir., 2015).

2.5 Health Interventional Services for Anaemia in Pregnancy

2.5.1 Use of Nutritional Supplements

Intake of iron supplements during pregnancy was found to have a protective effect in AIP (Gebremedhin et al., 2014). This was consistent with the findings of other studies on iron supplementation and pregnancy outcome (Hess et al., 2001 as cited by Begum et al., 2018). Iron supplementation during pregnancy protected women from becoming anaemic because the needed iron amounts provided by the diet were not adequate for the body's requirements. In the Asia region experience, (Kalaivani., 2009 as cited by Kalaivani & Ramachandran., 2011) noted in their study that though India had the highest prevalence, it had managed to witness a reduction in 15 years before 2011. It had followed a two-pronged strategy of increasing iron intake through dietary diversification and the use of iron-fortified iodized salt.

Studies done in Ethiopia, Uganda, Nigeria, Turkey, and Vietnam had corroborated the same findings that the odds of developing anaemia was more common among pregnant

women who were not supplemented with iron and folic acid (Haidar., 2010, Ononge et al., 2014, Nwizu et al., 2011, & Aikawa et al., 2006 as cited by Sendeku et al., 2020). The study further found that socioeconomic factors resulted in limited access to adequate food and antenatal care causing most cases of AIP hence, recognition as a leading risk factor for anaemia in pregnant women (Cüneyt et al., 2015). Tanzania on the other hand strengthened the provision of various interventional methods to reduce the burden of anaemia during pregnancy. These methods included; anaemia screening, anaemia active treatment, and prevention through the provision of a combination of folic acid and iron supplements. Other practices comprised deworming, intermittent malaria prophylaxis using sulfur-based drugs, free provision of mosquito-treated nets, and health education to expectant women which showed effectiveness (Msuya et al., 2011 as cited by Stephen et al., 2018).

2.5.2 Antenatal Care

The primary purpose of antenatal care was to assess the health statuses of both the mother and the foetus. This involved obtaining a comprehensive report on pregnancy history and identified risks to health. Thus, this assessment test provided a report on the physical, physiological, social, psychological, and emotional state of the pregnant woman (Wijayasundara et al., 2013).

Okafor and Odugu had indicated that early antenatal booking and good control of anaemia during pregnancy were two methods being utilized to achieve acceptable pregnancy outcomes (Okafor., & Odugu., n.d). These methods were also found to be in direct support of Focused Ante Natal Care (FANC) standards for antenatal care adopted by the MOH Kenya (MOH., 2004) from WHO, illustrating that early antenatal care was associated with positive pregnancy outcomes. The recommendation of a safe motherhood manual by MOH was thus the standard used to guide clinic bookings and

antenatal follow-ups (MOH, 2004). However, the 2004 MOH/WHO FANC policy standards for antenatal care were superseded by the new WHO guidelines of 2016. The new model increased the number of maternal and foetal assessments to detect complications, improved communication between health care provided and pregnant women, and increased the likelihood of positive pregnancy outcomes. The world health body endorsed initial clinic visits to be at twelve weeks of pregnancy and thereafter follow-ups at twenty, twenty-six, thirty, thirty-four, thirty-six, thirty-eight, & forty weeks. Additionally, the health care systems were to enact measures that improved the utilization and provision of excellent antenatal care. This approach was intended to facilitate flexibility for countries to employ useful options for the delivery of perinatal care based on their specific needs (WHO., 2016, MOH., 2004, Greer et al., 2003 as cited by Tahir., 2015, Gruber., 1998 as cited by Manzi et al., 2018).

2.5.3 Early AIP Prevention

As a prophylactic measure, young girls were advisable to build up iron stores before pregnancy. Girls of school-going ages were to be encouraged to use iron-rich foods fortified with iron and do annual anaemia screening for those with identified AIP risk factors (WHO., 2016, Tunçalp et al., 2017).

Literature review showed that AIP was preventable and easily treated if detected on time as an existing gap. Various interventional methods to reduce the burden of AIP were available. The methods employed included anaemia screening, active treatment; prevention by giving a combination of folic acid and iron supplements; and deworming. Other methods include intermittent malaria prophylaxis, provision of free mosquito-treated nets, and health education during the antenatal visits. Another identified gap existed in policy and practice. The MOH Kenya, through FANC policy protocol, supports this service. However, the success was yet to be determined at Mosoriot Sub-

County Hospital. This study was to enquire on whether the hospital offered this service and its significance to AIP management.

2.6 Maternal Anaemia and Birth Outcomes

Haemodilution was known to cause a physiological anaemic state being associated with severe consequences on health, social, and economic development (Dutta, et al., 2007 & Viveki et al., 2012 as cited by Baruah et al., 2020). Anaemic pregnant women were found to be at risk of low physical activity, increased maternal morbidity and mortality, especially those with severe anaemia. The neonates encountered negative consequences that included foetal anaemia, Low Birth Weight (LBW), prematurity, intrauterine growth retardation, perinatal morbidity and mortality. Researchers who had similar findings were (Wendland., 2018, Kisioglu et al., 2005 as cited by Vanamala et al., 2018). However, it was further found that AIP was not the only condition causing poor outcomes. Conditions such as diabetes, tuberculosis, and HIV infection, were implicated. The predisposing factors included grand multiparity, low socioeconomic status, and inadequate child spacing, among others (Dim & Onah., 2007 as cited by Njoku et al., 2017).

Maria and her team in the 2014 USA study had found that the most common IDA effect on AIP was impaired physical performance (91%) followed by spontaneous miscarriages (0.8%) of the cases with no neonatal mortality. However, it reported that 6% of pregnancies had ended up with the birth of healthy full-term infants without birth defects. Preterm birth occurred in 8.6% of cases while IDA persisted in 82.6% of them. 14.3% of patients with IDA in the third trimester reported maternal and foetal complications, such as chronic placental insufficiency; 57.9% placental abruption and 10.5% postpartum haemorrhage and 9.8% of the women experienced reduced lactation. 16.2% of the patients experienced anaemia during the postnatal period. The foetal

experiences were such that 36.8% reported foetal growth retardation syndrome and low birth weight for gestational age while 5.3% of the neonates had IDA (Maria et al., 2014, Renfrew et al., 2014).

A Chinese retrospective study conducted in 2018 by Lin and others on the prevalence of gestational diabetes among Chinese women noted that AIP was a serious health problem. Their study found the following adverse pregnancy outcomes: polyhydramnios, preterm birth, low birth weight, and other neonatal complications that required neonatal admission (Lin et al., 2018).

The researchers also found out that earlier observations existed on the association between maternal anaemia and foetal outcomes. For example, prematurity was a concern related to the effect of maternal iron deficiency on infant health according to (Nwizu et al., 2011 as cited by Symington et al., 2019). Other examples observed included that of Indian study on women in the first stage of labour with higher maternal haemoglobin concentrations which correlated with better APGAR scores and that of cases supplemented with iron in Niger showing better APGAR scores than the placebo group (Aikawa et al., 2006 as cited by Çakmak et al., 2018).

Suryanarayana et al., (2017) while conducting their prospective community-based study on AIP found that 35.6% of the subjects suffered from maternal and foetal health challenges. The maternal complications encountered were difficult labour, postpartum haemorrhage, preeclampsia, and abortions/stillbirths. The foetal complications were low birth weight, premature delivery, and birth asphyxia.

The Jamaican (1986) and Ghana (2006) perinatal mortality survey (Geelhoed et al., 2006) had found similar findings where there was a greater chance of mortality in the first year of life for those infants whose mothers did not use iron supplements. Foetal

and neonatal risks in this survey included low birth weight, poor Apgar score, foetal distress, neonatal distress requiring prolonged resuscitation, and neonatal anaemia. Infants with neonatal anaemia had a higher prevalence of failure to thrive, poorer intellectual developmental milestones, and higher rates of morbidities and mortalities than those without (Nwizu et al., 2011 as cited by Georgieff et al., 2019).

Stephen et al., (2018) had alluded that severe or untreated iron-deficiency anaemia during pregnancy could increase the risk of getting a preterm or low-birth-weight baby, postpartum haemorrhage, postpartum depression, a blood transfusion, an anaemic baby, or a child with developmental delays. Further, an untreated folate deficiency could increase the risk of having a preterm or low-birth-weight baby and a baby with serious neural tube defects.

A gap that existed was found to be the presence of AIP negative outcomes despite wide research and healthcare provision by experts in the fields of gynaecology, obstetrics, general medicine, paediatrics, nursing, midwifery, and public health. Thus, it became an unanswered question in our country and the county in particular. Answering it was to go a long way in achieving the global health aspirations of UN SDG 3.

2.7 Summary of Gaps Found from Literature Review

A gap existed for adequate knowledge and awareness of AIP determinants which was necessary as it would motivate perinatal health caregivers toward early detection and prompt management of AIP. There existed a gap in AIP prevalence identified in the area of study. In Kenya, studies tailored to local conditions about these factors are not available, especially in the counties. A gap existed in the identification of the factors associated with AIP which would be undertaken through the primary health care system for the implementation of prevention and treatment of pregnancy anaemia in existing

programs. A gap existed for the evaluation of AIP preventive services. The literature review showed that methods such as anaemia screening, prevention by provisioning IFAS, and free ITNs during the antenatal visits went a long way in AIP prevention. An identified gap existed in policy and practice. The MOH Kenya, through FANC policy protocol, supports perinatal services. However, the success was yet to be determined at Mosoriot Sub-County Hospital. An existing gap was present for AIP negative outcomes despite wide research from the fields of gynaecology, obstetrics, general medicine, paediatrics, nursing, midwifery, and public health. Answering it would go a long way in achieving the global health aspirations of SDG 3.

2.8 Conceptual Framework

The conceptual structure adopted by this research was to influence the information, understanding and awareness of AIP to all perinatal health care providers within the Mosoriot Sub-County Hospital and its catchment area. Figure 3 shows the conceptualization and approach of AIP for this study.

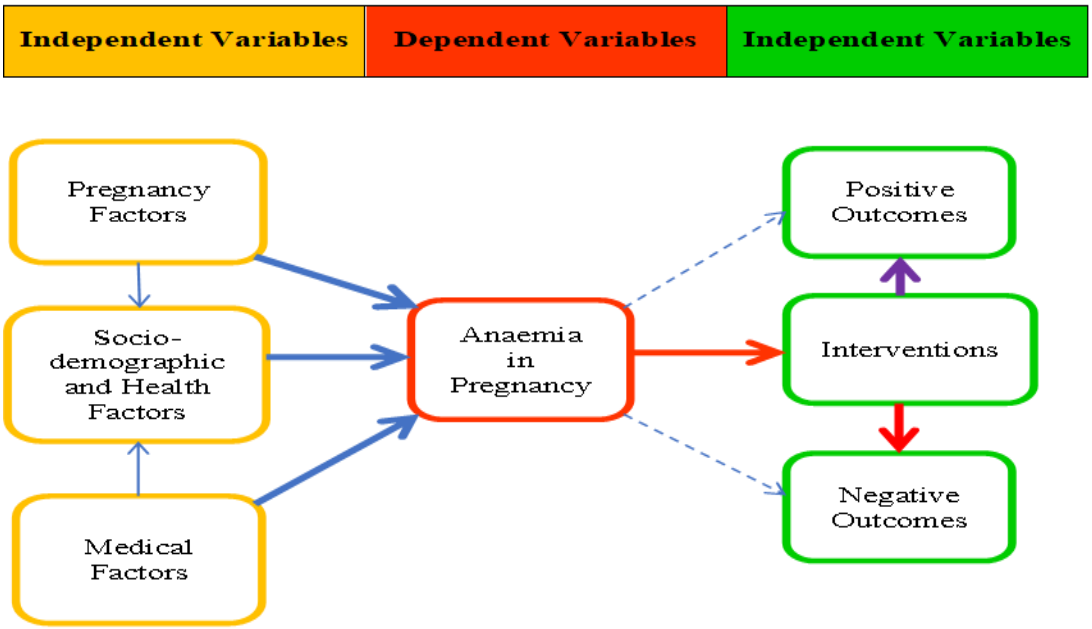

***Figure 3*: Conceptual Framework for the Determinants of Anaemia in Pregnancy**
(Adapted and modified from Nduhiu-Githinji, C.W. (2013)

AIP was described as the Hb level below <12g/dl in an expectant woman. It was considered severe when the Hb was < 7.0g/dl; moderate when between 7.0g/dl and 9.9g/dl and mild when at 10.0g/dl - 11.9g/dl.

The pregnancy factors considered were maternal and foetal characteristics; parity, gravidity, gestational age, general maternal condition, maternal anaemia status, birth weight, gestation at birth, mode of delivery, foetal and maternal outcomes at birth, and the amount of lochial loss. The socio-demographic and health factors comprised age, marital status, educational level, area of residence, occupational status, and nutritional status (BMI). The medical factors were classified as chronic illnesses, infections, and infestations that affect the anaemia status during pregnancy.

The AIP outcomes were either positive or negative depending on whether there were interventions. However, anaemic women could have positive outcomes and negative outcomes with no AIP interventions. The preventive interventional services to offset these adverse outcomes were described as active AIP management, ANC follow-up, nutritional support and supplementation (IFAS), provision of ITNs.

Positive maternal and foetal outcomes were healthy statuses for both the mother and the neonate. The negative outcomes consisted of post-partum haemorrhage, placental insufficiency, postnatal infections, preterm labour, maternal death and general poor health for the mother and poor weight gain, premature birth, low birth weight, neonatal sepsis, foetal cognitive impairment, poor APGAR scores, and foetal deaths for the neonate.

The researchers found out that in Sub-Saharan Africa, where poverty is a contributing factor, AIP was a significant public health problem. Poverty led to a failure to afford adequate and nutritious diets leading to iron deficiency. It was further noted some

pregnant women did not attend all prenatal clinics for various reasons such as ignorance on the benefits of early care, cultural beliefs, low economic empowerment for accessing the health care facilities and cost of health care. These vulnerabilities had been found in Uasin Gishu and Western Kenya is likely to mirror in Mosoriot as they are neighbours. Such determinants have been associated with anaemia in West Africa in the cross-sectional analysis. Implementation of various activities such as AIP curative, preventive, promotive programmes and administrative services is a sure systems approach. The ultimate goal is to improve the health status of expectant mothers.

The gaps that were identified informed on approach to the research. To learn these factors, this research undertook a retrospective chart (medical records) review of secondary data from all pregnant women.

The fast-evolving nature of knowledge through research and publishing have witnessed the citations of old literature in books and journals in wider contexts. The study considered the historical backgrounds and contexts when applying replicability to Kenya and Mosoriot in particular. In addition, the catchment regions of the hospital are mainly rural and as such challenges faced by these research participants are a reality. The community health extension workers need to be facilitated in awareness and understanding of linkages of AIP determinants. However, they may not be very exact in concept.

