DETERMINANTS OF NON-COMPLIANCE TO IRON FOLIC ACID SUPPLEMENTATION DURING PREGNANCY. A CASE STUDY OF NYERI COUNTY, KENYA

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DECLARATION

I hereby declare that this thesis is my original work and has not been presented for a degree in any other University.

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This thesis is submitted with our approval as University supervisors

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DEDICATION

I would like to dedicate this work to my lovely Late father John Ng'ethe Mburu and my Mum, Irene Wangeci Ng'ethe for being the pillar of support and inspiration throughout my academic journey.

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ABSTRACT

In the World, a deficiency of iron is the most common nutrition disorder affecting more than 30% of the global populace more so children and women. Countries in the developing world are working in programs on implementing the Iron and folic acid supplementation although the effectiveness of curbing anemia is usually affected by non-compliance to iron and folic acid supplements by women who are pregnant. In Nyeri County, anemia among pregnant women has continued to rise. The purpose of the study was to determine the determinants of non-compliance to iron folic acid supplementation during pregnancy in Nyeri County. This was a mixed methods study. The study targeted pregnant women. A sample of 385 pregnant women were calculated using the modified formulae by Fisher. The study employed the use of a structured researcher administered questionnaire. Themes and patterns were derived from the qualitative data, categorized through content analysis and then tabulated. SPSS version 20 for windows was employed for data analysis. Descriptive statistics and chi-square tests were used to analyze the data which was presented in form of frequency and percentage tables, bar graphs and pie charts. The study found that Majority (56%) of the participants in the study indicated that they had at one time forgotten to take iron folic acid supplement (IFAS). The results showed that the bulk of the respondents (55%) had acceptable levels of hemoglobin (121 g/l and 150 g/l). Chi-square tests showed a significant relationship ($p=0.018$) between compliance to IFAS and prevalence of Anemia. About 53% of the respondents indicated that they were not aware of the benefits of IFAS. About 56% of the respondents indicated that they had not been counselled on the dietary sources of iron and folic acid. All respondents agreed that IFAS supplements were available at their health facility when they needed them. A greater number of respondents 80% indicated that the waiting time when getting IFAS supplements was high. Results showed that 66% of respondents indicated that they were informed about IFA Supplements and where to get them. In Nyeri County, the study found out that the prevalence of non-compliance in women who were pregnant was high. However, IFAS non-compliance did not contribute to child mortality. Mothers understanding on the benefits of IFAS was poor and generally, current health care support system for the IFAS program is good. The study recommends that pregnant women should be sensitized about the importance of complying to IFAS.

TABLE OF CONTENTS

DECLARATION.....Error! Bookmark not defined.
DEDICATION..... iii
ACKNOWLEDGEMENT..... iv
ABSTRACT..... v
TABLE OF CONTENTS..... vi
LIST OF TABLES..... ix
LIST OF FIGURES..... x
ABBREVIATIONS AND ACRONYMS..... xi
CHAPTER ONE: INTRODUCTION..... 1

1.1 Background to the Study..... 1

1.2 Statement of the Problem..... 6

1.3 Purpose of the Study..... 6

1.4 Main Objective..... 7

1.5 Specific objectives..... 7

1.6 Research Questions..... 7

1.7 Justification..... 7

1.8 Limitations of the Study..... 9

1.9 Delimitations of the Study..... 9

1.10 Significance of the Study..... 10

1.11 Assumptions of the Study..... 10

CHAPTER TWO: LITERATURE REVIEW..... 11

2.1 Introduction..... 11

2.2 Theoretical Framework..... 40

2.3 Prevalence Of Non-compliance Among Pregnant Women..... 41

2.4 Influence of Non-compliance to Child mortality..... 45

2.5 Mother's understanding on benefits of Iron and folic acid supplementation. 46

2.6 Health Care Systems and Non-Compliance To IFA Supplementation..... 50

2.7 Conceptual Framework..... 54

CHAPTER THREE: RESEARCH METHODOLOGY 55

3.1 Introduction..... 55

3.2 Research Design..... 55

3.3 Study site..... 55

3.4 Target Population..... 56

3.5 Inclusion Criteria 56

3.6 Exclusion criteria 56

3.7 Sampling Procedure And Sample Size 57

3.8 Data Collection 58

3.9 Data Analysis and Presentation 59

3.10 Ethical Considerations 60

CHAPTER FOUR: RESULTS AND DISCUSSION 61

4.1 Introduction..... 61

4.2 Socio-Demographic Characteristics of Respondents..... 61

4.4 Prevalence of IFAS Non-Compliance 64

4.5 IFAS Non-Compliance and Child Mortality..... 65

4.6 Mothers Understanding on Benefits of IFAs 67

4.7 Health Care Support System Factors 72

4.8 Relation between Variables 77

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS 79

5.1 Introduction 79

5.2 Summary 79

5.3 Conclusions 80

5.4 Recommendations 81

REFERENCES 83
APPENDICES 104

Appendix I: Informed Consent and Cover Page 104

Appendix II: Authorization Letters 108

LIST OF TABLES

Table 3.1 Sampling Frame 58

Table 4.1 Socio-Demographic Characteristics of Respondents 63

Table 4.2 Forgetting to Take Supplements 64

Table 4.3 Reason behind forgetting to take Supplements 65

Table 4.4 Hemoglobin Levels 66

Table 4.5 Relationship between Study Site and Prevalence of IFAS Non-Compliance .. 66

Table 4.6 Child Mortality 67

Table 4.7 Respondents Knowledge about the Benefits of IFAS 70

Table 4.8 Foods Mothers Advised to Take 72

Table 4.9 Relationship between Residence and Compliance to IFAS 78

LIST OF FIGURES

Figure 2.1 Anemia among Pregnant Women in Nyeri County 21

Figure 2.2 Conceptual framework 54

Figure 4.1 Mother counselled on IFAS 68

Figure 4.2 Mother Counselled on Dietary Sources of Iron and Folic Acid 71

Figure 4.3 Distance to Health Facility 73

Figure 4.4 Purchasing of IFAS 74

Figure 4.5 Perceived Costliness of IFAS 75

Figure 4.6 Waiting Time When Getting IFA Supplements 76

Figure 4.7 Respondent Informed About IFAS and Where to Get Them 77

ABBREVIATIONS AND ACRONYMS

ANC	Antenatal Care
HBM	Health Belief Model
IDA	Iron deficiency Anemia
IFA	Iron and Folic Acid
KDHS	Kenya Demographic Health Survey
KNBS	Kenya National Bureau of Statistics
MCH	Maternal Child Health
SPSS	Statistical Package for Social Sciences
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

When a woman is pregnant, it marks an important stage in her life and those close to her; this affects her directly and indirectly. An increase in iron and folic acid occurs owing to hormonal and physiological variations in her body (Siabani et al., 2018). Iron and folic acid dietary sources requirements must be provided through diet to meet the daily-recommended dietary allowances in pregnancy, which in some cases are usually insufficient from dietary sources (Bothwell, 2000) therefore women in developing Countries must be supplemented with iron and folic acid as a preventive strategy of anemia during pregnancy (Dinga, 2013). Subsequently, the body losses are unregulated. Dietary sources must contain foods of high biological value and must be taken with others that boost absorption as the body itself works on releasing iron from recycling hepatocytes and macrophages (Dev & Babitt , 2017) .

A deficiency of iron is among the most extensive nutrition disorder affecting higher than 30% of the global population(Miller, 2013). World Health Organization notes that 46.3% of the African region and globally 38.2% of pregnant women are anemic. Iron and folate deficiencies are the major risks facing the pregnant women. This is due to an increase in nutrient demands because of the developing fetus and increasing blood volume (World Health Organization [WHO], 2008a). During pregnancy, the developing fetus causes elevated demands of folate. Most abnormalities in both the mother and fetuses have been

linked with a deficiency of folic acid. The abnormalities include peripheral neuropathy, congenital abnormalities and anemia (Greenberg et al.,2011). There are drugs that inhibit absorption of folic acid or inhibit conversion of folate to its active form resulting to folic acid deficiency (Khan & Jialal, 2018).

There exist factors that affect compliance of supplementation of iron and folic acid. These include non-compliance to drug regimens, gastro intestinal side effects, frequency of side effects, fear of having big babies, insufficient service delivery, personal problems (Ibrahim *et al.*, 2011). Others are stock outs of drugs in the health facilities, in adequacy of counseling by providers of health services on the use and benefits of the supplements, low uptake of health care services, lack of information on the iron and folic acid supplements, inconsistence on anemia knowledge (Dinga, 2013).

Indirectly anemia is the main cause of high maternal and neonatal deaths, It is worth noting that when anemia prevalence in expectant mothers is above 40.0%, this brings about a severe public health concern (Okube et al., 2015) . Thus, The Government of Kenya has come up with strategies to deal with anemia which include supplementation of Iron and Folic acid, implementation of Focused Antenatal care even though they have encountered a few hurdles resulting to sub optimal coverage and low levels of compliance (Ministry of Health [MOH], 2013a).

In Kenya, government health facilities offer Iron and folic acid supplements freely to expectant mothers. However, the main problem is noncompliance to the supplements which now affects efficacy in fighting iron deficiency anemia this could be due to culture

issues, environmental factors, lack of awareness, personal behaviors, side effects, inadequate service delivery and social demographic status(Mithra et al., 2013).

The Ministry of Health in Kenya has come up with a policy that seeks to address the issues of behavior change and communication so as to improve iron and folic acid coverage and usage so as to achieve the national target of 80% coverage and 30% utilization of 90+ IFA supplements (MOH, 2013b). A National demographic health survey conducted in nineteen African Countries analyzing their datasets proposed that supplementation iron and folic acid in pregnancy for 90 days can bring about a significant reduction of neonatal mortality by 34% (Digssie et al., 2019).

A woman is considered anemic if the hemoglobin concentration levels in the initial three months or last three months of her expectancy is less than 110 grams per deciliter or if in the second trimester is less than 105 g/L (Shaw, 2012). This could be as a result of genetic traits such as sickle cell anemia, thalassemia, folic acid deficiency, iron inhibition in the diet or diet inadequacy, malaria which is common in the tropical areas and causes anemia as a result of hemolysis of both red blood cells which are infected or uninfected red blood cells and bone marrow dyserythropoesis which reduces the chances of rapid recovery from anemia schistosomiasis, Human immunodeficiency virus infection, some non-communicable diseases and Hook worm infections (Stevens, 2013 ; White, 2018)

In Anemia there are three causes of death and these include, excessive blood loss in the course of giving birth or after resulting to low hematological reserves (Kumari et al., 2017). Resistance of severe anemia could be reduced and infection vulnerability

augmented. Finally, a low hemoglobin concentration of below 4 grams per deciliter is linked to increased risk of congestive heart failure and fatality predominantly while delivery or soon after (Khaskheli, 2016).

Around the World, expectant women are the highest proportion of persons presenting with anemia contributing to 41.8% of anemia in the developing Countries. On average the prevalence of anemia in expectant women is about 18% in developed Nations. This is significantly below the average 56% in countries that are developing. In Asia and Africa the definite prevalence of anemia in expectant mothers is thought to be 48.2% and 57.1% whereas that of Europe and America is 25.1% and 24.1% correspondingly (Niguse & Murugan, 2018).

In a Kenyan study conducted by Dinga (2013), Women who took iron supplements during their last pregnancy for more than 90 days was only 8%, those who took iron supplements for 60-89 days was 5% and less than 60 days was 53% while some mothers 30% did not take the iron supplements at all. Forgetfulness (15.0%), abdominal side effects of iron supplements (41.7%), in ability to afford of iron supplements (28.3%), and others were reported as the main challenges of compliance to iron supplementation in expectant mothers (Ugwu, 2014)

Most Sub-Saharan African Countries including Kenya developed a Policy at the national level on deterrence and management of anemia during gravidity which directs the use of ferrous sulfate and folic acid. The endorsed prescription is 60 mg and 400µg of ferrous sulfate and folic acid respectively ingested every day for a total number of 180 days during pregnancy, if possible with food. This prescription normally comes as a combined

iron and folic acid tablet (MOH, 2013b). 28.5% of expectant women in Central Province hardly took any iron tablets or syrup during ante natal period, although 56.3% ingested for below 60 days, 2.6% ingested for 60-89 days and only 0.7% ingested for 90 days or more (Dinga, 2013). Anemia deterrence and control has been a challenge to most developing countries even though they have implemented programs for iron supplementation. However, some countries have shown significant enhancement in deterrence and control of anemia (WHO, 2012).

According to Ugwu et al. (2014), the unending high anemia prevalence in expectant women is linked to non-compliance of iron supplements. This underscores the need determination of the relationship between iron and folate supplementation compliance and prevalence of anemia in Nyeri County. The findings of this study will help the nutrition department strengthen the program and reduce anemia prevalence in the county. Several clinical trials done throughout the years they have repeatedly shown efficacy in supplementation programs though they have not shown reduction in incidences and prevalence of anemia when done at the community level (Taye et al., 2015).

The execution of a good plan in behavior change communication strategy to pass on information on the advantages of the interventions and treatment of side effects beside giving supplements of iron and folate is the key to improving compliance and acceptability of supplementation schemes. This approach could similarly be used to encourage the use of diversified diets and food consumption to improve iron absorption (WHO, 2012) there is also need to encourage knowledge on anemia as it improves compliance (Kamau et al., 2018)

1.2 Statement of the Problem

Iron deficiency anemia is a risk factor for perinatal and maternal deaths and morbidity and was estimated to have contributed to 115,000 of the 510,000 Maternal deaths (22%) and 591,000 of the 2,464,000 perinatal deaths (24%) occurring yearly around the globe (WHO, 2011a). In every 100,000 live births , 34 cases of maternal mortality occurs as a result of anemia (Helmy *et al.*, 2018). According to The World Health Organization 41.8% of women who are expectant globally are anemic. In Kenya, anemia prevalence is estimated to be at 55.1% accounting to about 10% maternal and 20% perinatal deaths (Kamau et al., 2018), 46.4% of non-pregnant women are anemic.

Kenya registered a very low proportion of pregnant women supplemented with iron and Folic acid in their pregnancy for at least 90 days in which about 2.5% were supplemented for more than 90 days while Nyeri County supplementation was low at 5.6% (Kenya National Bureau of Statistics [KNBS], 2014). According to KNBS and ICF Macro (2010), In Central Kenya where Nyeri County lies 56.3% of expectant mothers take Iron supplements for less than 60 days, 2.6% take for 60-89 days while as 28.5 % hardly take iron tablets during pregnancy. Data on non-compliance of iron and folic acid in Nyeri County is scarce and a study on determinants of non-compliance to iron folic acid supplementation during pregnancy was needed.

1.3 Purpose of the Study

The aim of this study was to establish determinants of non-compliance to iron folic acid supplementation during pregnancy in Nyeri County.

1.4 Main Objective

To evaluate the determinants of non-compliance to Iron and Folic Acid Supplementation among pregnant women in Nyeri County.

1.5 Specific objectives

i. To determine the prevalence of non-compliance with IFAS among pregnant women in Nyeri County.
ii. To determine if IFAS non-compliance influences child mortality
iii. To assess the level of knowledge on IFAS among pregnant women in Nyeri County.
iv. To investigate the health system factors affecting the IFAS Program

1.6 Research Questions

i. What is the prevalence of non-compliance with IFAS among pregnant women in Nyeri County?
ii. Is there an association between IFAS non-compliance and child mortality?
iii. What is the level of knowledge on IFAS among pregnant women in Nyeri County?
iv. What are the the health system factors affecting the IFAS Program?