CHAPTER THREE

METHODOLOGY

3.1 Study Site

The research study was carried out in Mosoriot Sub-County Hospital after piloting at Kapsabet County Referral Hospital (Appendices F & G). The hospital is located near the Mosoriot trading centre and serves the Chesumei Sub-County, which comprises three divisions, namely Kosirai, Kabiyet, and Kipkaren with a total of 23 locations in Nandi County, Kenya (Appendix A). It has an estimated population of 169,433 and a density of 282/km². It is inhabited majorly by the Nandi sub-tribe of the Kalenjin community. Mosoriot Sub-County Hospital has a catchment of one health centre, 21 public dispensaries, four faith-based dispensaries, and nine private dispensaries and clinics (Appendix B). Clinical officers and nurses are in charge of a majority of these facilities. The facilities do not handle complicated maternal cases due to a lack of emergency maternity wings. There are approximately forty deliveries per month conducted at the hospital that does not have a maternity theatre and hence results in the referral of serious cases to Kapsabet County Referral Hospital. Participants came from different locations that included urban areas such as Eldoret, Kapsabet, Nandi Hills, and Iten; peri-urban centres such as Mosoriot, Kipsimo, Mutwot, and Mlango, while rural dwellers were broadly spread in the surrounding regions (Appendix A).

3.2 Study and Target Population

The general study population comprised records of all pregnant women who attended the antenatal clinic at Mosoriot Sub-County Hospital. The study population was records of all pregnant women who attended the antenatal clinic and had a delivery with correctly recorded Hb levels. The target population was records of all pregnant women who attended the antenatal clinic and had a delivery with recorded Hb< 12g/dl.

3.3 Study Design

This was a retrospective review of medical records of women who delivered at Mosoriot sub-County Hospital in 2018. This method was used because it enabled a quick and easy way to obtain information from pregnant women which could have otherwise been difficult to obtain prospectively. The study design also enabled the investigation of determinants of anaemia in pregnancy among these women to inform facility managers and relevant authorities on interventions to address the risk factors and propose areas of further research with respect to this population (Matt Vassar & Matthew 2013, Sarkar, & Seshadri, 2014).

3.4 Sample Size and Sampling Procedure

3.4.1 Sample Size

Fisher's formula (Fischer et al., 1998) for estimating means and proportions were used to determine the sample size. However, all the records meeting the inclusion criteria were used.

$$n=1.96^2 * p* (1-p) /d^2$$

Where;

p = Kenya AIP prevalence = 57% (Nyamu et al, 2020)

d=0.05 is the margin of error at 95% confidence interval

n =minimum sample size

$n=1.96^2*0.57*0.43/0.0025$

$n=3.8416*0.57*172$

$n=376.6304680$

Thus, n=380: (Rounded nearest whole number)

3.4.2 Sampling Procedure

A total of 3064 medical records were extracted for review. A total of 2440 records were omitted due to exclusion criteria. The sampling procedure was as illustrated in Figure 4.

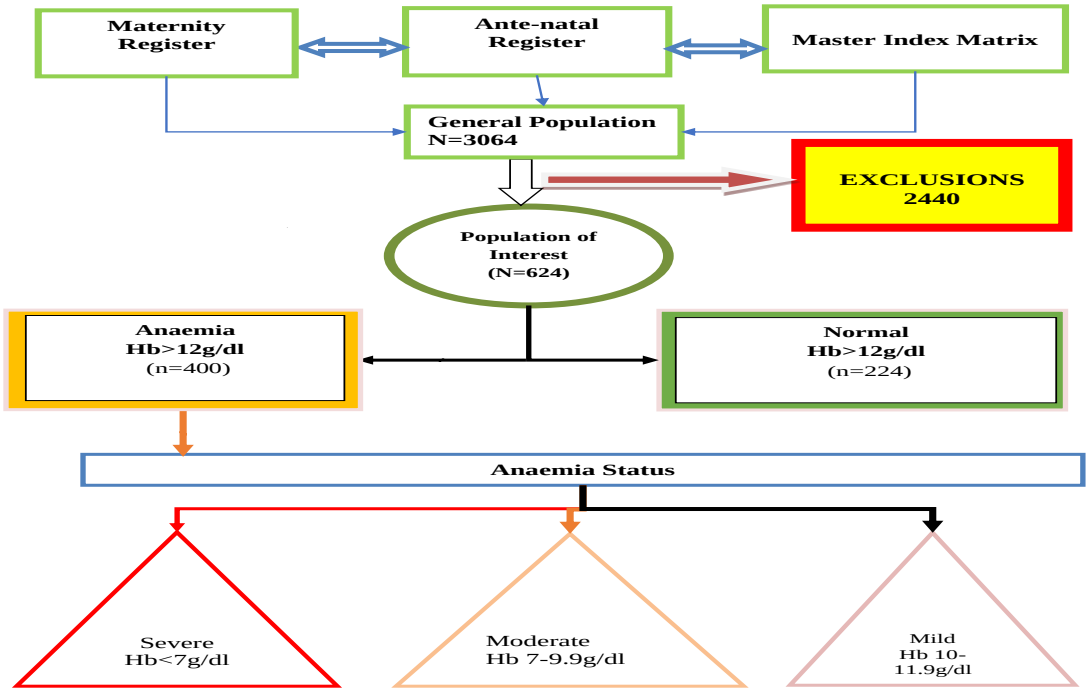

***Figure 4*: Sampling Procedure Flow Chart**

The number of records utilized for the study were those of all mothers who had received all ante-natal services as per the hospital protocols with recorded Hb levels. These records (N=624). formed the denominator unit for the calculation of prevalence. The number of records that were omitted because of having a recorded Hb >12g/dl were (224), which then resulted in n=400 records with Hb <12g/dl as the study target population and the numerator unit for calculation of prevalence. The sample size calculated for the study using fisher's formula was n=380. Our study sampling frame of n=400 collection of all data was larger than this critical minimum sample ensuring acceptable statistical power of 0.8 (Sepulveda., Paulino., & Drakeley., 2015).

3.5 Study Variables

3.5.1 Dependent Variable

Anaemia in pregnancy (Hb, less than 12g/dl)

3.5.2 Independent Variables

The independent variables included the following maternal factors: age, marital status, residence, parity, trimester, number of ANC visits, interventional service methods, level of education, occupation, maternal outcomes, foetal outcomes, APGAR score, BMI and haemoglobin levels. Other factors considered included counselling services, medical preventive services, enumeration of health conditions; modes of delivery, labour duration, clinic booking with antenatal profile, the sex of the baby gravida, and follow-up services. Clinic visits and counselling services were AIP intervening factors.

3.6 Eligibility Criteria

3.6.1 Inclusion criteria

Complete medical records of all pregnant women with anaemia who attended ANC clinic and delivered at the Mosoriot Sub-County Hospital in 2018.

3.6.2 Exclusion criteria

a. All records of pregnant women without Hb results recorded.

b. Complete records with pre-existing chronic medical conditions that are known to affect Hb; for example, malaria, HIV, tuberculosis and diabetes.

3.7 Data Management

3.7.1 Data Collection

Data collection was done in October 2019. All ANC, delivery and master index (discharge summary – Appendix I) records were availed for reviewing. Systematic sorting was adopted via the progressive exclusion of disqualified participants on

monthly basis. Data were collected, extracted, reviewed, and recorded using a structured data abstraction form (Appendix H) by Trained Research Assistants (RAs). The Principal Investigator (PI) coded and validated all the data abstraction forms daily during the entire data collection period.

3.7.2 Data Cleaning, Entry and Processing

The raw data generated was collated, sorted, and cleaned for analysis using excel and CSV spreadsheets. Processing using R Studio software 1991 version 2 yielded two population samples with Hb >12 g/dl and below <12 g/dl respectively. The records of women with Hb <12g/dl became the target population. This target population was then classified as severe anaemia level (Hb <7.0g/dl), moderate anaemia level (Hb 7.0 - 9.9g/dl), and mild anaemia level (Hb 10.0 - 11.9g/dl).

3.7.3 Data Analysis

The researchers used parity instead of gravida for the data analysis due to the completeness of records. To analyse the determinants of AIP, the study utilized recorded Hb levels in all three trimesters. The three levels of the Hb were analyzed against the independent variables. The Hb levels were derived from the records of any of the hospital visits. The researchers excluded records with more than 10% incomplete data. The research used modal values in imputing data in cases where the records were more than 90% complete. It was noted that the missing data did not affect the study results as most files utilized were screened to ensure completeness. The researchers conducted initial descriptive statistics (central tendencies, proportions, distributions, and frequencies) to compare the characteristics of the independent variables against the dependent variable. Further, they conducted a bivariate analysis to investigate the relationships between the independent variables in relation to AIP. ANOVA and correlation were conducted to measure the associations between the Hb

levels and independent variables (Hb, socio-demographic and health characteristics; interventional services, and pregnancy outcomes). Tukyi, post hoc and contrast post hoc analysis analysed the strengths of associations among the independent variables. Multiple logistic regression was conducted to predict the odds for AIP with age, marital status, education level, parity, occupation, number of ANC visits, residence category, trimester and BMI respectively. The study utilized the Akaike Information Criterion (AIC) for Proportional Odds Ratio (POR) analysis. The result of group comparisons of odds and risks for determining factors in AIP and pregnancy outcomes was expressed as POR for categorical variables. The p-value was set at <0.05 for statistical significance for all statistical analysis models (Pour et al., 2016).

3.7.4. Data Validity and Reliability

Strict control measures were observed to enhance the validity and reliability of the research results. Data validity and reliability were achieved by ensuring that the reviewed data was complete as per the registers, data abstraction forms, and managing the research through a clear research assistant training syllabus as described by Barr et al., (2009) for secondary data retrospective design procedures. The principal investigator gave a two-day training of research assistants on the data collection tools, collection and integrity procedures to ensure data quality. The study sampling procedures could provide information that could be replicated in areas with similar populations in Kenya.

3.8 Ethical Considerations

Ethical concerns which could have impacted the research were addressed.

3.8.1 Ethical Approval

Approval was sought and issued from IREC before the research was carried out; License No 0003420 (Appendix C). Clearance from the School of Public Health,

College of Health Sciences was sourced and granted (Appendix E). Research approval was further requested and issued by NACOSTI; License No 448519 (Appendix D). Research authorization and permission were obtained from the Director of Health Services, Nandi County and hospital Medical Superintendent, Mosoriot Sub-County Hospital respectively (Appendices F & G).

3.8.2 Data Confidentiality, Storage, and Security

Confidentiality and security of all personal identifiers were ensured as coded in the data abstraction form (Appendices H). As a retrospective study, there was minimal risk to the subjects except for the potential loss of privacy; nonetheless, every reasonable effort was made to protect the patient information while their data were in use. Data was stored in a locked office and a password-secured computer. Subjects' information was coded and delinked using separate documents correlating subjects' medical record numbers. After the data collection, the key was de-activated, leaving no access to health records. Presentations and publications of this study did not identify subjects individually as they presented the data results in an aggregated form.

3.8.3 Study Benefits

The study had direct benefits to academia in general through an understanding of the determinants of AIP in Mosoriot Sub-County Hospital. The participants, relevant stakeholders and authorities in the health management (Nandi County, MOH, and NACOSTI, peer-reviewed journal and Moi University) were given copies of the research report to enable the community to benefit through better future management and practice policies making pregnancies safer.

3.8.4 Risks to the Participants

There were no direct risks to patients whose records were used in the research. Further, there were no study interventions and no direct contact with patients. Additionally, the

patients' identities were not to be revealed in publications from this investigation. The potential risk of breaching patients' privacy was mitigated by protecting the patient information while their data were used. The subjects involved did not incur any costs during the study.

3.8.5 Informed Consent

Since this was a retrospective study based on existing medical records, an approval for a waiver on the consent filling form was obtained from IREC. The study did not conduct any interventional procedures on the subjects, and all study data had been in existence before this study. Thus, the participants' capacity to give legally effective consent was not considered.

3.8.6 Strengths and Limitations

The researchers relied on the use of already collected data that eliminated the researcher and information bias. It was quicker, relatively cheaper, and easier to conduct. The study required less time to complete and was convenient to analyse multiple variables. Several limitations were encountered. Firstly, data collection was restricted to available completed documents. Secondly, this study did not include information on the anaemia history of the population at risk leading to difficulties in calculating the prevalence rate. Thirdly, the study sample was generated from participants who attended and received care at the hospital and not including those who were disadvantaged to seeking hospital care resulting in selection bias and may not have been generally representative of the population characteristics especially those pregnant women who did not attend the hospital or health centres for perinatal services.

3.8.7 Conflict of Interest

The principal investigator and the supervisors had no known conflict of interest in the study.

CHAPTER FOUR

RESULTS

4.1 The Magnitude of AIP at Mosoriot Sub-County Hospital

The total number of medical records which incorporated the population of interest was (N=624), of whom n=400 was the target population that had a recorded Hb<12g/dl. Those participants with Hb>12g/dl (normal) were n=224 while those with Hb <12g/dl and considered to have anaemia were n=400. The prevalence of AIP among the participants was 64% (n=400/624). The proportion of women who had a mild level of anaemia was 82% (328), moderate anaemia at 17% (68), and severe anaemia at 1% (4) as shown in Figure 5.

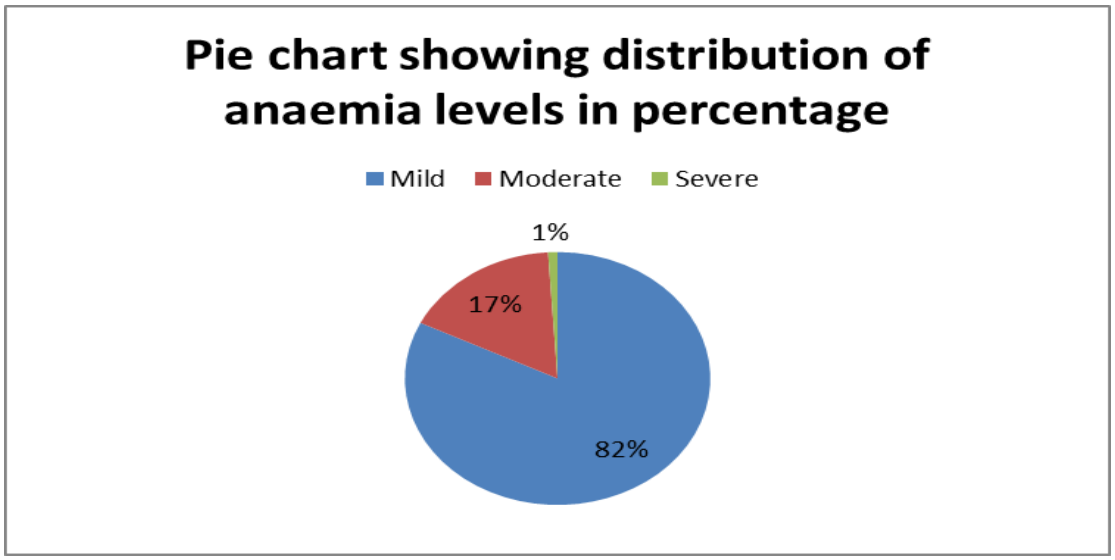

Figure 5: **The proportions of AIP at Mosoriot Sub-County Hospital in 2018**

4.2 Socio-Demographic and Clinical Characteristics

4.2.0 Socio-Demographic Characteristics

4.2.1 AIP among Participants in Different Age Categories

The age distribution of the study population ranged from 15 - 44 years with the majority lying between 20 - 34 years at 79% (n=316) of which participants falling under the age group 20 - 24 contributed the highest proportion at 35% (n=111) as illustrated in Figure

6. The median age was 25 with a standard deviation of 6 years, modal age being 20 years, and variance of 37.2

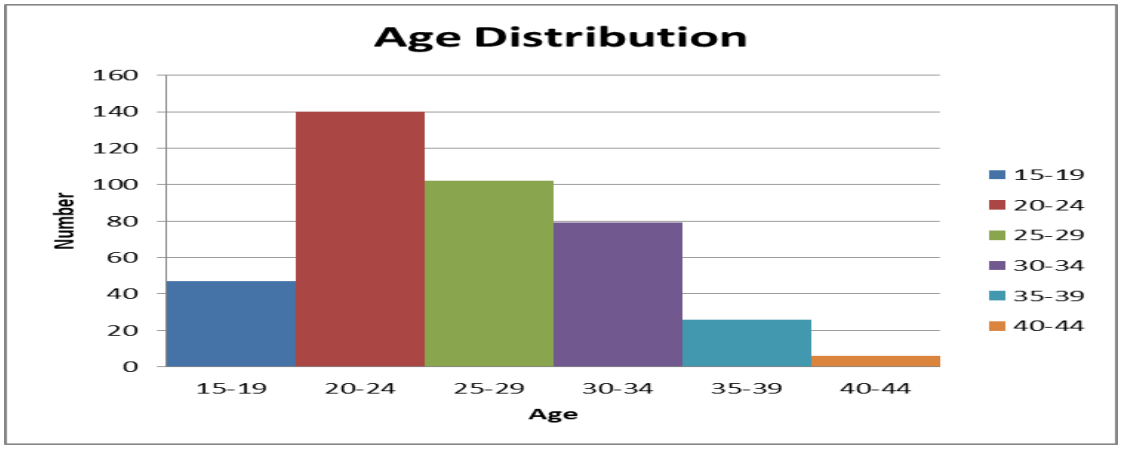

Figure 6: **Charts Showing the Age Distribution and categories of the Study Participants**

4.2.2 AIP Levels across the Residence Categories

The mean Hb for Peri-Urban, Rural, and Urban dwelling participants were 11.92g/dl, 11.57g/dl, and 12.02g/dl respectively against the population mean of 11.68g/dl. The majority of the women who attended the hospital with anaemia were from rural areas (80%). Mild cases of anaemia were higher among subjects from rural and urban dwellings. All severe anaemia cases were pregnant women living in rural and peri-urban regions. Women from peri-urban dwellings had the lowest proportion of anaemia across all anaemia levels as illustrated in the bar chart shown in Figure 7.

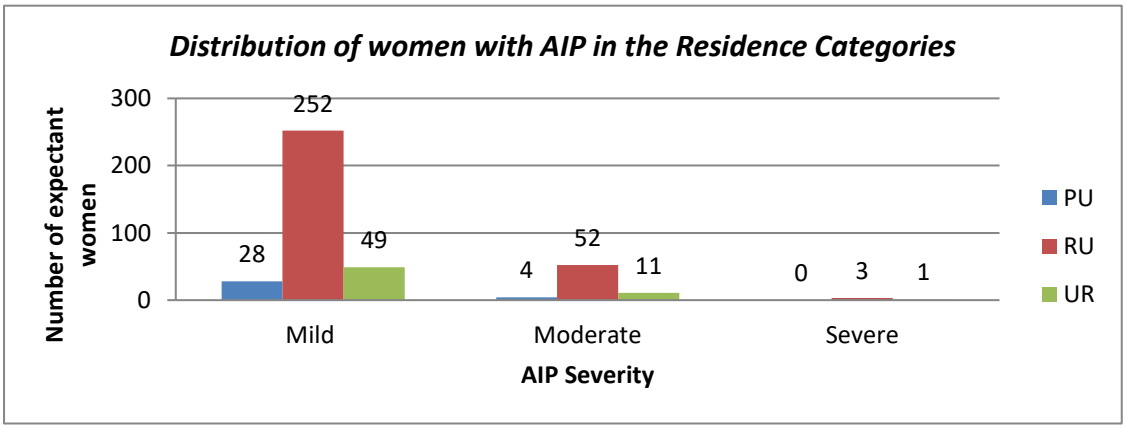

Figure 7**: Distribution of AIP in the Residence Categories**

4.2.3 AIP Levels and the Marital Status

The mean Hb for married women was 11.87g/dl while that of single women was 11.13g/dl respectively in comparison to the population mean of 11.67g/dl. Women who were married experienced mild and moderate types of AIP (Figure 8).

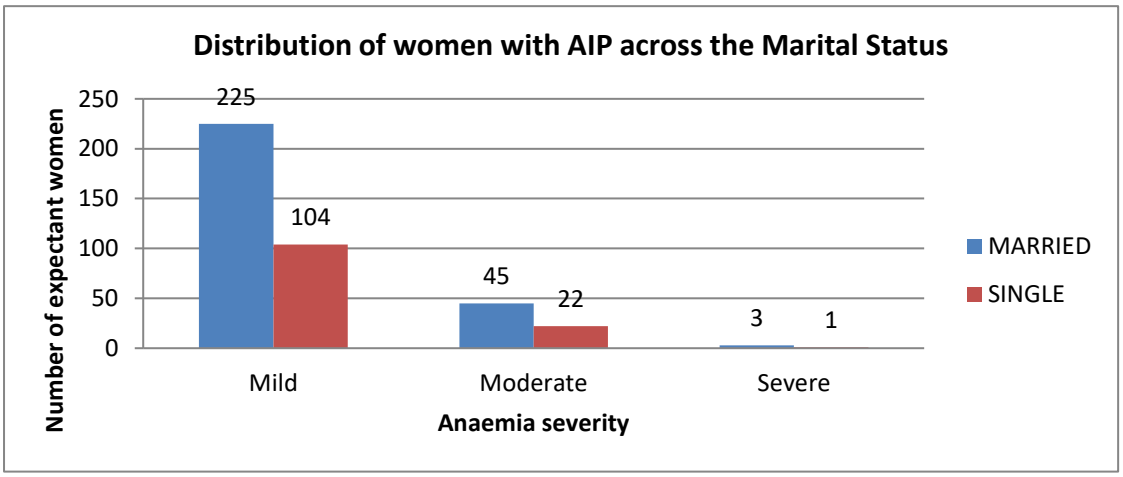

Figure 8: **Distribution of Women with AIP across the Marital Status**

4.2.4 AIP and Parity

Women across all parity experienced the mild form of AIP. The severe cases of anaemia came from the women who were para one, three and four. Regardless of parity, the risk of anaemia was recorded highest under the mild category. However, the trend was that the higher the parity, the lower the risk for AIP as illustrated in Figure 9.

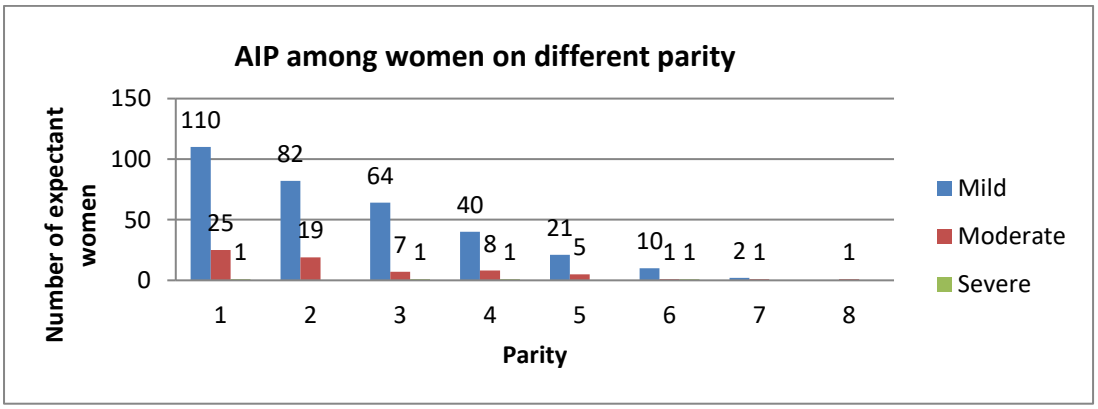

Figure 9: **Distribution of AIP among Women in Different Parities**

4.2.5 Proportion of Women in Different Educational Levels with AIP

Most participants had received basic education with 42% and 44% having completed both primary and secondary education. Mild anaemia was experienced by women across all education levels. Most women who experienced severe anaemia had attained their secondary and primary education as shown by the bar chart (Figure 10).

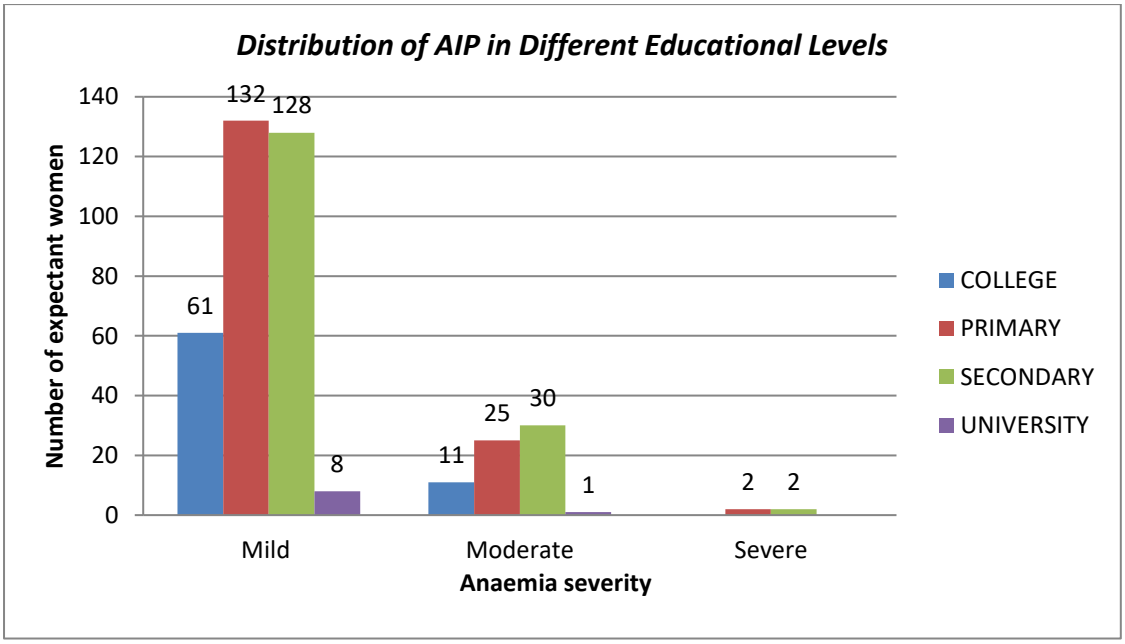

***Figure 10*: Distribution of AIP in Different Educational Levels**

4.2.6 Work Characteristics of Women with AIP

The mean Hb for the women who were employed was 11.5g/dl; housewives had an average level of 11.9g/dl, those who were self-employed at 11. 7g/dl and those who were students at 11.1g/dl against the population mean of 11.7g/dl respectively. The results indicate that most women with anaemia were self-employed 40% and housewives 34%. The mild type of AIP was experienced by the majority of participants. However, noteworthy is the fact that students represented the category with a high proportion of both moderate and mild anaemia at 18%. Women who were housewives and self-employed had cases of mild and severe anaemia as shown in Figure 11.

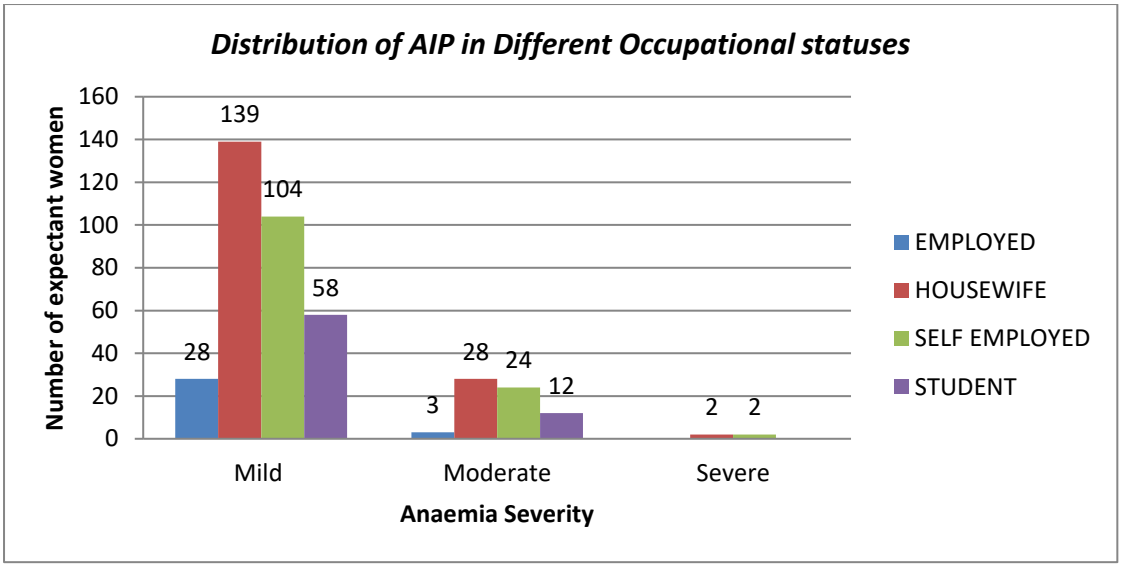

Figure 11: **Distribution of Women with AIP in Different Working Occupations**

4.2.7: Descriptive and Inferential Data Analysis of Socio-Demographic Characteristics

It was found that all age groups had a significant percentage of the mild anaemia category. Age groups (15 - 19), (20 - 24 and 25 - 29) contributed to severe anaemia. Peri-urban dwellers had the lowest proportion of anaemia across all anaemia levels. Both single and married pregnant women recorded cases of mild anaemia. The majority of severe cases of anaemia came from the married category. Regardless of parity, the risk of anaemia was recorded highest under the mild category. The mild category was notably high across the education levels. Severe anaemia was reported having attained their secondary education. Irrespective of occupational status, the percentage of the mild anaemia category was high. Employed and self-employed contributed a high percentage of lower normal and severe anaemia Table 1 summarizes these data analysis products.