1.7 Justification

According to WHO (2008a), Anemia affects around 32 million pregnant women globally and more than 50% of all expectant women are in low and middle-income Countries.

There are limited studies on non-compliance to iron and folic acid supplementation around Central Kenya and more specifically Nyeri County. A study conducted by Dinga in 2013, Central Province 28.5% of pregnant women do not take any iron tablets or syrup during pregnancy, while 56.3% take for less than 60 days, 2.6% take for 60-89 days and only 0.7% take for 90 days or more. Kenya registered a very low proportion of pregnant women supplemented with iron and Folic acid in their pregnancy for at about 90 days in which about 2.5% were supplemented for more than 90 days while Nyeri County supplementation was low at 5.6 % (KNBS, 2014).

Iron Deficiency Anemia (IDA) is among the most predominant diseases impacting on expectant women in countries that are developing with more than half of the pregnant women suffering from it. Expectant women are particularly prone to iron deficiency due to increment to nutrient requirements prenatally (WHO, 2014). Folic acid deficiency on the other hand can bring negative outcomes like peripheral neuropathy, megaloblastic anemia, depression diarrhea and mental confusion (Priya et al., 2016). Accordingly supplementation of iron and folic acid is a documented interventional approach for control of anemia in mothers who are pregnant.

In line with World Health Organization guidelines Kenya has implemented the program of iron and Folic Acid supplementation as an intervention to deal with anemia in pregnant women as a highly beneficial intervention meant to particularly address anemia in pregnant women with an aim of achieving 80 per cent coverage by 2017 . In Kenya, The anemia prevalence stands at 55.1% accounting to about 20% perinatal and 10% maternal deaths in spite of efforts to prevent and control anemia (Kamau et al., 2018).

The study outcome will help the health facilities, the County government and the ministry of health to have an in-depth understanding of compliance of supplementation of iron and folic acid hence inform on policy and how to improve the program. The participants will also benefit from the study as the results will highlight the determinants of compliance that can then be addressed hence reducing anemia in the County. Compliance to iron and folic acid prenatally is deliberated as fundamental to prevention and control of folate and iron deficiency anemia. This is the motivation behind this study which pursues to establish determinants of Non-compliance to iron and folic acid supplementation among expectant mothers.

1.8 Limitations of the Study

The study is limited to the accuracy of recall and truthfulness of participants in the study. The descriptive survey is a limitation as it can only establish association but not causation between variables. The study was time bound, as it had to be in line with researchers' university's academic calendar. The researcher conducted the study in the major level 4 facilities and level 5 facilities in Nyeri County.

1.9 Delimitations of the Study

The researcher conducted the study in Antenatal clinics in the level 4 and 5 health facilities in the county hence easier access to mothers taking supplements of Iron and Folic acid.

1.10 Significance of the Study

Iron and folic acid are micronutrients of public health concern. If pregnant mothers complied with the drug regime they can help reduce the prevalence of anemia and cases of spina bifida in the population. The study findings provide information on non-compliance and this will help to formulate policies and programs aimed at lowering the risk of anemia in Nyeri County. The information obtained will also be useful in persuading the pregnant mothers on the importance of complying with the drug regime. Other stake holders that would benefit from the results are Ministry of Health and the County government of Nyeri.

1.11 Assumptions of the Study

In conducting the research the researcher hoped that the targeted individuals were pregnant were willing and available to participate in the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Prenatally, anemia can be as a result of various reasons and contributing factors that range from socio economic factors, abnormal demands, numerous pregnancies, under nutrition, maternal illiteracy, lack of employment opportunities, teenage pregnancies, short pregnancy intervals, gestation age, primi gravidas, multi gravidas and Hyperemesis gravidarum during pregnancy (Boti et al., 2018; Helmy et al., 2018)

In expectant mothers, concentrations of hemoglobin below 11g/dl in blood or hematocrit $< 33\%$ during the 1^{st} and 3^{rd} trimesters and hematocrit levels below $< 32\%$ in the 2^{nd} trimester is usually defined as anemia in pregnancy. This low hemoglobin concentration declines oxygen ferrying volume of the blood to the tissues (Asmare, 2016; Auerbach, 2018). The essence of adequate hemoglobin concentration in pregnant women cannot be over emphasized. Being important for the fetus and the mother's oxygen. A below normal can be detrimental to both (Okube et al., 2015;)

A review by World Health Organization (2016), found out that most data on prevalence of folic acid and cobalamin deficiencies are gotten from relatively small local studies although, these and national surveys from a few countries suggest that deficiencies of these two micro nutrients could be a public health concern and could be affecting millions of people around the World (WHO, 2008b)**.**

Anemia in pregnancy increases the risk of low birth weight and prematurity in the first and the second trimester (Sing et al., 2014), A deficiency of iron is the most prevalent nutrition condition facing slightly above 30% of the population in the globe; the condition is more prevalent in women and children. Expectant mothers are at predisposed to iron and folic acid insufficiency due to an increase in nutrient demands due to developing fetus and increasing blood volume (WHO, 2008b). Although the main deficiency of iron is Anemia, it is rarely coming in isolation. In most cases it occurs with additional causes like malaria(MOH, 2013a) where more than six types of malaria parasites are responsible for causing malaria disease which can be attributed to maternal mortality and advanced disease as a result of the parasite plasmodium falciparum (White, 2018).In addition, helminthes infection, nutritional deficiencies (including Vitamin B9, Vitamin A and B12, and hereditary or assimilated conditions that interfere with hemoglobin production, erythrocytes production or survival of red blood cells (MOH, 2011).

A woman is considered anemic if she has a hemoglobin concentration < 110 g/L throughout the last three months or the initial three months of gravidity, or in the second trimester a hemoglobin concentration of below 105 g/L (Shaw, 2012). A deficiency of iron comes about as a result of inadequate iron, insufficient iron in the human body, and the body's loss of iron and cannot sustain production of red blood cells in the body, the condition is rarely fatal, but the effect on an individual’s health is significant (Miller, 2013).

According to the Center for Disease Control and Prevention(CDC), hemoglobin concentrations below 11grams per deciliter is regarded as anemia in the third and first trimesters or below 10.5 g/dl in the 2nd trimester (Siabani et al., 2018). Anemia in pregnancy is related to diseases and fatalities of the expectant mums and the fetus, threat of delivering low birthweight neonates, prematurity miscarriages and stillbirths. It damages learning capacity and development of children's additionally impacting on development and economic productivity (Birhanu et al.,2018).

During pregnancy expectant mothers are the most venerable to a deficiency of iron and folate as their biological needs of iron go up and the quantity of iron supplied from the foods is never adequate to meet the iron needs for the sustaining of the pregnancy (Agegnehu et al., 2019; Miller, 2013) . However, the plasma enlargement being augmented in the second trimesters, the foods consumed cannot meet the needs of the two elements because of the elevated needs which leads to Iron deficiency anemia (Taye et al., 2015). In pregnancy anemia brings about poor mental growth, impaired immunity, below average work capacity and low birth weights (Asmare, 2016; Mithra et al., 2013; Okube et al., 2015)

Folic acid deficiency comes from several causes that include not getting enough folate from dietary sources, poor food preparation methods that makes it to be destroyed during cooking.(MOH, 2013b) Folate in the gastro intestinal tract is assimilated in the large intestines by passive and active transport mechanisms inside the intestinal wall (Khaskheli et al., 2016). Therefore, gastro intestinal diseases such as, amyloidosis, short bowel syndrome, celiac disease, mesenteric vascular insufficiency and tropical sprue

gastric bypass or can hinder folic acid assimilation bringing about a deficiency (Khan et al., 2018)

According to World Health Organization, 41.8 per cent of expectant mothers around the globe are estimated to be anemic to which at least 50 per cent of this anemia burden is assumed to be as a consequence of iron deficiency with the rest owing to diseases like folate, cobalamin or a deficiency of vitamin A, prolonged inflammation, inherited disorders and parasitic infections (Taye et al., 2015) Helminthes infections are a major contributory factor to anemia prevalence in Kenya and promoting ingestion of dewormers during pregnancy is a cheaper method against intestinal worms so as to facilitate improved assimilation of nutrients thereby decreasing the anemia prevalence. (KNBS, 2014).