Table 1*: Summary of Descriptive and Inferential Analysis of the Socio-Demographic Characteristics*

Variable	Categories	Frequency (%)	Frequencies (%) of levels of Anaemia in Pregnancy			X^2 P-value
			Severe	Moderate	Mild	
Age	15-19	48 (12%)	2 (4.2%)	7 (14.9%)	39 (80.9%)	0.005
	20-24	140 (35%)	1 (0.7%)	23 (16.4%)	116 (82.9%)	
	25-29	104 (26%)	1 (1.0%)	19 (18.6%)	84 (80.4%)	
	30-34	80 (20%)	0 (0.00%)	13 (16.5%)	67 (83.5%)	
	35-39	24 (6%)	0 (0.00%)	3 (11.5%)	21 (88.5%)	
	40-44	4 (1%)	0 (0.00%)	1 (33.3%)	3 (66.7%)	
	Total	n=400 (100%)	4 (1%)	66 (16.5%)	330 (82.5%)	
Residence	Peri-urban	32 (8%)	0 (0.00%)	5 (15.62%)	27 (84.4%)	0.957
	Rural	308 (77%)	4 (1.3%)	56 (18.24%)	248 (80.5%)	
	Urban	60 (15%)	0 (0.00%)	6 (9.84%)	54 (90.2%)	
	Total	n=400 (100%)	4 (1%)	67 (16.75%)	329 (82.25%)	
Marital Status	Married	272 (68%)	2 (0.73%)	41 (15.0%)	229 (84.2%)	0.944
	Single	128 (32%)	2 (1.6%)	26 (20.5%)	100 (77.9%)	
	Total	n=400 (100%)	4 (1%)	67 (16.75%)	329 (82.25%)	
Parity	1	236 (59%)	5 (2.3%)	44 (18.6%)	187 (79.1%)	0.736
	2-3	120 (30%)	1 (0.6%)	20 (17.0%)	99 (82.4%)	
	3+	44 (11%)	0 (0.0%)	6 (12.6%)	38 (87.4%)	
	Total	n=400 (%)	6 (1.5%)	70 (17.5%)	324 (81.0%)	
Education Level	Primary	164 (41%)	0 (0.0%)	29 (17.6%)	135 (82.4%)	0.920
	Secondary	156 (39%)	4 (2.5%)	22 (14.4%)	130 (83.1%)	
	College	72 (18%)	0 (0.0%)	13 (18.0%)	59 (82.0%)	
	University	8 (2%)	0 (0.0%)	3 (33.3%)	5 (66.7%)	
	Total	n=400 (100%)	4 (1%)	67 (16.75%)	329 (82.25%)	
Occupation	Employed	32 (8%)	1 (3.1%)	6 (19.4%)	25 (77.5%)	0.887
	Self employed	128 (32%)	1 (0.6%)	20 (15.4%)	108 (84.0%)	
	Housewife	168 (42%)	0 (0.0%)	24 (14.0%)	144 (86.0%)	
	Student	72 (18%)	2 (2.8%)	17 (24.3%)	52 (72.9%)	
	Total	n=400 (100%)	4 (1%)	67 (16.75%)	329 (82.25%)	

The test for goodness of fit showed that the independent variables were normally distributed. The p-values were all above the significant 5% value, thereby suggesting that was no sufficient evidence of an association between the variables. That meant there was not sufficient evidence to conclude that the true distribution of variables was different from the distribution of the general public. Inferential statistical analysis was undertaken. ANOVA analysis showed a strong association between AIP and marital status ($p=7.328^{e05}$), educational level ($p=1.247^{e06}$), Hb level ($p=1.672^{e05}$), and maternal

outcomes ($p=1.672^{e05}$) while that of occupation (p=0.08181) and the number of visits (p=0.03839) was moderate. A mild association existed in birth outcome (p=0.054) and residence (p=0.0975) with low existence in IFAS (p=0.4838) and trimester (p=0.6718). Further, Tukyi's correlation showed a strong association between age ($p=<2.2^{e-16}$), marital status ($p=1.196^{e-11}$), educational level ($p=1.247^{e-06}$), and occupational (p=0.00241). Multiple logistic regression through Proportional Odds Ratio (POR) analysis carried out to determine the odds of developing AIP indicated that women of age categories 25 - 29 years had POR 2.10 (95%, CI 0.58 – 7.64), 35 - 39 years had POR 1.57 (95%, CI 0.32 – 7.77) and 40 – 44 years had POR 5.38 (95%, CI 0.03 –3.6). Residing in rural areas had POR 2.36 (95%, CI 0.17 – 2.36), primary education level had POR 1.86 (95%, CI 0.67 – 5.16) and secondary education level had POR 1.69 (95%, CI 063 – 4.6). Women who were para three or more had POR 2.36 (95%, CI 0.15 – 1.2) as illustrated in Table 2 and Appendices J, K, L, & M.

Table 2*: Summary of Proportional Odds Ratios Analysis of the Socio-Demographic characteristics*

Variable	**POR**	**2.50% (CI lower)**	**97.50% (CI upper)**
a. Age (Years)			
15-19	Applied as reference age group		
20-24	1.02	0.36	2.90
25-29	2.10	0.58	7.64
30-34	1.11	0.28	4.49
35-39	1.57	0.32	7.77
40-44	5.38	0.03	3.60
b. Residence			
Peri-urban	Applied as reference residence category		
Rural	0.63	0.17	2.36
Urban	0.26	0.06	1.18
c. Marital Status			
Married status	Applied as marriage status category		
Single status	1.21	0.56	2.61
d. Level of Education			
College	Applied as the level of education category		
Primary	1.86	0.67	5.16
Secondary	1.69	0.63	4.6
University	0.42	0.1	2.3
e. Occupation			
Employed	Applied as occupation status category		
Housewife	0.38	0.10	1.41
Self- employed	0.24	0.06	0.90
Student	0.59	0.13	2.72
f. Parity status			
Para 1	Applied as reference gravidity		
Parity 2 to 3	0.90	0.38	2.17
Parity 3 and above	2.36	0.15	1.20

4.3 Clinical Characteristics of the Participants

4.3.1 AIP among Women Based on the Different Trimesters

The mean Hb for the women in trimester one (4 - 27 weeks) was 11.8g/dl; trimester two and three (28 - 35 and 36 - 42 weeks respectively) was at 11.6g/dl against the population mean of 11.7g/dl respectively. Most women had moderate anaemia in the second trimester (53.7%). All severe cases of anaemia occurred during the second and

third trimesters in equal proportions (50%, & 50%). The occurrence of mild anaemia was highest during the second trimester (40.4%) followed by the first trimester (31.6%) and lowest during the third trimester (28%). The distribution of AIP during the trimesters was almost uniform for mild anaemia at 32%, 40%, and 28% respectively. This is illustrated in Figure 12

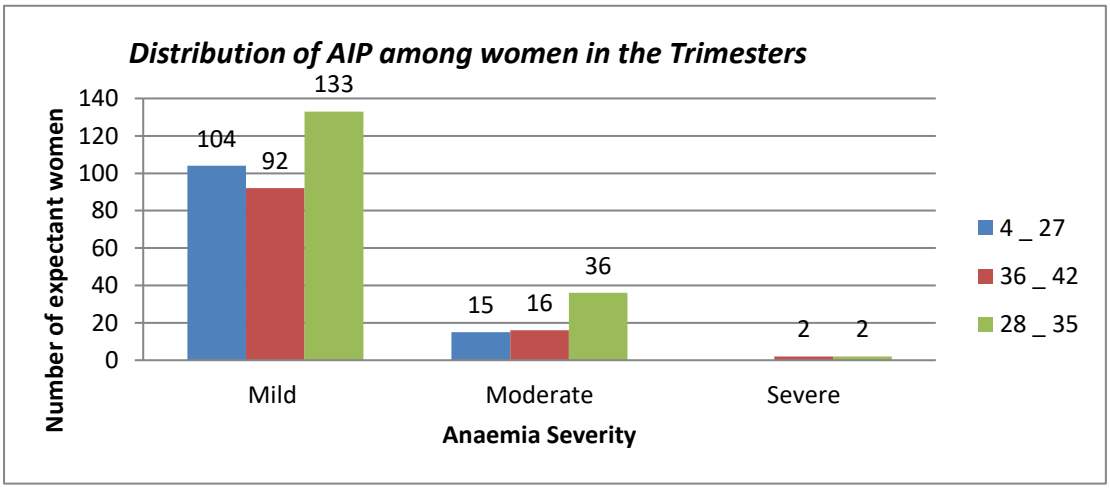

Figure 12: **Distribution of AIP in the Different Trimesters**

The measure of the association between the dependent variable Hb mean of 11.7g/dl and the trimester showed that the p-value = .5154 was greater than the significance level (p >. 05). It indicated that there was no significant association between AIP and trimester. The POR was found to be 1.11 (95%, CI 0.74 - 1.68) signifying no marked difference with its occurrence.

4.3.2 AIP among Women Based on the Number of Clinic Visits

The percentage of participants who were found to have made between 1 - 4 antenatal visits was 90%. Mild and moderate anaemia was experienced by mothers who had less than two visits in comparison to the higher occurrence of all anaemia levels for mothers visiting more than twice. There was a progressive improvement of Hb levels at each clinic visit. There was a progressive decline in the number of antenatal clinic attendance

with n=122 in the 1st clinic visit and n=0 for the 7th visit. This was a negative relationship between the number of clinic attendance and the number of mothers attending the clinics as shown in Table 3. In comparison, there was a progressive improvement of Hb levels at each clinic visit with a mean of 11.68g/dl at less than 4 visits and 12.23g/dl above 4 visits.

Table 3*: Average Hb Levels Based on each Clinic Visit*

Average Hb Levels during each Clinic Visit								
Number of Antenatal Visits	1	2	3	4	5	6	7	8
Mean Hb Per Visit (g/dl)	11.34	11.58	11.69	12.11	11.89	12.51	12.28	0
Number of Mothers (n=400)	122	88	105	46	30	8	1	0
Mean Hb per Cohort	**4 Visits Mean Hb: 11.68g/dl**				**8 Visits Mean Hb: 12.23g/dl**			

The measure of the association between the Hb mean of 11.7g/dl and the number of ANC clinic visits showed that the p-value = .03839, was less than the significance level ($p < .05$). It indicated that there was an association between AIP and the number of ANC clinic visits. Multivariate logistic regression results indicated that the expectant women who made 3 and 4 ANC visits were 1.66 times, POR 10.32 (95%, CI 0.3176 – 1.140), and those with more than four ANC clinics were 1.82 times less likely to experience maternal anaemia as compared to those who made less than 3 ANC visits, POR 0.55 (95%, CI 0.2066 – 1.4588) as illustrated in Table 4 and Appendices J, K, L, & M. Therefore, the number of ANC visits was a determinant of AIP.

Table 4*: Proportional Odds Ratios Analysis of the Number of Clinic Visits*

Variable	**POR**	**2.50% (CI lower)**	**97.50% (CI upper)**
1-2 visits	Used as a reference for the number of visits		
3 & 4 visits	10.32	0.3176	1.14
4 and above visits	0.55	0.2066	1.4588

4.3.3 Haemoglobin Characteristics of AIP among the Women

The range of the Hb was 6.7 - 17.3g/dl with a mean and median of 11.68 and 11.70g/dl respectively. The mild anaemia category (Hb 10 – 11.9g/dl) accounted for 52%, the moderate category (Hb 7 – 9.9g/dl), 11%, and those in the severe category (Hb <7/dl), 1% of the pregnant women attending Mosoriot Sub-County Hospital respectively (Figure13).

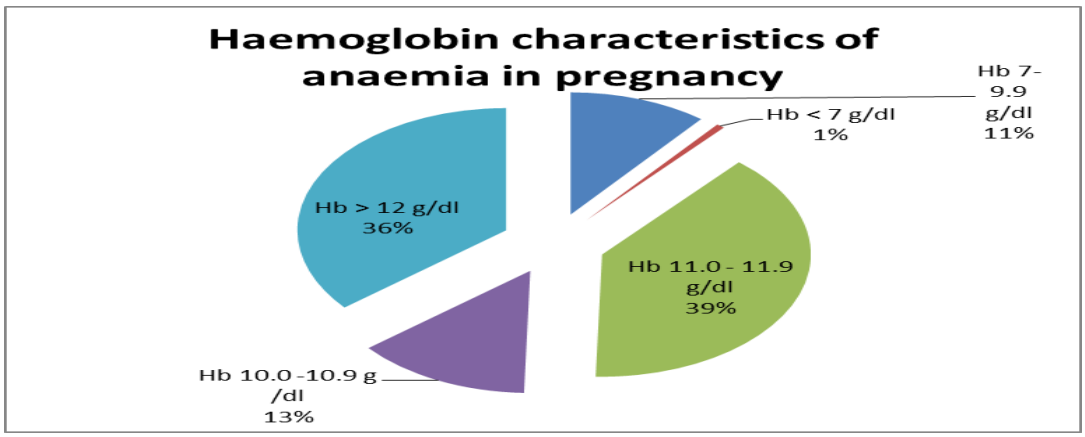

Figure 13: **Pie Chart showing the Haemoglobin Characteristics of AIP among the Women**

The ANOVA measure of the association between the dependent variable and the Hb levels showed that the p - values = .001 (1.672^{e-05} ***, F value 2.4915) was less than the significance level (F < 0.05). It indicated that there was a strong association between AIP and Hb level and Appendices J, K, L, & M.

4.4 Commonly used Interventional Preventive Service Methods

The commonly used interventions in the management of AIP were; the number of clinic visits, provision of ITNs, and IFAS. The provision of IFAS and ITN were methods of intervention used for AIP in this section, whereas the number of clinic visits is considered in the health characteristics section. Over 80% of the women had mild anaemia. Severe anaemia was recorded at 2% and 1% for women who had made 2-3 and 4-8 clinic visits respectively. Mild anaemia levels were witnessed in the high

proportion of mothers across all visit numbers. The distribution of anaemia in pregnancy during the trimesters was almost uniform in variation. There was a progressive decline in the number of clinic attendance. Most of the participants (96%) had received IFAS supplementation during the current pregnancy while those who used ITNs were 22%. The measure of the association between the dependent variable Hb mean 11.7g/dl and IFAS showed that the p-value was greater than the significance level (F > 0.05) indicating no significant association between AIP and IFAS. While that of AIP and ITNs showed that the p-value was greater than the significance level (p > 0.05) indicating no significant association between AIP and ITN as shown in Table five.

Table 5: ***Commonly used Interventional Preventive Services Methods***

Variable	Categories	Frequency and Percentage Level of Anaemia			Measure of Association	
		Severe	Moderate	Mild	F value	Pr (p>0.05)
ANC Visits	0 (n=34)-8.5%	0 (0%)	6 (18%)	28 (82%)	2,2404	0.03839 *
	1 (n=25)-6.25%	0 (0%)	3 (12%)	22 (88%)		
	2-3 (n=147)36.75%	2 (1%)	19 (13%)	126 (86%)		
	4-8 (n=194)-48.5%	2 (1%)	33 (17%)	159 (82%)		
	n=400(100%)	4 (1%)	61 (15.25%)	335 (83.75%)		
ITNs	Yes (n=88)-22%	0 (0%)	3 (3%)	85 (97%)	0.000	0.9827
	No (n=312)-78%	4 (1%)	37 (12%)	271 (87%)		
	n=400 (100%)	4 (1%)	40 (10%)	356 (89%)		
IFAS	Yes (n=386)-96.5%	4(1%)	65 (17%)	317 (82%)	0.4911	0.4838
	No (n=14)-3.5%	0 (0%)	1 (7%)	13 (93%)		
	n=400 (100%)	4 (1%)	66 (16.5%)	330 (82.5%)		
Hb level	Mean = 11.68 g/dl	(1%)	(17%)	(82%)	2.4915	1.672e-05 ***
Key: Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1						

4.5 Anaemia in Pregnancy Outcomes

4.5.1 Maternal Characteristics

The results show that approximately 94% of the women had normal deliveries with 6% experiencing challenges before, during, and after delivery. Most poor maternal outcome complications were recorded by women with mild anaemia. There was a progressive increase in blood loss with increasing anaemia levels. All haemoglobin levels contributed to PPH. The proportion of women who were referred in the mild, moderate and severe forms were 82%, 13% and 5% respectively. The referral cases were mostly to Kapsabet County Referral and Teaching Hospital. Maternal outcomes were related to the levels of anaemia. The measure of association between the dependent variable and the maternal outcomes showed that the p-value was less than the significance level ($p < 0.05$) indicating a strong association between AIP and maternal outcomes as illustrated in Table 6 and Appendices J, K, L, & M.

Table 6: ***Maternal Outcomes***

Characteristic	Specific outcomes n-400	Frequency and percentage of Level of Anaemia			Measure of Association	
		Severe	Moderate	Mild	F value	Pr (0.05>p)
Maternal characteristics	Antepartum Haemorrhage (n=5) - 1.25%	0 (0%)	0 (0%)	5 (100%)	2.4915	1.672e-05 ***
	Born Before Arrival (n=3) - 0.75%	0 (0%)	0 (0%)	3 (100%)		
	Fresh Still Birth (n=2) - 0.5%	0 (0%)	0 (0%)	2 (100%)		
	Postpartum Haemorrhage (n=6) - 1.5%	0 (0%)	0 (0%)	6 (100%)		
	Referred (n=45) - 11.25%	2 (5%)	6 (13%)	37 (82%)		
	Well (Discharged Home) (n=339) - 84.75%	3 (1%)	58 (17%)	278 (82%)		
	(n=400) - 100%	5 (1.25%)	64 (16%)	331 (82.75%)		
Blood loss	Normal Blood Loss (n=345) - 86.25%	3 (1%)	59 (17%)	283 (82%)		
	Mild Blood Loss (n=12) - 3%	0 (0%)	1 (8%)	11 (92%)		
	Moderate Blood Loss (n=13) - 3.25%	0 (0%)	1 (5%)	12 (85%)		
	Severe Blood Loss (n=30) - 7.5%	1 (3%)	7 (23%)	22 (74%)		
	n=400-(100%)	4 (1%)	68 (17%)	328 (82%)		
Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1						

4.5.2 Foetal Outcomes

At delivery, over 85% of the neonates had normal weight. Most of the underweight babies were delivered by mothers with mild (81%) and moderate (19%) forms of anaemia. However, women from the mild anaemia category delivered n=7 (10%) of the neonates who were overweight. Women in both mild and moderate anaemia levels delivered the majority of the underweight neonates. The measure of the association between the dependent variable Hb mean of 11.7g/dl and the foetal outcome showed that the p - values were marginally greater than the significance level ($p > 0.05$). The summary of foetal outcomes as birth weight and APGAR score at one minute and five minutes are as illustrated in Table 7 and Appendices J, K, L, & M.

Table 7: ***Foetal Outcomes***

Characteristic	Categories	Frequency and percentage of the Level of Anaemia			Measure of Association	
		Severe	Moderate	Mild	F value	Pr (p>0.05)
Foetal Outcomes	Normal weight (n=293) - 73.25%	3 (1%)	47 (16%)	243 (83%)	1.4797	0.054
	Overweight (n=86) - 21.5%	1 (1%)	14 (16%)	71 (83%)		
	Underweight (n=21) - 5.25%	0 (0%)	4 (19%)	17 (81%)		
	(n=400) - 100%	4 (1%)	65 (16.25%)	331 (82.75%)		
APGAR score at 1 min	0-4 min- (n=3) - 0.75%	0 (0%)	0 (0%)	3 (100%)		
	5-7 min (n=21) - 5.25%	0 (0%)	4 (19%)	17 (81%)		
	8-10 min -(n=376) - 94%	4 (1%)	64 (17%)	308 (82%)		
	(n= 400) - 100%	4 (1%)	68 (17%)	328 (82%)		
APGAR score at 5 minutes	0-4 min(n=3) -0.75%	0 (0%)	0 (0%)	3 (100%)		
	5-7 min (n=8) - 2%	0 (0%)	1 (10%)	7 (90%)		
	8-10 min (n=389) - 97.25%	4 (1%)	66 (17%)	319 (82%)		
	(n=400) - 100%	4 (1%)	67 (16.75%)	329 (82.25%)		
Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1						

4.6 Findings Summary

A subset of n=400 pregnant women with anaemia was considered the target population of this study where various determinants of anaemia were analyzed and reported using tables and figures. The findings identified AIP as of high prevalence and its determinants included age, rural residence, lower parity, being a housewife

and student, socio-economic status, number of ANC visits, levels of Hb, and non-use of AIP preventive services. The birth outcomes were positively associated with AIP. Table 8 summarizes the predictors with their odds ratios (age, residence, marital status, education level, occupation, parity and ANC visits as related to the findings.

Table 8: ***Summary of the Odds for the AIP Predictors***

Variable level	POR	Confidence Interval		Comments
		2.50 %	97.50 %	
Age 20-24	1.023	0.360	2.904	For mothers within age category 20-24 their odds of being more likely to suffer from AIP was 1.02 times (2.32%) higher than mothers between 15-19
Age 25-29	2.096	0.575	7.635	For mothers within age category 25-29, the risk of developing anaemia in pregnancy was 2.09 (9.64%) times higher than those aged 15-19
Age 30-34	1.114	0.276	4.490	For mothers within age category 30-34, the risk of developing anaemia in pregnancy was 1.11 times (11.5%) higher than those aged 15-19
Age 35-39	1.567	0.316	7.767	For mothers within age category 35-39, the risk of developing anaemia in pregnancy was 1.57 times (56.8%) higher than those aged 15-19
Age 40-44	5.379	0.599	48.260	For mothers within age category 40-45, the risk of developing anaemia in pregnancy was 5.4 (38%) times higher than those aged 15-19
Rural	0.634	0.170	2.361	Mothers in peri-urban residence were 36.53% (1.57 time) less likely to develop maternal anaemia than those in rural
Urban	0.261	0.057	1.179	Mothers living in peri-urban residence were 3.82 (73.85%) times less likely to experience maternal anaemia than those living in urban
Single	1.210	0.560	2.613	Single mothers were 1.2 times (21%) more likely to experience maternal anaemia than married women
Primary	1.857	0.668	5.161	Mothers with primary education were 1.9 times (85.76%) more likely to experience maternal anaemia than those with college education
Secondary	1.689	0.626	4.553	Mothers with secondary education were 1.69 times (69%) more likely to experience maternal anaemia than those with college education
University	44.112	0.450	4321.4	Mothers with university education were 44 times more likely to experience maternal anaemia than those with college education
Housewife	0.382	0.103	1.407	Employed women were 2.61 times (61.75%) less likely to develop maternal anaemia than women working as housewives
Self Employed	0.238	0.063	0.901	Employed mothers were 76.14% (4.2 times) less likely to develop anaemia than self-employed women
Student	0.589	0.127	2.716	Expectant women under student category were 41% (1.7 times) more likely to develop maternal anaemia than employed mothers.
Parity 2&3	0.904	0.377	2.166	There was no difference in risk of experiencing anaemia among mothers who have parity one to three
Parity3+	0.424	0.150	1.195	Mothers with more than three births were 2.36 times (57.6%) less likely to experience maternal anaemia than mothers on first pregnancy.
No.of. Visits. 3&4	0.601	1 0.317	1.140	Expectant women who go for 3&4 ANC visits were 1.66 times (39.8%) less likely to experience maternal anaemia compared to those who make less than 3 ANC visits
No.of. Visits.4+	0.549	9 0.206	1.458	Expectant mothers who attend more than four ANC clinics were 1.82 times (45.1%) less likely to experience maternal anaemia than those who attend less than 3 visits

CHAPTER FIVE

DISCUSSION

5.1 Prevalence of AIP at Mosoriot Sub-County Hospital in 2018

All levels of anaemia (severe, moderate, and mild) were experienced. The prevalence rate of this study was higher than the national (57%), the Nandi County (55%) rates as well as the Eastern Africa region represented by Ethiopia (23.2%) and Tanzanian (48%) (Nyamu et al., 2020, NCIDP., 2018, Grum et al., 2018). It was comparable to Yemen in Asia (63.0%) and the Gambia in Africa (61.8%) (WHO/CDC., 2008). However, it was lower than Western Kenya (69%) study among pregnant women who had visited Kisumu District Hospital for their first ANC in 2016 (Okube et al., 2016). Our study prevalence differed from the highs in South Asia and Central/West Africa and those of East and Central Africa which were moderately affected. Some of the factors contributing to the high prevalence could include low socioeconomic conditions, inadequate nutritional intake, repeated infections, frequent pregnancies, and small health-seeking behaviours. Tailored and scaled up prevention interventions are needed in County of Nandi and Mosoriot Sub-County Hospital, in particular, to reduce anaemia during pregnancy to achieve a reduction in both the prevalence and incidence among the expectant women by 2025 which requires a yearly reduction of 6.1% in line with WHO recommendations (WHO, 2016).

5.2 The Socio-Demographic Characteristics of the Study Population

The study population fell within the definition of reproductive age. The majority of the expectant mothers were young. All age groups had a significantly higher proportion of the mild category of anaemia. The majority of the expectant mothers were young. Participants below 34 years had the highest proportion of the mild anaemia level. The odds of mothers developing gestational anaemia at 35 - 44 years was significantly high.

The results indicate that only two age groups (20 - 24 and 25 - 29) contributed to a few severe forms of anaemia. Majority of women in this study were of younger age groups. However, the odds of anaemia were found to increase as maternal age advances. Expectant mothers aged above 39 years were found to be more anaemic compared to those mothers of 20 - 24 years. Besides, gestational anaemia was significantly associated with women older than 35 years. Age was a determinant for AIP. The study findings were consistent with those of (Okube et al., 2016, Lin et al., 2018) which showed that the odds of anaemia were higher among older women. Expectant mothers aged above 39 years were found to be significantly more anaemic compared to those mothers of 20 -24 years as observed by Okube et al., (2016). Besides, gestational anaemia was significantly associated with women older than 35 years, low family per capita monthly income, rural residence, and pre-pregnancy BMI less than 18.5 (Lin et al., 2018). Studies by Morsy & Alhady., (2014), on increasing parity, disagreed with the findings of this study. Adequate reproductive health follow-up should be encouraged for all pregnant women above 35 years. The majority of the participants lived in rural areas, while a number lived in urban areas and a few lived in peri-urban areas. Women from both urban and rural regions in Mosoriot contributed to the mild, and moderate levels of AIP. The mild anaemia was high across all rural, peri-urban and urban residential areas. The women with severe anaemia resided in rural and urban areas. The odds of experiencing pregnancy anaemia in rural settings were high. The residence was a predictor for AIP. The findings were in agreement with those of (Msuya et al., 2011) who established a correlation between geographical location, dietary practice, and season with AIP. This study further agreed with the WHO that worldwide, pregnant women in both rural and urban areas were vulnerable to anaemia with a variation of 5.7% in the USA, and 75% in the Gambia. There is evidence that anaemia

affects women from low-income countries and high-income countries (Ayoya et al., 2006). Further, it is noted that a large number of women from developing countries especially among minority populations have pre-existing anaemia secondary to poor nutrition leading to 20 – 40% maternal deaths. Expectant mothers in low and middle-income nations are found to be in low socioeconomic categories with the poorest, ethnically disadvantaged, and least educated being at the greatest risk of AIP (Mbangama et al., 2021, Knight et al., 2020, WHO., 2004).

It is an understood occurrence that global and regional distribution levels of AIP vary across villages, areas, regions and countries. High-income areas had the highest haemoglobin distributions whereas the developing ones had the lowest mean concentrations and hence the highest anaemia which is attributable to good health care and availability of food and minerals. This is the opposite for women in poor and underprivileged areas in our country.

This study had found that residence, income, education status, multiparity, geographical location, dietary practice, and season affected the distribution of AIP (WHO, 2014). Geelhoed et al., (2006) study indicated that residence and income tended to affect the patterns of AIP with a higher prevalence present in rural areas.

A large proportion of pregnant women were married. However, single mothers contributed to the highest cases of anaemia across all levels. Women who were married were less likely to have anaemia than single women. This could potentially be attributed to material support, emotional provisions, better dieting due to the pool of resources, and family fulfilment. Being single was a potential confounder of AIP among the expectant mothers.

Women with different levels of parity experienced the mild form of AIP with the severe forms among those who were para one, three and four. Mothers who had delivered less than three children had lower odds of experiencing AIP. However, the category of women who had experienced more than three pregnancies had the highest percentage of risk of anaemia under the mild category. Parity was a weak predictor of AIP standing alone but could have a multiplier effect when combined with other socio-economic factors. This was in keeping with the studies by Gebremedhin that showed an association of anaemia with multiparity (Gebremedhin et al., 2014). In their population-based cohort study, Xu and team had hypothesized that pregnant women in subsequent pregnancy could be more familiar with knowledge about anaemia prevention and pay more attention to the preventive measures (Xu et al., 2016). Compared with pregnant women in the second pregnancy, pregnant women in the first pregnancy have inadequate experience and preparation with knowledge of prenatal care and are more likely to have inadequate dietary iron intake which agreed with (Morsy & Alhady, (2014) study on increasing parity. To reduce this vulnerability, women are encouraged to have a parity not exceeding three through the family planning services as postulated in child spacing principles in new FANC 2016 (WHO., 2016).

Education levels varied from primary grade to university with primary education at the lowest. Data showed that most participants had basic education with the completion of primary and secondary education respectively. All women who experienced severe anaemia had attained their secondary and university education. The odds of experiencing pregnancy anaemia for those mothers who had completed primary and secondary levels of education was high. Due to the small sample for those mothers who had attained university level of training, their odds were not determinable. Educational level was a predictor of AIP. This was in keeping with the findings of studies in China

that showed an educational level could influence knowledge and behaviour that are important for making health behaviour choices (Xu et al., 2016). Pregnant women with a higher education level did not necessarily have better knowledge about anaemia, and better knowledge of anaemia did not necessarily translate into health behavioural outcomes. There is a need for future anaemia interventions to focus on pregnant women of all education levels through behaviour change communication.