In Asia, 12.8% of maternal deaths are as a result of anemia (irrespective of severity) and not considering the deaths due to post-partum hemorrhage. Additionally, about 20% of the deaths of expectant mothers are as a result of anemia and with anemia as an additional risk factor it accounts to around 50% of all maternal deaths (Khaskheli et al., 2016). Supplementation of iron and folate is the preferred approach in prevention of iron and folic acid deficiency in expectant mothers to help boost maternal and foetal outcomes as its plays an integral role in development of a normal spinal column, brain, and skull of the foetus (WHO, 2011b) Folic acid likewise helps to cater for the pregnant woman's increasing blood volume and developing fetal and maternal tissues (Taye et al., 2015)

A study done in Nepal (2016), found out that supplements of iron and folic acid taken prenatally significantly decrease the adjusted risk of stunting by 14% as likened to pregnant women who hardly use the prescribed regimen. There has been increased efforts to promote uptake of IFA supplements in Kenya although this has not shown increase in compliance of IFA supplements, the high impact nutrition interventions geared towards addressing poor compliance needs to be boosted (Kamau et al., 2018).In Kenya, development of tools for communication has been done by Ministry of Health and these include information education and communication (IEC) materials in an effort to create public awareness on supplementation Iron and folic acid. There exists a policy document and guideline that was developed in the year 2013 and is usually displayed in most health facilities to address the most frequently asked questions concerning the iron and folic acid supplements. a key preventive strategy is meant to decrease mortality of women by 50% through extermination of pregnancy anemia (Okube et al., 2015).

2.1.1 History of Anemia in Pregnancy

Iron plays an integral role in the human body where it helps in various functions that include electron transport, cognitive function, it's a constituent of myoglobin which plays an important part is serving as a store of oxygen to the muscles, plays a part in the synthesis of hormones and neurotransmitters and is also a component of various enzymes that are essential in metabolism of fatty acids and glucose for energy and strengthening the immune system (Asmare, 2016). Oxygen transport and deoxy ribose nucleic acid synthesis, growth of the cells and differentiation, binding of oxygen gas, ferrying and storage, reactions of enzymes, physical and mental growth (Kumari et al., 2017).

In developing Countries anemia is among the most prevalent diseases with a prevalence of (43%) than in developed countries (9%) and the prevalence varies in mothers from various social economic backgrounds, different cultures, health seeking behaviors and lifestyles (Lin et al., 2018). Prehistoric human remains more so the skeletal structure frequently show minute holes in the dense external covers of the human skull accompanied by broadening of the diploe, what is medically termed as porotic hyperostosis, they look like the bony outcomes in hereditary anemias nonetheless is wide-ranging in parts like as America on the Northern and Europe on the Northern sides someplace heritably determined anemias are unusual suggesting that anemia was prevalent with the early man. (Poskitt, 2013). Mr. Herman Nasse a German physician in the year 1836 was the first person to accurately describe anemia in pregnant women, previously it was thought that anemia and folate deficiency were the same condition (Dinga, 2013).

In the year 1842 there was a description of a condition that was severe, fast, progressive and sometimes a fatal form of anaemia. In India, a researchist by the name Lucy Wills noted that the feeding habits of mothers with prematures' was deficient of a vitamin that would later be known as folic acid. Isolation of folate was done in 1941 from spinach leaves and later synthesized in the year 1946 (Erbe et al., 1984)

2.1.2 Physiological Needs of iron and Folic acid in Pregnancy.

An expectant mother is said to have anemia if hemoglobin levels in the blood is less than 110g/L at sea level (WHO, 2011a) it's worth noting that in the 2nd trimester hemoglobin concentrations reduce considerably by around 5g/L even though hemoglobin and

hematocrit tests are taken for screening they are not explicit to deficiency of iron (Peña et al., 2015). During pregnancy the physiological needs of folate and iron needs are highest and the demands of the two micronutrients in the diet is not adequate to cater for the needs of the fetus and the mother (Taye et al., 2015) because of this insufficiency in the diet folate and iron deficiency brings about an disproportion between supply and demand which results to anemia.

In Kenya, deficiencies of micronutrients including folate and iron are highly prevalent at this critical stage of the life chiefly prenatally which could bring damaging effects to the growing fetus and the mother intra uterine or after. (Kamau et al., 2018)The blood plasma volume goes up from 25% to 80 % in a normal gravidity(Lin et al., 2018) the plasma rise starts from around the sixth week of gravidity and continues until the sixth month from which there is slower increase. (Miller, 2013) , further studies have suggested that plasma volume rises in multigravidas, by the fact that their newborns weigh more than those who are carrying pregnancy for the first time.

Soma-Pillay et al. (2016) note that a pregnancy causes a 2-3-fold rise in iron requirement, not only for hemoglobin synthesis but also for the fetus and the production of certain enzymes. There is a ten- to twenty-fold upsurge in folic acid needs and a 2-fold rise in the requirement for cobalamin. Iron needs during pregnancy increases intensely to cater for the expanding red blood cells volume, the placenta and the growing foetus and including foreseen or unforeseen hemorrhage during delivery. this is a clear indicator if the foetus will be delivered surgically(Bothwell, 2000)

Studies have suggested that per day iron needs go up from0.8, 4.5 to 6 mg/day in the first trimester, second trimester and third trimester, it is likely that the needs of iron prenatally may go well above 1000 mg, with 500 mg catering for expansion of the erythrocytes, 300–350 mg being required for the placenta growth of the foetus, with some losses catering for the delivery period (Auerbach, 2018) to prevent conditions like puerperal sepsis, birth of premature's, and low birth weights ingestion of iron and folate tablets with 60 mg of elemental iron and (0.4 mg) 400 g of folate is recommended for expectant women (WHO, 2016).

2.1.3 Iron and Folic Acid Metabolism

Iron is a transition metal that willingly accepts and donates electrons in which the oxidation reduction processes occur in many of the fundamental biological processes(Milman, 2011) Iron is a trace mineral which plays a vital role for fetus development and growth, it forms part of the erythrocytes whose function is to carry oxygen around the body. Folic acid on the other hand is essential for normal neural development and is used for synthesis of deoxy ribose nucleic acid during organogenesis(Agegnehu et al., 2019).

Iron is merged with proteins as a component of heme these include hemoglobin, cytochrome and myoglobin, myeloperoxidase, proteins, nitric oxide synthetases or other functional groups like hypoxia inducible factor proxyl hydroxylases. These proteins are mainly made of iron are central for functions of the cells and organisms like xenobiotic metabolism, respirations of the mitochondria, cell signaling, oxygen transport, replication of nucleic acid and repair, host defense and signaling of the cell (Dev et al., 2017)

Iron deficiency anemia occurs in stages where in the first stage also called depletion of iron, the stores of iron are usually decrease and serum ferritin levels becomes low. In the next phase deficiency of iron erythropoiesis transpires when stores of iron are exhausted and the human system becomes unable to absorb iron effectively (Dinga, 2013).after ingesting iron this causes an elevated serum hepcidin causing reduced absorption suggesting further reduced effectiveness. Studies have proposed that iron when taken intravenously is harmless and efficient in the second trimester and the last three months of gravidity(Auerbach, 2018)

Iron is bound by transferrin in the blood circulation as a result it is ferried to the bone marrow for erythrocytes development, with a little quantity being taken to others tissues for other activities of the cell and the remaining ferried to the liver for storage. Iron recycling is predominantly maintained by systematic iron homeostasis from the erythrocytes through macrophages in the reticuloendothelial region. Little quantities of iron is provided by food absorption through enterocytes of the duodenum which are coordinated by an unregulated loss of iron via hemorrhage and desquamation (Dev et al., 2017; Lin et al., 2018;Miller, 2013). Folic acid must be well metabolized in the body as an association has been established between blood folate concentrations in pregnant women and dangers of placental abruption and delivering infants that are small for gestational age and premature(WHO, 2008b).

2.1.4 Etiology and Diagnosis of Iron Deficiency Anemia and Folic acid Deficiency

The etiology of iron deficiency anemia (malaria prevalence and haemoglobinopathies) and prevalence of risk factors is required at the National level to advice on choices that

are context specific to the adaptations. This will also help in surveillance systems, monitoring and evaluations (WHO, 2016). A haemoglobin of 110g/L in the first and the third trimesters is a cut off for anemia ,the threshold is 105g/L(Dinga, 2013)(Auerbach, 2018) When a woman has been regarded as anemic while expectant she should take 120 mg of elemental iron till her hg levels reach the normal ranges (Hb 110g/L) or higher. Pregnant women with anemia are susceptible to diseases and fatalities in developing Countries, outcomes with moderate form of anemia are asymptomatic (Khaskheli et al., 2016) severity in anemia presents with symptoms like lethargy, drowsiness, athenia and dizziness some other forms of symptoms include change of color in fair skinned individuals and also in nails, tongue and lips (Abdullahi et al, 2014), pallor of the skin and eyelids (MOH, 2013b).

In evaluation of a diagnosis of anemia two steps are involved and these include the clinical profile of the patient (intolerance of exercise, general malaise, irritability and fatigue of varying degrees, headache, blood diseases in the family history, incidence of bleeding and evaluation of the serum(Helmy et al., 2018).A deficiency of iron in pregnant women precedes anemia. Additionally, even when anemia is not there significant morbidity has been shown in an insufficiency of iron.

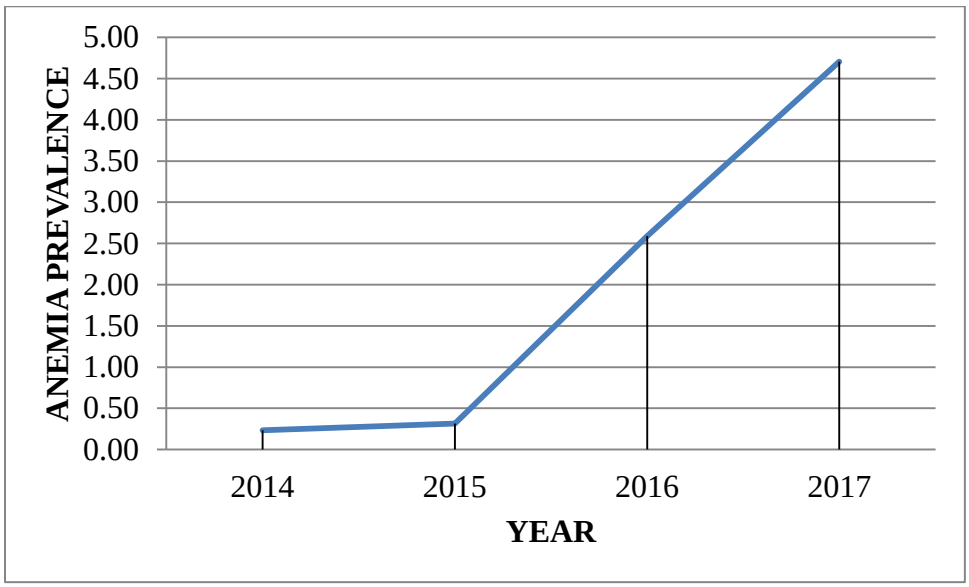
IDA cannot be detected by screening alone. Where there is heavy vaginal hemorrhage coupled with an inadequacy of iron at the early stages of pregnancy the chances of preterm labor goes up fivefold. The mothers who are iron deficient regardless of anemia are prone to delivering neonates who are iron deficient(Auerbach, 2018) Transferrin receptor circulating concentrations in the blood has been found to be normal in pregnancy

and increase has been noted in iron deficiency anemia. This concludes that serum transferrin receptor concentrations may be an important method in diagnosing iron deficiency anemia in pregnancy(Bothwell, 2000).

Despite the determinations made by the national government to lessen anemia burden by enhancing consumption of Iron and Folate supplements, anemia remains a public health concern. In Nyeri County the anemia among pregnant women has continued to rise as shown in the Figure 2.1 below

Figure 2.1

Anemia among Pregnant Women in Nyeri County



Source: Nyeri County data on District Health Information Software (2020)

A deficiency of iron is common in expectancy and is often linked to adverse implications both in the foetus and in the mother. The expectant woman may be overwhelmed by easy

fatigability, general malaise and difficulty in breathing, while the foetus could be be faced by an elevated risk of being born preterm and death (Juarez-Vazquez et al., 2002). Perinatal asphyxia and complications in preterm deliveries are the common causes of early neonatal fatalities (Engmann et al., 2012).

Studies suggest that plasma homocysteine is a strong predictor of folic acid and cobalamin status. elevated plasma homocysteine is thought to have negative effects on pregnancy though no direct correction such as pre-eclampsia, preterm delivery and low birth weight(WHO, 2008a), In ensuring that there are best outcomes in pregnancy, pregnant women should be counseled during the ante natal clinics and dietary advice given. At the 28^{th} week of gestation a full blood count should be redone to screen for iron and folate deficiency, an extra test of hemoglobin levels should be redone for expectant women who are at high risk and multiple pregnancies (Okube et al., 2015)

2.1.5 Non nutritional causes of Iron and Folate Deficiency Anemia.

The malaria parasite namely plasmodium falciparum which is a protozoon is known to cause malaria in human beings as it causes the red erythrocytes to rapture and by suppressing their production(Dinga, 2013). In areas some areas where the virulent parasites plasmodium falciparum and plasmodium vivax are prevalent, they cause anemia in pregnant mothers, growth retardation in the foetus and risk of foetus being born before term. The fetus begins to develop at a disadvantaged stage having a low levels of hemoglobin(White, 2018).

In pregnancy helminths infestations especially schistosomiasis and hook worms are a serious contributing factor to anemia. they cause blood loss therefore increasing the risk of anemia. There is need to evaluate the role of hemoglobinopathies to understand the preventable cause of anemia(Ouédraogo et al., 2012) In most of the developing Countries there are multifactorial causes of anemia and these include iron deficiency, malaria, Hiv infection, folate and vitamin B12. It is worth nothing that 75% of anemia in pregnancy is caused by iron deficiency(Okube et al., 2015).

There are drugs that inhibit iron absorption by impairing enterocyte iron uptake and these include phosphates binders, antacids, elevated hemorrhage from hemodialysis, frequent canulation and platelet dysfunction as a result of uremia in patients with kidney failure (Dev et al., 2017).The supplementation of iron in developing countries remains low since women who are pregnant do not attend antenatal clinics or do not get enough doses for the supplements of iron and folate or simply because the health workers do not emphasize on the need of supplement use, poor access, poor utilization of antenatal health care service, insufficient IFA supplements, inadequate counseling on anemia, and myths and misconceptions on iron and folic acid supplements (Stevens et al., 2013). Nevertheless, many studies suggest that compliance to IFA supplements is the major cause of ineffectiveness of iron and folic acid deficiency program for control and prevention of anemia (Agegnehu et al., 2019)

A deficiency of folic acid can occur if someone is born without the enzymes that are responsible for the metabolism of folate and that could lead to a deficiency it could also occur due to a deficiency of cobalamin due to a deficiency of methionine synthase

consequential in the trapping of folate as methyl tetrahydrofolate in which methylene gathers in serum causing to folate trap phenomenon and augmented urinary excretion of folate. Alcoholism is a noteworthy cause of folic acid deficiency. Gravidity, hemolytic anemia, and dialysis can also result in folate deficiency (Gebreamlak *et al.*, 2017; Khan, 2018; MOH, 2013a).