Most women diagnosed with AIP were self-employed and housewives. Students represented the category with a high proportion of moderate anaemia while the employed and self-employed women had mild Hb levels and severe anaemia. The odds of experiencing AIP for the housewives, self-employed and students mothers were high. The occupation status was an exposure of pregnant women to the risk of AIP. The study also found out that unemployed, self-employed, and students often represented the category with unreliable income, poor work environments, and low salary, which may have contributed to irregular dietary habits and patterns. These findings agreed with those of Xu and the team in those women with a medium-income had a lower prevalence of anaemia than those with a low income at 16.7% and 10.8% respectively which was in keeping with contemporary knowledge. They concluded that pregnant women with high income do access more varieties of food and pay more attention to nutrition (Xu et al., 2016). Further, studies in Pakistan and Brazil indicated that the proportion of anaemia was high among employed women in comparison to homemakers. The study also found out that unemployed, self-employed, and students often represented the category with unreliable income, poor work environments, and low salary, which may have contributed to irregular dietary habits and patterns (Baig-Ansari et al., 2008).

The type of occupation of the expectant mother also plays a major role in predicting the risk of experiencing gestational anaemia. Special attention should be paid to those women with manual jobs or those who are unemployed in the prevention of anaemia during pregnancy. The occupation of the women as a determinant of anaemia pregnancy in Pakistan and Brazil (Baig-Ansari et al., 2008) was in agreement with this study. It showed that the proportion of anaemia was low among employed women in comparison to housewives. This was attributed to rural women not having sufficient time to visit the clinics as compared to their employed counterparts. Suman et al. (2016) found that wealth, age at pregnancy, education status, antenatal care visits, and dietary factors predicted trends in gestational anaemia prevalence which agreed with this study.

There is a need for the provision of intervention measures to reduce anaemia among pregnant women with jobs that are categorized as of low income. Tailored studies to local conditions on these factors are lacking, especially in the counties. And yet they are key to taking into account the specific aetiology and trends of pregnancy anaemia in a given setting and population groups and should be built into the primary healthcare system for implementation of prevention and treatment of pregnancy anaemia in existing programs.

5.3 Clinical Characteristics Related to AIP of the Study Population

All severe cases of anaemia occurred during the second and third trimesters in equal proportions. The occurrence of anaemia was highest during the second trimester and lowest during the first trimester. There was a progressive improvement of Hb levels at each clinic visit. The mild category recorded a higher percentage regardless of the number of antenatal visits. The odds of experiencing AIP during the trimesters were not statistically significant even though there was a positive association. The distribution of AIP during the pregnancy period was consistent with the advancement in trimesters

The findings were in agreement with the work by K Tunkyi & Moodley., (2016) which had shown that irrespective of the trimester and parity the percentage of the risk of mild anaemia was notably high. Further, Work by Tunkyi & Moodley., (2016) had shown that irrespective of the trimester the percentage of the risk of mild anaemia was notably high. The study, however, did not find statistically significant differences among the women concerning; occupation, residential area, age, level of education, and parity. The mild category recorded a higher percentage regardless of the number of antenatal visits. The odds of experiencing AIP during the trimesters were not statistically significant even though there was a positive association. It was therefore considered as a confounder.

The study population had a widely varying Hb distribution resulting in the distribution being skewed to the right for the levels of anaemia in the order of normal, mild, moderate, and severe. This was similar to the findings of the study by Baig-Ansari et al., (2008) who used gestational ages of 20 to 26 weeks to determine the prevalence and risk factors establishing that 9.5% had some anaemia, 75% were mildly anaemic, 14.8% moderately anaemic, and 0.7% had severe anaemia. All forms of gestational anaemia are detrimental to pregnancy outcomes across regions and interventional measures need to be considered when attending to them (Allen., 2000, Kapil et al., 1999, Dim & Onah., 2007, Kisioglu et al., 2004).

In 2016 Nandi County had 55.7% of expectant mothers attending first ANC visits and only 24.3% completed the fourth visit. In the same reporting period, 42.3% of the expectant mothers were delivered by skilled personnel in the health facilities. AIP was at 55%. The rate of utilization of IFAS was low (Nandi County Integrated Development Plan 2018-2022). Incentives such as free maternity services should be offered to women

especially younger ones to encourage them to give birth in a health facility and under the care of a health professional.

5.4 Commonly used Interventional Service Methods for AIP

The provision of IFAS and ITNs coupled with ANC visits were methods of intervention used for AIP. The majority of the subjects had received IFAS supplementation and very few had received ITNs during the current pregnancy. It was noted that the provision of IFAS and ITNs showed reduced cases of anaemia across all levels. IFAS users had no severe cases, a low percentage for moderate cases and a high percentage for mild cases. Those women who did not use ITNs had severe anaemia cases, a sizeable percentage of moderate anaemia cases and a high percentage of mild cases. This translated into a positive association between their use and pregnancy outcomes. The findings observed that the odds of developing anaemia among pregnant women who did not take iron and folic acid supplements was higher than those who took. The findings that the lack of ferrous supplementation was a significant risk for developing AIP. Interventions through IFAS supplementation and nutritional support show improved anaemia patterns among pregnant women and should be supported. There was a progressive decline in the number of antenatal visits among the participants. The mild anaemia category recorded a higher proportion regardless of the number of antenatal visits. inferential analysis established some association between the number of ANC visits and AIP. The odds of expectant women who made more than 4 ANC visits were two times less likely to suffer AIP. Hence, the increasing number of ANC visits had a strong association with improvement in Hb level among pregnant mothers. The number of ANC visits was a predictor of AIP. The study findings were in agreement with that of Tunkyi & Moodley, (2016) who determined the prevalence of anaemia at the initial antenatal visit and third trimester and evaluated the perinatal and maternal outcomes.

They found that the prevalence of anaemia was 42.7% at the first antenatal visit (35% had mild anaemia). At the 32.-.34-week visit, the prevalence of anaemia was 28.1% (19.3% had mild anaemia).

Health care workers are encouraged to utilize the recommended eight antenatal visits as per the WHO (WHO., 2016). This recommendation by WHO encourages conduct with expectant women aiming at offering standard care that include perinatal investigations, management, treatment and prevention of associated medical conditions. The identified perinatal health care problems during these visits receive prompt management during pregnancy or immediately after birth, thus allowing good pregnancy outcomes (Ononge et al., 2014, Ojo, 1965). The methods recommended for pregnancy anaemia prevention included anaemia screening, active treatment, prevention by giving a combination of folic acid and iron supplements and deworming. Others are intermittent malaria prophylaxis treatment with sulfadoxine-pyrimethamine, free provision of mosquito-treated nets, and health education during the antenatal visits in countries that have succeeded in reducing the prevalence. The MOH Kenya, through FANC policy protocol, supports this service and further as a basis for the antenatal care objective (WHO., 2016). However, this policy has been superseded by the WHO's new guidelines of 2016.

The new model increases maternal and fetal assessments to detect complications, improves communication between health care providers and pregnant women, and increases the likelihood of positive pregnancy outcomes. During these antenatal visits, a complete blood count test is performed which gives important information about the level of haemoglobin count and helps the health care worker understand such symptoms as lethargy, and easy fatigability (Greer et al., 2003; Gruber, 1998; Igwebueze and Uwaezuoke 2010).

Health education and behaviour change communication play a crucial role in the prevention and management of anaemia in pregnancy, including the promotion of maternal health. As a prophylaxis measure, young mothers are to improve their iron levels before pregnancy. All forms of malnutritional deficiencies (chronic, moderate and severe) need to be addressed. Their poor absorption indicators include low health care staff levels, inadequate and inconsistent AIP information, faulty assessment tools, hard to reach areas and inadequate nutrition commodities and health education. Newly emerging anaemia management technologies proposes the use of erythropoietin for its treatment in erythropoietin deficiency or in progressing iron deficiency which is gaining popularity as a therapeutic option during pregnancy and in the postpartum period may be considered in future (Apouey et al., 2017).

A suitable way of managing anaemia in pregnancy is pre-pregnancy counselling where dietary advice and therapy are very important for ensuring better pregnancy results. It is recommended that full blood estimation be checked at the booking visit in pregnancy and repeated during each subsequent visit. In high-risk mothers and multiple pregnancies, an additional haemoglobin check should be performed near term. Dietary advice to all mothers for improvement of intake and absorption of iron from food becomes necessary. Rich sources of iron include haeme iron in animal proteins, plant proteins, fruits, and iron-fortified cereals. Using cast iron utensils for cooking and taking iron with vitamin C can improve its intake and absorption.

5.5 Maternal and Foetal Outcomes of AIP

The majority of the women had normal deliveries. Those cases referred had experienced all types of anaemia. Severely anaemic pregnant women have been shown to have a higher risk of maternal morbidity and mortality during delivery. The neonates encountered low birth weight and low APGAR scores. The majority of the neonates at

delivery had normal weight. Regarding the APGAR score, there was a minimal difference in the baby's condition at one and five minutes from mothers who experienced mild anaemia compared to those who were had severe anaemia. The study findings pointed to poor maternal and foetal outcomes for AIP which comprised the risk for low physical activity, increased maternal morbidity and mortality, foetal anaemia, low birth weight and birth asphyxia. Additionally, severe or untreated iron-deficiency anaemia during pregnancy increased the risk of serious maternal and neonatal outcomes. Milman's team in their work had found that iron-deficient anaemic pregnant women had shorter pregnancies than non-anaemic or even anaemic but not iron deficient pregnant women (Milman, 2006). Study teams of Seifedine and Greer similarly established that blood loss during delivery would expose women to anaemia if delivery Hb is at 11-11.9g/dl threshold level to mild anaemia. Authors such as (Seifedine et al., 2018, Greer et al., 2003, Milman., 2006, Kadry et al 2018, Gebremedhin et al., 2014) have stipulated that Hb values below 12g/dl were associated with poor foetal and maternal outcomes which agreed with our study. More research needs to be undertaken on AIP's effects on foetal health and the barriers for young mothers in accessing prenatal care. This one-year retrospective medical records review study gave a snapshot picture of the determinants of anaemia among pregnant women in Mosoriot Sub-county Hospital.

5.6 Summary of the Discussions

All age groups had a significantly higher proportion of mild and moderate levels of anaemia. Younger participants below 34 years had the highest proportion of mild and moderate anaemia. However, the odds of mothers developing gestational anaemia at 35-39 and 40-44 years were significantly high. Age was a determinant for AIP.

The majority of the respondents came from rural settings. The low Hb level was experienced across all the three residential areas while mild cases of anaemia were high among subjects from both rural and urban dwellings. The women with severe anaemia resided in rural and urban areas. The residence was a predictor for AIP.

All women who experienced severe anaemia had attained their secondary and university education. The odds of experiencing pregnancy anaemia for those mothers who had completed primary and secondary levels of education was high. Educational level was a predictor of AIP. Single mothers contributed to the highest cases of anaemia across all levels. Being single was a potential confounder of AIP among the expectant mothers.

Women who had experienced more than three pregnancies had the highest percentage of mild anaemia whereas those with less than three children had lower odds of experiencing AIP. Parity was a predictor for AIP.

Students represented the category with a high proportion of moderate anaemia while the employed and self-employed women had mild Hb levels and severe anaemia. The odds of experiencing pregnancy anaemia for the housewives and students were high. Women's occupation status as a predictor of AIP.

The practice of ANC visits; provision of IFAS and ITNs were methods of intervention used for the prevention of AIP and showed reduced cases of anaemia across all levels. An association between the number of ANC visits and AIP existed with the odds of expectant women who made less than 4 ANC visits being high. The number of ANC visits was a predictor of AIP.

The majority of the women had normal deliveries. Those cases referred had experienced all types of anaemia. Severely anaemic pregnant women have been shown to have a higher risk of maternal morbidity and mortality during delivery. The neonates encountered low birth weight and low APGAR scores. The majority of the neonates at delivery had normal weight. Regarding the APGAR score, there was a minimal difference in the baby's condition at 1 and 5 minutes from mothers who experienced mild anaemia. The confounding factors were trimester and BMI; while marital status was a potential confounder.

In conclusion, the prevalence of AIP was high. Age was a determinant for AIP. The predictors of AIP were the number of ANC visits, Hb level, parity, level of education, type of occupation, and residential area. The confounding factors were trimester and BMI; while marital status was a potential confounder.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Understanding the scope of factors influencing the occurrence and prevalence of anaemia among pregnant women is essential in guiding policy, practice, development and intervention programs for the enhancement of maternal and child health. This research was aimed at identifying the determinants of AIP as measured against the prevalence and severity of AIP, describing its socio-demographic and health characteristics; exploring the interventional preventive service methods used in AIP and describing the pregnancy outcomes among women in Mosoriot sub-County Hospital in 2018.

The prevalence of AIP for women in Mosoriot sub-County Hospital in 2018 was high. Women in all age groups experienced AIP with adolescent mothers aged 15-19 years presenting with a severe form of anaemia. Most women had mild anaemia, lived in rural areas, were married, had attained a primary level of education, and were housewives with at least one child. Severe anaemia was experienced by all mothers in the second and third trimesters in equal proportions. There was a progressive improvement of Hb levels with increasing clinic visits. High parity women had lower chances of AIP compared to women with one to three children. Most women had used IFAS and a few had used insecticide-treated mosquito nets for anaemia prevention. Most severe anaemic cases were referred to the Kapsabet County Referral Hospital. Some neonates were under-weight and had experienced asphyxia at 5 minutes of birth.

Age was a determinant for AIP. Younger participants below 34 years had the highest proportion of mild and moderate anaemia. The odds of developing AIP at 35-39 years and 40-44 years were high.

6.2 Recommendations

1. Tailored scale-up of AIP awareness campaigns and interventions by MOH and County Health Department to address determinants and achieve a reduction in the prevalence of anaemia in pregnancy.

2. The primary health care facilities to design targeted routine clinic follow-ups and ensure timely referral of vulnerable age women with AIP through a common multidisciplinary approach consisting of perinatal service providers, community health care workers and family support groups.

4. Optimization of FANC activities is a necessity. The holistic approach recommended standards of antenatal care should be adopted. The targeted activities during each of the eight clinic visits should be geared towards prophylaxis for anaemia (monthly Hb checks) and malaria control by use of ITNs and IFAS.

5. There is a need to combat AIP in primary health care facilities to minimize maternal and foetal negative outcomes. Scale-up of awareness programmes and appropriate dissemination in the community is necessary.

6. Further studies should be conducted to identify barriers for the uptake of perinatal care among women in the vulnerable older age groups and exploration of risk factors for the different age groups.

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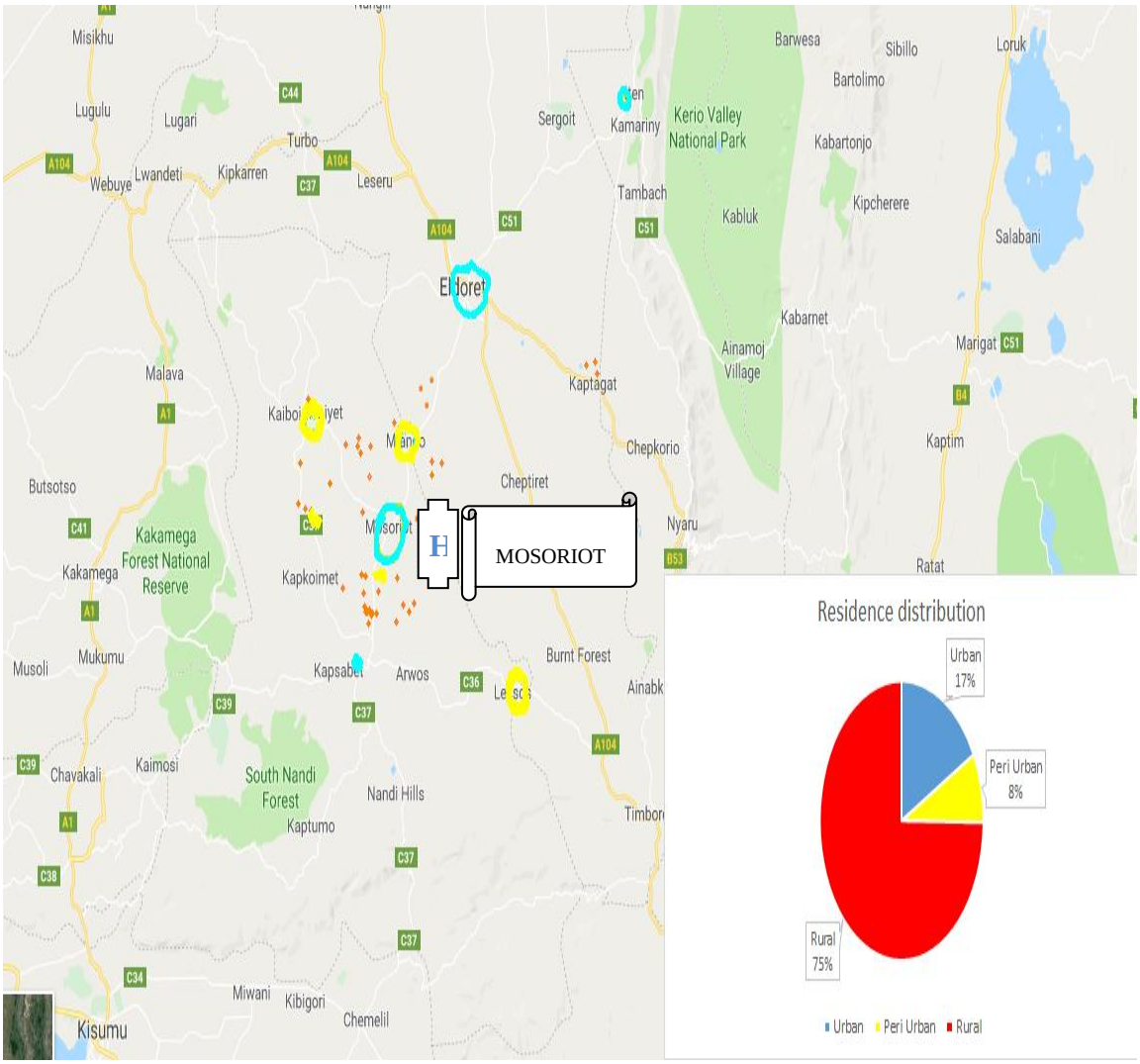
APPENDICES

APPENDIX A

Map Showing Study Site and the Geographic Distribution of Study Population



(Courtesy Google Maps)

The typical topography of the catchment area is rolling hills to the west, the central Kapsabet plateau, the wooded highlands and the foothills of Tinderet volcanic mass at the south-east, the King'wal swamp at the centre and the dissected Nyando escarpment at the southern border. These features do affect the economic activities and transport network. The reliability of rainfall implies that the catchment areas have high economic potential harnessed through various agricultural activities that alleviate poverty such as dairy activities, tea plantations, and agricultural production. The study areas experience a range of temperatures between 14^{o}C and 26^{o}C during the year depending on the season. These stable conditions are conducive to malaria infections during the rainy seasons.

APPENDIX B

Health Facilities Serving the Chesumei Sub-County

PRIMARY HEALTH FACILITIES SERVING MOSORIOT SUB-COUNTY HOSPITAL	
GOK FACILITIES	Mogoget Dispensary
Kapsisywo Health Centre	Sironoi Dispensary
Biribiriet Dispensary	Saniak Dispensary
Chepkumia Dispensary	Ngechek Dispensary
Chemundu Dispensary	Kimondi Forest Dispensary
Chemuswo Dispensary	**FAITH-BASED & PRIVATE FACILITIES**
Cheplengu Dispensary	Mother Francesca Hospital – Kapsabet
Itigo Dispensary	Chepterit Mission Hospital
Kamurguiywa Dispensary	Sironoi SDA Dispensary
Kapkibimbir Dispensary	Baraton Jeremiah University Hospital
Kapsisiywo Dispensary	Kokwet Medical Clinic
Kapchepkok Dispensary	Alphax Hill Medical Centre
Kaptel Dispensary	Masan - Chepterit Clinic
Kaptildil Dispensary	Chepsoo Pharmaceuticals
Kingwal Dispensary	ICL Baraton
Kokwet Dispensary	Mosoriot Medical Services
Lelmokwo Dispensary	Olimilla VCT

APPENDIX C

Copy of IREC Approval

INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

MOI TEACHING AND REFERRAL HOSPITAL
P.O. BOX 3
ELDORET
Tel: 33471//2/3

MOI UNIVERSITY
COLLEGE OF HEALTH SCIENCES
P.O. BOX 4606
ELDORET
Tel: 33471/2/3

Reference: IREC/2019/185
Approval Number: 0003420

29th August, 2019

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
29 AUG 2019
APPROVED
P. O. Box 4606 - 30100 ELDORET

Fredrick Kipkosgei Mutai,
Moi University,
School of Public Health,
P.O. Box 4606-30100,
ELDORET-KENYA.

Dear Mr. Mutai,

DETERMINANTS OF ANAEMIA IN PREGNANCY AMONG WOMEN ATTENDING MOSORIOT SUB-COUNTY HOSPITAL, NANDI COUNTY, KENYA

This is to inform you that ***MU/MTRH-IREC*** has reviewed and approved your above research proposal. Your application approval number is ***FAN:0003420.*** The approval period is ***29th August, 2019 – 28th August, 2020.***

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used.
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by ***MU/MTRH-IREC***.
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to ***MU/MTRH-IREC*** within 72 hours of notification.
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to ***MU/MTRH-IREC*** within 72 hours.
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to ***MU/MTRH-IREC.***

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

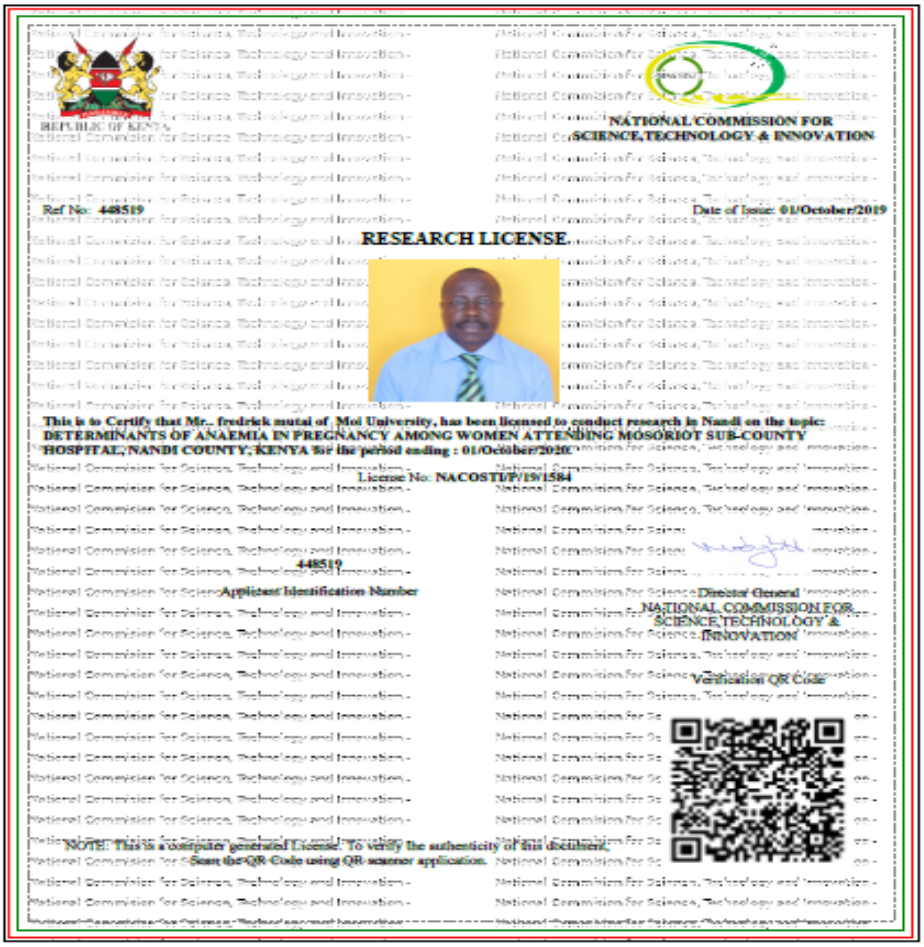
Sincerely,

DR. S. NYABERA
DEPUTY-CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

cc CEO - MTRH Dean - SOP Dean - SOM
Principal - CHS Dean - SON Dean - SOD

APPENDIX D

Copy of NACOSTI Approval



REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

Ref No: 448519

Date of Issue: 01/October/2019

RESEARCH LICENSE

This is to Certify that Mr., fredrick mutai of ,Moi University, has been licensed to conduct research in Nandi on the topic: DETERMINANTS OF ANAEMIA IN PREGNANCY AMONG WOMEN ATTENDING MOSORIOT SUB-COUNTY HOSPITAL, NANDI COUNTY, KENYA for the period ending : 01/October/2020.

License No: NACOSTI/P/19/1584

448519

Applicant Identification Number

Director General

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013

The Grant of Research Licenses is Guided by the Science, Technology and Innovation (Research Licensing) Regulations, 2014

CONDITIONS

1. The License is valid for the proposed research, location and specified period
2. The License any rights thereunder are non-transferable
3. The Licensee shall inform the relevant County Director of Education, County Commissioner and County Governor before commencement of the research
4. Excavation, filming and collection of specimens are subject to further necessary clearence from relevant Government Agencies
5. The License does not give authority to tranfer research materials
6. NACOSTI may monitor and evaluate the licensed research project
7. The Licensee shall submit one hard copy and upload a soft copy of their final report (thesis) within one of completion of the research
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National Commission for Science, Technology and Innovation
off Waiyaki Way, Upper Kabete,
P. O. Box 30623, 00100 Nairobi, KENYA
Land line: 020 4007000, 020 2241349, 020 3310571, 020 8001077
Mobile: 0713 788 787 / 0735 404 245
E-mail: dg@nacosti.go.ke / registry@nacosti.go.ke
Website: www.nacosti.go.ke

APPENDIX E

Introduction Letter to Nandi Health Department from SPH

School of Public Health,
P. O. Box 4606 - 30100
ELDORET, Kenya
Email: deansph@mu.ac.ke or
deansphmu@gmail.com

PDN Building, Nandi Road,
Eldoret town, Kenya
Office Tel: +254 (0)733764361
Website: www.mu.ac.ke

MOI UNIVERSITY
COLLEGE OF HEALTH SCIENCES
SCHOOL OF PUBLIC HEALTH
Office of the Dean

13th, September 2019

County Director of Medical Services and Sanitation, Nandi County
P.O Box 802,
Kapsabet

Dear Sir,

RE: LETTER OF INTRODUCTION FOR MUTAI K. FREDRICK A SECOND YEAR MASTER OF PUBLIC HEALTH STUDENT AT MOI UNIVERSITY TO CONDUCT RESEARCH IN YOUR COUNTY HEALTH FACILITIES

This is to introduce Mr. Fredrick K. Mutai, our MPH student, registration SPH/PGH/01 /2017 our 2-year MPH programme is by course-work (first year) and thesis (second year). In the second year Mr. Mutai has developed a proposal for his thesis titled **"Determinants of Anaemia in Pregnancy Among Women Attending Mosoriot Sub-County Hospital in Nandi County, Kenya",** which has been approved by Moi University/MTRH Institutional Research and Ethics Committee (see letter of IREC approval attached).

Mr. Mutai is therefore ready to undertake his pilot/pre-test at Kapsabet County Referral or one of the other sub-County Hospitals and then proceed to conduct his data for this study at the Mosoriot sub-County Hospital in your County.

We kindly request you to facilitate his access to the relevant health facilities in your county to enable him collect appropriate data for the proposed area of interest. We also expect that the findings of this study will be disseminated to your so that you can address any priority areas of concern arising from the study recommendations at the respective institutions and/or County health services at large.

Please contact the undersigned at the addresses provided herein, should you need any further clarification or information.

Yours Sincerely,

Prof. Mabel Nangami,
Dean, School of Public Health

DEAN SCHOOL OF PUBLIC HEALTH MOI UNIVERSITY Box 4606 ELDORET

Cc. - Medical Superintendant, Kapsabet County Referral Hospital, Box 5, Kapsabet
- Medical Superintendant, Mosoriot Sub-County Hospital, Box 2745, Mosoriot, Eldoret

APPENDIX F

Permission to Undertake Research

COUNTY GOVERNMENT OF NANDI

DEPARTMENT OF HEALTH AND SANITATION

Telephone 053 52233
When replying
Please quote

County Director of Health
Nandi County
P.O. Box 5-30300
KAPSABET.

REF:CDH/NDI/R.A/2019/56

19/9/2019

MEDICAL SUPERINTENDENT
MOSORIOT SUB COUNTY HOSPITAL

REF: PERMISSION TO UNDERTAKE RESEARCH- MUTAI K. FREDRICK MPH STUDENT MOI UNIVERSITY

The above named has been granted permission to carry out research in your facility on the **Determinants Of Anaemia in Pregnancy**.