Underlying conditions should be treated and clients dewormed as a preventive measure for preventive therapy, iron and cobalamin play a vital part in embryogenesis and deficiencies could bring about congenital deformities. Recognizing the source is crucial to management. To avert anemia in the neonates, omphalotomy should not be delayed during child birth (by 1-2 min)(Okube et al., 2015).

Reduced consumption of IFA supplements during gravidity has been significantly related to socio demographic factors and these include, maternal age of 45 years and above, no maternal education, uneducated husband, no use of ante natal care services, specifically, a mother who was educated are some of the factors that were associated with compliance (Asmare et al., 2016).

2.1.6 Nutritional causes of Iron and folate deficiency Anemia

The major cause of anemia in expectant mothers is incompatibility between needs and ingestion, it is projected that 20% and 80% of women in various countries suffer from anemia during pregnancy(Siabani et al., 2018),rapid growth in young girls , inadequacy with diet and loss of iron during menses are the other blood losses including gastrointestinal bleeding as a result of helminthes, duodenal or peptic ulcers, non

steroidal anti-inflammatory drugs like aspirin, malignancy and gynecological issues(Boti *et al.,* 2018). Iron deficiency anemia comes in as a result of pathological or physiological causes and affects mental and physical growth and development reducing the capability of learning and work productivity.(Getachew et al., 2018). Malabsorption is one of the causes for inadequate dietary assimilation which is among other contributing causes to iron deficiency anemia. Other conditions that cause Malabsorption include helicobacter pylori, colonization protein pump, hydrogen antagonists, celiac disease, gastric resection(Dev et al., 2017).

2.1.7 Iron and Folic acid requirements during Pregnancy

Anemia caused by iron deficiency happens as a result of increased requirements during pregnancy whereby the demand for iron cannot be met by diet(Agegnehu et al., 2019), this is because some foods that the pregnant mother takes inhibit iron absorption and these inhibitors include calcium, zinc, or magnesium, phytates, tannins and the inability to absorb iron as a result of damaged intestinal lining(Dinga, 2013)

Iron requirements during pregnancy increases remarkably through with variations in the trimesters.(WHO, 2008a) however, the demand for iron decrease during the first trimester as a result of cessation of menstruation which epitomizes a median saving of 0.56 mg Fe/d (160 milligrams/expectancy). There is an iron requirement opening that must be bridged during this critical stage which are from the body through the gastrointestinal tract, integumentary system, and urine, which total to 0.8 mg/d in a 55-kg female (14 $g•kg^{-1}•d^{-1}$or 230 milligrams /expectancy)(Bothwell, 2000)**.**

Averagely, more iron needs to be absorbed throughout the pregnancy with an additional 6 milligrams /day. The foetus retains around 600 milligrams, 60 milligrams is reserved by the placenta which is also used for the making of extra maternal erythrocytes (450 milligrams), about 200 milligrams of iron caters for post-partum hemorrhage and the mothers increased red cell mass parturition (Bothwell, 2000; Scott et al., 2014). In pregnancy the iron needs are between 800 and 1000 mg depending with the size of the mother (45-55kg). the extra needs arise during the second trimester of the expectancy(Stevens et al., 2013).

In an Indonesian study by Dibley et al., (2012), the prevalence of Iron and folic acid supplement was low at 38% in the intake of the iron and folic acid supplements in their previous pregnancy, in which slightly above a third of the pregnant mothers consumed below 60 supplements during their expectancy. It's interesting to note that mothers who are expectant and received counseling on importance of IFA supplementation are more expected to be compliant to than their counterparts who did not(Getachew et al., 2018)

2.1.8 Significance of Iron deficiency Anemia

Anemia related to pregnancy prevalence globally extents from 41.8 to 43.8% making it to about 59 million expectant mothers. Africa has the highest burden (61.3%)) closely followed by south east Asia (52.5%).this translates to every second expectant woman being anemic in the developing countries (Kamau et al., 2018). In 2013,3.0 million neonatal and maternal deaths in the developing countries occurred. This was an important contributor to overall deaths globally. Further, it is projected that 90 000 fatalies in both male and female and all age groups are as a result of a deficiency of iron alone (WHO,

2011b) a protozoa Plasmodium falciparum, a malaria parasite brings about anemia in expectant mothers. The virulent form of human malaria is caused specifically by a parasite known as Plasmodium falciparum protozoan. This protozoa brings about bursting of erythrocytes and suppresses their production(Dinga, 2013). However, a noteworthy contributor is the improved annihilation of non-parasitized erythrocytes that because severity of the disease. It is anticipated that the loss of unparasitized erythrocytes are around 90% of the insignificant form of anemia coming from one infection, the parasite in the blood of plasmodium falciparum essentially go above 1% of parasitized erythrocytes and in severe disease it could surge above 10%(White, 2018).

A deficiency of iron is typically characterized by a flaw in hemoglobin synthesis, causing microcytic and hypochromic erythrocytes. This could be as a result of a hemorrhage, diet that is inadequate in iron or iron inhibitors in foods, or increased physiological needs (Getachew et al., 2018; Scott et al., 2014). The anemia prevalence in the World varies depending on different factors that include poor dietary habits, social economic status, multi gravidas, low contraceptive prevalence, infections, taboos, and with all these haemoglobinopathies are added contributors (Miller, 2013).

Iron deficiency anemia is linked adversely to pregnancy outcomes more so with an increased risk of placenta Previa, premature rapture of membrane, maternal low weight gain, premature labor, cardiac arrhythmia, blood losses, reduced immunity to disease, reduced mental development and work capacity is reduced (WHO, 2011b; Birhanu et al., 2018). Likewise, anemia of iron deficiency on the foetus and neonates are aggravating a of risk of births prematurely, fetal impairment, low APGAR score, low birth weight, intra

uterine growth restriction, fetal distress which could consequently bring about the perinatal morbidity and deaths (Kassa *et al.,* 2019; Okube *et al.,* 2015).

A deficiency of anemia in expectant women is linked to perinatal blood losses, high risk in blood transfusion, increased risk for caesarian section, pre-eclampsia, impaired wound healing, abruption of the placenta, maternal thyroid status which are abnormal and heart failure and mortality (Auerbach, 2018). Consumption of Iron and folic acid supplements in expectancy upsurges the hemoglobin concentration but most expectant mothers continue being anemic, this could be attributed to issues of compliance and irregular intake of IFA supplements (Ibrahim et al., 2011) Increased knowledge on iron and folic acid in expectant mothers coupled with information on anemia and their relationship are associated with better compliance(Kamau et al., 2018).

IFA supplements significantly reduce the threat of children being stunted below the age of two years. The highest threat reduction was shown with timely initiation within 6 months of age or with usage of ≥90 Iron and folic acid supplements intra uterine(Sing et al., 2014). Iron deficient neonates present with delayed milestones as well as notable increment in behavioral and cognitive challenges which occurs after iron is depleted as shown by current studies (Auerbach, 2018; Asmare, 2016). Lowered oxygen to the human tissues could be as an outcome of iron deficiency and the presentation of the condition include fatigue, fainting, apathy, pallor, breathlessness. some of the other symptoms include palpitations, hair loss, and tinnitus(Dinga, 2013). If the deficiency lasts for a long time it lowers the quality of life, productivity and decreases the work tolerance (Okube et al., 2015).

Advance degree of anemia causes cardiac failure(Abu et al., 2015) this is because iron is the most abundant transition metal in the brain essential for sustaining elevated respiratory activity for melanogenesis and for the synthesis if several neurotransmitters the likes of dopamine and norepinephrine. Iron overload in the brain is a major cause of neurodegenerative disorders(Dev et al., 2017)Several studies have concluded that notable morbidity from iron deficiency may arise even when anemia is absent. It's worth noting that iron deficiency precedes anemia. Some of the foetus sequelae are delayed milestones and abnormalities with serious consequences on brain programming, neurotransmitters programing and myelination (Auerbach, 2018). In pregnancy, severe anemia (hemoglobin less than 7g/dl) calls for urgent medical intervention and Hb below 4g/dl should be addressed immediately bearing a likelyhood of sepsis, congestive heart failure and death(Okube et al., 2015).