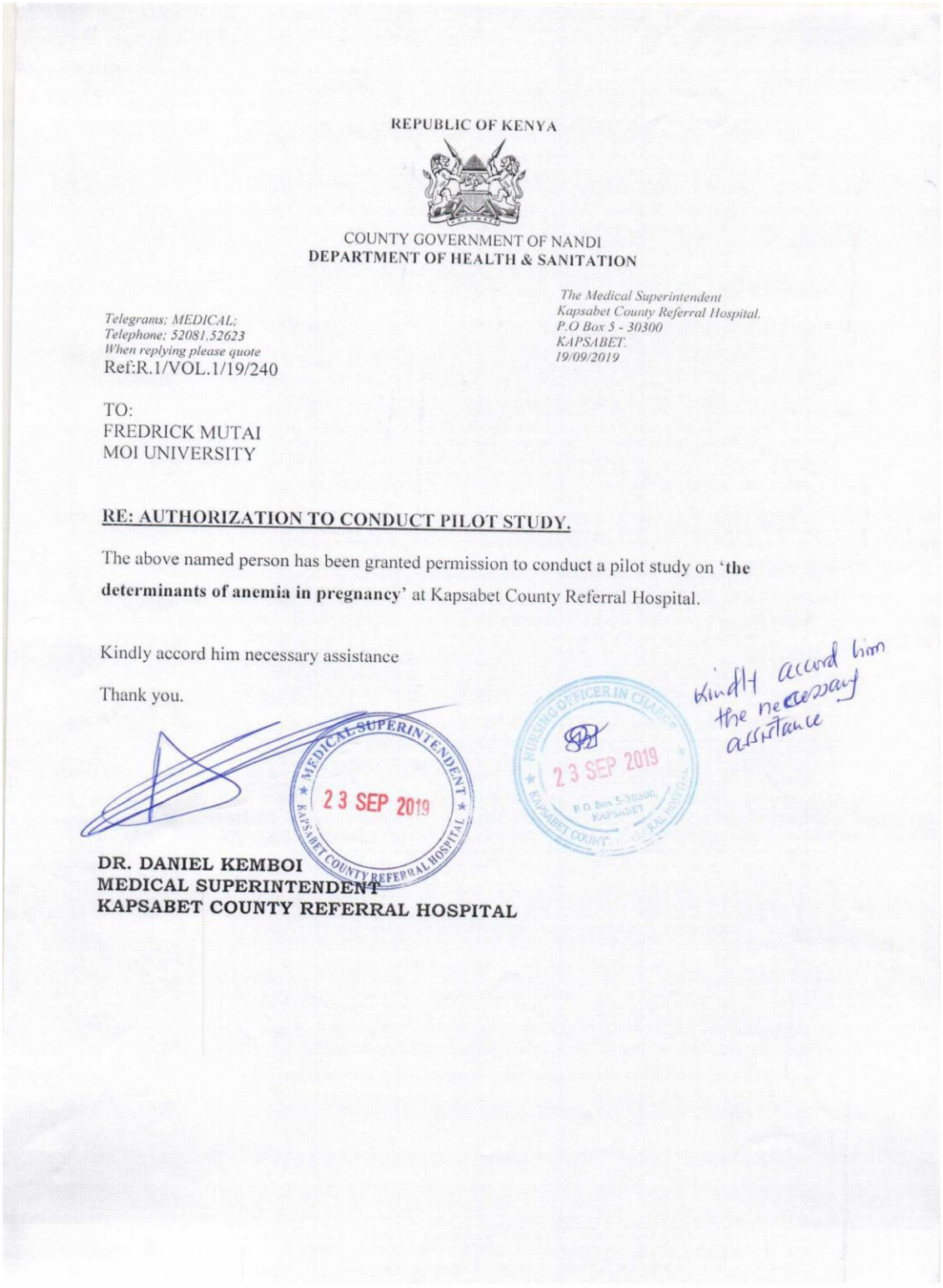
DIRECTOR HEALTH SERVICES
19 SEP 2019
HEALTH & SANITATION
COUNTY GOVERNMENT OF NANDI

Please accord him the necessary assistance.

DR. DAVID BUNGEI
COUNTY DIRECTOR OF HEALTH
NANDI.

APPENDIX G

Authorization to Conduct Pilot Study



REPUBLIC OF KENYA

COUNTY GOVERNMENT OF NANDI
DEPARTMENT OF HEALTH & SANITATION

Telegrams; MEDICAL;
Telephone; 52081,52623
When replying please quote
Ref:R.1/VOL.1/19/240

The Medical Superintendent
Kapsabet County Referral Hospital.
P.O Box 5 - 30300
KAPSABET.
19/09/2019

TO:
FREDRICK MUTAI
MOI UNIVERSITY

RE: AUTHORIZATION TO CONDUCT PILOT STUDY.

The above named person has been granted permission to conduct a pilot study on '**the determinants of anemia in pregnancy**' at Kapsabet County Referral Hospital.

Kindly accord him necessary assistance

Thank you.

MEDICAL SUPERINTENDENT ★ KAPSABET COUNTY REFERRAL HOSPITAL ★ 23 SEP 2019

NURSING OFFICER IN CHARGE ★ 23 SEP 2019 ★ P.O. Box 5-30300, KAPSABET ★ KAPSABET COUNTY REFERRAL HOSPITAL

Kindly accord him the necessary assistance

DR. DANIEL KEMBOI
MEDICAL SUPERINTENDENT
KAPSABET COUNTY REFERRAL HOSPITAL

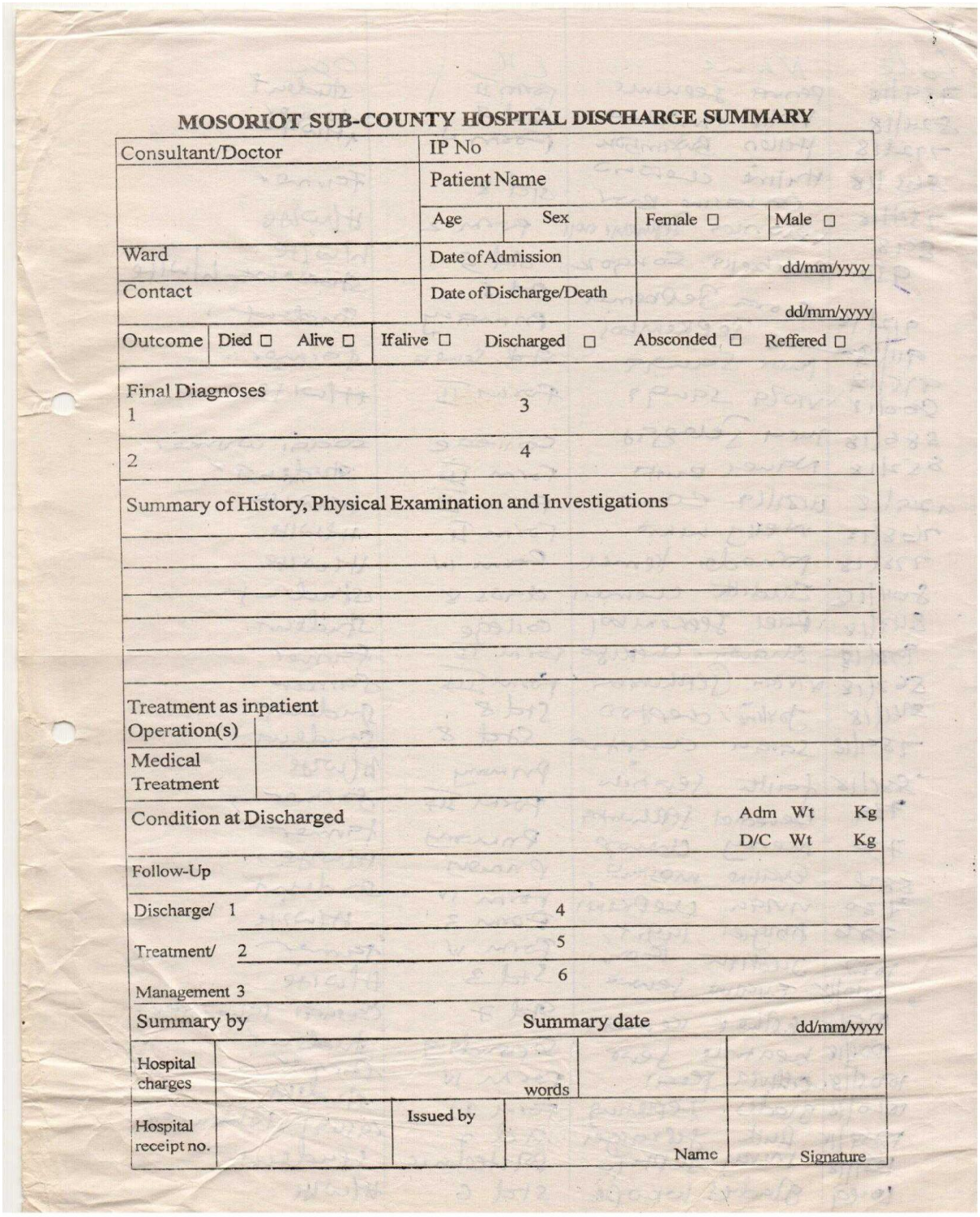
APPENDIX H

Data Abstraction Form

1-Unique I.D Code	10- Physical Exam (Y/N)	19- Labour Duration (Hours)
2- Age	11- Follow-Up Visits (Y/N)	20- Birth Weight
3- Marital Status	12- Antenatal follow-up (Y/N)	21- APGAR Score (1min)
4- Parity	13- Obstetric Ultra Sound (Y/N)	22- APGAR Score (5min)
5- Gravity	14- Preventive Services (Y/N)	23- Residence
6- Gestational Maturity	15- HB Level	24. Weight
7-Maternal Profile (Y/N)	16- Iron/Folic Acid (Y/N)	25- Educational Level
8- Medical History (Y/N)	17- Repeat HB	26- Health Education
9- Pregnancy History (Y/N)	18- Blood Group	27- Summary Sheet (Mortality/Morbidity/Well)
28- Remarks Recorded (Yes Errors < 10%); (No: Errors > 10%)		

APPENDIX I

Copy of Discharge Summary



MOSORIOT SUB-COUNTY HOSPITAL DISCHARGE SUMMARY

Consultant/Doctor	IP No			
	Patient Name			
	Age	Sex	Female ☐	Male ☐
Ward	Date of Admission		dd/mm/yyyy	
Contact	Date of Discharge/Death		dd/mm/yyyy	
Outcome	Died ☐ Alive ☐	If alive ☐ Discharged ☐	Absconded ☐	Reffered ☐
Final Diagnoses 1		3		
2		4		
Summary of History, Physical Examination and Investigations				
Treatment as inpatient Operation(s)				
Medical Treatment				
Condition at Discharged			Adm Wt Kg D/C Wt Kg	
Follow-Up				
Discharge/ 1		4		
Treatment/ 2		5		
Management 3		6		
Summary by		Summary date	dd/mm/yyyy	
Hospital charges		words		
Hospital receipt no.		Issued by	Name	Signature

APPENDIX J

Table of ANOVA Analysis

Source of variation	Statistical Outcomes				
	Df	Sum Sq	Mean Sq	F value	Pr (>F)
Age	5	6.80	1.3604	1.097	0.3640
Residence.Category	2	5.85	2.9268	2.359	0.0975
Marital status	1	48.98	48.983	16.008	7.328e-05 ***
Parity	2	3.31	1.6567	1.335	0.2657
Educational level	3	9.600	3.1999	10.4611	1.247e-06 ***
Occupation	4	37.34	9.3361	3.0072	0.0181 *
HB.Level	33	235.05	7.1226	2.4915	1.672e-05 ***
Trimester	3	4.9	1.6325	0.5154	0.6718
Visit Number	6	41.78	6.9640	2.2404	0.03839 *
IFAS	1	1.55	1.5524	0.4911	0.4838
Maternal.Outcome	33	235.05	7.1226	2.4915	1.672e-05 ***
Birth Weight in Grams	29	131.61	4.5382	1.4797	0.054 .
Signif. Codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1					

APPENDIX K

Table of Correlation Analysis

S/No	Factor Combination	Ratio	X^2	DF	p-value (>x^2)
1	Anaemia vs Age+Marital.Status + Maternal.Outcome	Likelihood Ratio	110.2516	60	8.324388e-05
		Pearson	123.8570	60	2.437843e-06
2	Anaemia +Age+Occupation + Maternal.Outcome,	Likelihood Ratio	228.5102	130	2.122836e-07
		Pearson	253.6038	130	5.318969e-10
3	Anaemia +Age+Residence.Category + Marital.Status	Likelihood Ratio	117.5168	27	2.905454e-13
		Pearson	112.8703	27	1.810663e-12
4	Anaemia +Age+Residence.Category, MARRIED	Likelihood Ratio	28.02493	10	0.001788732
		Pearson	26.69308	10	0.002911784
5	Anaemia +Age+Residence.Category, Single	Likelihood Ratio	23.73791	10	0.008327285
		Pearson	30.89135	10	0.000611462
6	Anaemia +Age+Residence.Category + Educational.Level	Likelihood Ratio	176.1223	61	4.140022e-13
		Pearson	176.7012	61	3.409495e-13
7	Anaemia +Age+Residence.Category, Primary	Likelihood Ratio	18.76238	10	0.04338669
		Pearson	20.15357	10	0.02783321
8	Anaemia +Age+Residence.Category, Secondary	Likelihood Ratio	59.95216	10	3.700632e-09
		Pearson	75.72962	10	3.430256e-12
Residuals 175 217.10 1.2406 Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’					

APPENDIX L

Post Hoc Analysis between the Independent Variables and AIP

Variable	DF	Sum Sq	Mean Sq	F value	Pr(>F)
Age	5	73.839	14.7678	48.2788	< 2.2e-16 ***
Residence.Category	2	0.465	0.2323	0.7594	0.46866
Marital.Status	1	14.959	14.9589	48.9034	1.196e-11 ***
Educational. Level	3	9.600	3.1999	10.4611	1.247e-06 ***
Occupation	3	4.482	1.4940	4.8840	0.00241 **
Residuals	*385*	*117.766*	*0.3059*		

*Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

APPENDIX M

Contrast Post Hoc Analysis between the Independent Variables and AIP

Contrast	Estimate	SE	DF	T-ratio	P-value
Primary - College	0.421	0.0918	385	4.586	<.0001
Student - Housewife	0.329	0.0959	385	3.431	0.0037
Married - Single	0.392	0.0678	385	5.778	<.0001
(15-19) - (25-29)	0.6503	0.1127	385	5.769	<.0001
(15-19) - (30-34)	0.7169	0.1188	385	6.036	<.0001
(15-19) - (35-39)	1.1708	0.1495	385	7.834	<.0001
(15-19) - (40-44	0.8375	0.2463	385	3.401	0.0096
(20-24) - (25-29	0.4181	0.0780	385	5.359	<.0001
(20-24) - (30-34)	0.4847	0.0863	385	5.616	<.0001
(20-24) - (35-39)	0.9386	0.1254	385	7.483	<.0001
(25-29) - (35-39)	0.5205	0.1238	385	4.206	0005
(30-34) - (35-39	0.4539	0.1265	385	3.589	0.0050

Marital. Status, Educational. Level, Occupation, Age

P-value adjustment: Tukey method for comparing a family of 6 estimates