2.1.9 Significance of Folic acid deficiency

In Kenya, Folate prevalence among the pregnant women stands at 32.1% and 30.9% in non-pregnant women, however, there was a slight difference in prevalence in pregnant women whereby women who resided in urban areas had a prevalence of 25.0 as compared to a prevalence of 36.0 in women who reside in rural areas (MOH, 2011). According to Gebreamlak et al. (2017), the biggest population of women with anemia is in Africa followed by South and Southeast Asia. Iron deficiency anemia brings about unfavorable effects on motor and cognitive development, body malaise and reduced productivity. When it occurs during expectancy it may be coupled with low birth weight and elevated threat of maternal and perinatal fatalities (Okube et al., 2015). In chronic

kidney disease patients, anemia is connected to lower quality of life and an elevated threat of various consequences that include cognitive impairment, cardiovascular disease, hospitalization and death(Dev et al., 2017).

Anemia that is severe is connected to increased threat of infant and maternal deaths. Almost half of anemia in expectant women is related to lack of iron supplementation though this could be lower in areas where malaria is endemic. (Milman, 2011; Ouédraogo et al., 2012) Iron deficiency also depletes the energy reserves in the muscles therefore affecting physical functions and work output, the deficiency also lowers the immunity and increases morbidity as a result of infections (WHO, 2016). Folic acid serves an important function in growth and development of the foetus and also being a cofactor in the homocysteine metabolism including non-proteinogenic , α-amino acid to methionine (essential amino acid) and biosynthesis of nucleotides. Methylation process of deoxy ribose nucleic acid (DNA) involves the essential amino acid methionine, proteins and lipids with the synthesis of the final product which is homocysteine(Dinga, 2013)

Anemia caused by cobalamin and folic acid is usually not common globally, and a measure of increased mean blood cells volume in a complete blood count (CBC) signifies a deficiency(WHO, 2008a). Neural tube anomalies and other defects such as clefts of the face, preeclampsia, miscarriages, death of the foetus, delayed milestones, birth of prematures are consequences of folate deficiency in conception (Kassa et al., 2019)

Folic acid deficiency in expectancy is linked to macrocytic anemia, congenital malformations and birth of low weight neonates of less than 2500gms (Siabani et al., 2018) these occurs during embryogenesis as a result of a defect in neurulation a process

that takes place in 21st to 28th day after conception, before the woman even realizing she is pregnant (Nisar et al., 2016). Studies have suggested that intake of folic acid supplements or iron and folic acid supplements three months before neurulation can reduce the threat of neural tube defects by 75%(Siabani et al., 2018).

There is a noteworthy positive implication with the consumption of iron and folic acid supplements during intra utero and infants birth weight, every year it is projected 20 million neonates are born with low birth weight. Child stunting reflects linear growth as a result of restricted growth due to poor dietary consumption and recurrence of infections pre and post child birth (Seck et al., 2008). In adults, studies have suggested that low folic acid status is connected to impaired cognitive function and in some cases dementia although evidence for beneficial results for supplementation with folate is inconsistent. Low serum or erythrocytes folate concentrations is associated with a longer duration of depression(WHO, 2008b).

2.1.10 Strategies to address Iron and Folic Acid deficiency

The Ministry of Health in Kenya embraced the World Health Organization guidelines on iron and folic acid supplements to expectant mothers. IFA supplements are given country wide in all health facilities operated by the National government, county Governments, Non-Governmental Organizations, church, mission, private sector and community based organizations(MOH, 2013b). The Ministry has also employed other approaches to deal with anemia in pregnancy and these include nutrition education to focus on intake of diets that are rich in bioavailable iron and control of helminthes (WHO, 2006), Fortification of

foodstuffs and IFA supplementation are best approaches to deal with adverse effects of pregnancy outcomes(Kassa et al., 2019).

A deficiency of folate has been noted in about 5% of all anemia cases, a recommended dose of 5 mg oral folic acid should be given to correct anemia. If a patient presents with cobalamin deficiency, 250ug cyanocobalamin is administered parenterally every week is recommended. In the event there is severe anemia near term a daily cobalamin dose of 100ug should be given for a week (Okube et al., 2015). Giving information to pregnant women on diet, healthy living, IFA supplements adherence and compliance is an important strategy in effective communication(Dinga, 2013) Complying to IFA supplementation is vital to preventing and treatment of anemia amongst expectant women whose iron needs soars up in the second trimester and the last three months of gravidity.

2.1.10.1 Dietary sources of Iron and Folic Acid

An important way to deal with folic acid intake is to promote the intake of foods that are high in the micronutrient, advocating on programs that promote the consumption of such foods and identification of local food sources encourage their use (WHO, 2008a). The extent in which the elevated requirements of iron needs can be addressed varies on the amounts of stores of iron at the early stages of expectancy and the dietary provisions of iron during pregnancy(WHO, 2012), iron deficiency anemia mostly comes in during pregnancy as a result of high physiological adaptations whereby the increased needs are not met(Agegnehu et al., 2019). Therefore, supplements of iron and folic acid are used a common strategy in addressing the gap (Bothwell, 2000)**.** Foods that contain high concentrations of folate include dark green leafy vegetables, various fruits and legumes

have high concentrations. Some staple foods that are not fortified like wheat, maize or rice are low in folic acid (MOH, 2013a).

The efficacy of elemental iron supplementation is affected by a diverse factors like supplements availability and regimens compliance as a result of side effects (Peña-Rosas et al., 2015)Various ways have been suggested to increase the consumption of iron and folate and these include fortification of food stuffs, health dietary education and anti-parasitic treatment (WHO, 2006). A study conducted in Canada after the compulsory fortification of foods with folate among the expectant mothers showed a prevalence of 1% of a deficiency of folic acid. In South Africa a similar study looking at the comparison between the folic acid status in women of reproductive age before fortification and after fortification period indicated a decrease in prevalence of a deficiency of folic acid from 27.6% to 0%(Mgamb et al., 2017).

Providing mothers who are expectant with IFA supplements is a deterrent approach aimed at improving infant and maternal outcomes (MOH, 2013a).although, the degree of effects may solely depend on the background risk of anemia. In areas that are prone to Malaria its advocated that iron and folate supplementation should go hand in hand with other measures such as preventing, diagnose and treatment of malaria to increase of compliance (Peña-Rosas et al., 2015;WHO, 2006). An amendment of the Food, drug and chemical substances act in Kenya was done in the year 2012 to ensure fortification of wheat and maize flour was made mandatory. the use of media campaign strategy has been employed to promote the use of fortified flours since the year 2012 (Mgamb et al., 2017).

Dietary sources of Iron and folic acid are key to the intake of the two micronutrients, pregnant women are advised to take a nutritious variety of meals high in protein and iron together with foods that enhance absorption like ascorbic acid rich foods(Helmy et al., 2018). However, increased amounts of ascorbic acid have been noted to interfere with absorption of iron and folic acid supplements(Kamau et al., 2018) Foods containing huge amounts of bioavailable iron that include poultry, fish, and meat when consumed with vitamin C the general iron assimilation is usually 3–4 milligrams per day and, at most, 5 milligrams per day. The quantity is less when ingested with foods that contain lower amounts of bioavailable iron(Bothwell, 2000).

Folic acid and cobalamin when ingested in a synthetic form are absorbed in the human system as twice as when given in food(WHO, 2008a) However, reduction of folic acid occurs during cooking and low bioavailability with estimates being 50% to 82%(Dessie et al., 2017). When a woman is pregnant maternal serum and red blood cells concentrations of folate decline due to various reasons like elevated demands, dilution as a result of elevated intravascular volume, increased folic acid and clearance break down and poor dietary habits (Khan et al., 2018).

Diversification and modification of diets involve gardening at the household level, processing of food techniques, food intake that enhances uptake of non heme iron and reduce intake of foods that reduce absorption of non heme iron. These methods increase bioavailability of iron in the human system(Dinga, 2013) fortification of foods with iron has an advantage in that its low cost when applied to large masses of people who are in need of iron supplementation(Bothwell, 2000) some of the foods that are rich in heme

iron include meat like poultry, egg yolk and fish, fruits that are dried, dark green leafy vegetables and cereals fortified with iron. Some of the iron inhibitors include polyphenols that are usually found in some vegetables and tannins found in tea(Okube et al., 2015).

A systematic review of twenty seven studies conducted in costa Rica, Argentina, and Canada on the assessment of changes in neural tube defects prevalence as a result of the compulsory fortified foods with folate found out that there was a reduction in neural tube abnomalities as follows, Costa Rica 58% decline, 50% decline in Argentina and 49% decline in Canada (Mgamb et al., 2017).

Oral elemental iron is usually ineffective in expectant mothers with gastric bypass, inflammatory, uterine hemorrhage, hemorrhagic telangiectasia and intravenous iron is indicated (Siabani et al., 2018) ,There are side effects related with supplements of iron and folate and they include intense abdominal pain, constipation, heart burn sensation, nausea, vomitus, change in stool color, and urine (black)(Kassa et al., 2019). Pregnant women who consume huge amounts of elemental iron additionally on an empty stomach complain of gastro intestinal distress, therefore the gastrointestinal side effects are thought to be based on tolerable upper amounts of elemental iron intake. Overdose of iron supplements are related with gastrointestinal effects depending on the frequency and the amounts of iron released in the stomach(WHO, 2012)

In pregnancy the use of intravenous iron is still effective and in the previous studies conducted there has been shown efficiency and with serious adverse effects extremely rare(Auerbach, 2018) In the human body a major source of daily iron is through recycling of macrophages, this occurs after around 120 days where the old phagocytes and

damaged red blood cells are broken down to which iron is freed from hemoglobin by heme oxygenase-1(Dev et al., 2017)

Nutritional deficiencies should be tackeled through including variety and diversity in diets, enhancing food accessibility that are of high biological value including those form animal sources. Fortification of staple foods is also a key measure with folic acid and iron(Stevens et al., 2013) in addressing the issues of iron and folic acid by supplementing the expectant mother it reduces risks of anemia in pregnant mothers at term by 70% and IDA at term by 57%(WHO, 2012).

Studies have suggested that there is a probability of harmful effects in high folic acid intakes with people with low vitamin B12 therefore supplementation of folic acid can help mask megaloblastic anemia a condition that cannot be detected through hematological changes(WHO, 2008b). Studies have suggested that iron cooking pots could increase hemoglobin concentrations levels significantly especially in adults when used at the community although the problem is with acceptability as they are heavy and can rust if not properly dried(WHO, 2006).

2.1.10.2 Supplementation on iron and folic acid

The World Health Organization endorses that all expectant mothers in regions where anemia is prevalent get supplements of iron and folate; the optional 6-month IFA dosage should contain 60 milligrams of elemental iron coupled with 400 micro grams of folic acid for all expectant mothers ingested everyday (Peña-Rosas et al., 2014). The World Health Organization categorizes noteworthy health significances founded on the prevalence of anemia, where the anemia prevalence is 4.9 per cent or below that is

regarded as a non-issue to a nation. A prevalence of 5.0 and 19.9 per cent is regarded a mild public health concern. Moderate public health concern is identified when the prevalence ranges from 20.0% to 39.9%. a severe public health concern is well-thought-out when the prevalence is above 40.0%(Okube et al., 2015) In regions where the prevalence of anemia in expectant mothers is above 40 per cent the expectant women ought to continue the iron and folic acid supplements as a prophylaxis for 3 months post-partum (WHO, 2006).

The recommendation is that in the first 28 days of pregnancy all women who are pregnant ought to be supplemented with a recommended dose of 30–60 milligrams iron and 400 micrograms folic acid on contact with a health workers as soon as possible during the first three months of expectancy (Taye, 2015)however, The World Health Organization recommends that all expectant women in areas where anemia is prevalent by above 40%, a daily oral dose of 60 mg of iron ought to be given (Nisar, 2014) the comparable amount of 60 mg of elemental iron is about 300 mg of ferrous sulphate hepahydrate, 500 mg ferrous gluconate and 180 mg of ferrous fumarate (WHO, 2016).

An increase of 1g/dl of hemoglobin can help avert the risk of 1.8 million mortalities for neonates to 10 years or can reduce the deaths by 24%. Supplementation of iron and folate is an easy strategy to achieve such increments in hemoglobin. Studies conducted in Nepal showed reduction in neonatal deaths by 57% and Pakistan by 45% when supplementation was done with more than 90 tablets on or before the second trimester in pregnancy. Likewise, the threat was reduced by slightly above 50% in those mothers who ingested iron and folic acid during expectancy (Agegnehu et al., 2019; Birhanu *et al.*, 2018).

In randomized studies, iron supplementation was noted to increase hemoglobin concentrations by an average of 10.17g/l for women who were pregnant, 8.64grams per liter for non-expectant women, 8.0 grams per liter for children. The projected hemoglobin concentrations proportions for all anemia related to iron was around 50 per cent for expectant and non-expectant women and 42% in children(Stevens et al., 2013). A reduction of upto 80% of neural tube defects was noted in China after supplementing pregnant women with with 400µg/d of folic acid, a 70% reduction rate was noted in England after supplementing the pregnant mothers with 400µg folic acid (Dinga, 2013).

Studies suggest that there is need in treating anemia with higher doses of oral iron supplements and that combined treatment of oral iron supplements with Vitamin A ought to have a superior influence in the management of iron deficiency anemia in the second trimester of expectancy(WHO, 2006). Hence, there are recommendations that women who are pregnant should be supplemented depending on the present extent of anemia, those living in regions with a prevalence of 40 per cent to consume 60 milligrams iron plus 400micro grams folic acid per day, and those others in regions with a prevalence of 20 per cent anemia intermittent oral iron 120milligrams + 2800micro grams folic acid once weekly when oral iron is compared to parenteral iron patients on iron taken intravenously has hastened hematological recovery mostly because of variations in oral acceptability, assimilation and compliance (Okube et al., 2015).

Ingestion of iron and folate is key to a healthy gravidity and in deterrence of neural tube defects(Dinga, 2013), documented studies have proposed that an intake of 400 mg of folic acid every day for least four weeks before gravidity and for the initial three months

of gravidity decreases the threat of neural tube defects by up to 80%. The neural tube joins at the fourth week after conception and therefore scores the need to consume folic acid on daily basis and before conception(Dessie et al., 2017)also in the countries with neural tube defects exceeding 0.6/1000 live births a daily intake of 400 mg of folate may be considered (WHO, 2008a).

There are several issues that stall elemental iron and folic acid supplementation and these include factors like drugs supply, non-compliance to drugs regimen, gastro intestinal side effects, side effects frequency, poor utilization of ante natal care services(Kamau et al., 2018), lack of counseling services by health care workers, ignorance on IFA supplements and their benefits, effects of supplementation, lack of anemia information, adherence to the drugs regimen(Boti et al., 2018).

In oral iron intolerance which may be harmful or ineffective, intravenous iron is the other option with severe anemia less than 8 grams per deciliter in the second trimester of gravidity or even in the last three months where there is less hopes that sufficient quantities of iron will be conveyed to the foetus as the iron necessities upsurge with every trimesters(Auerbach, 2018), Iron could also be given intramuscularly or intravenously for parenteral infusion. Several studies have revealed that little or moderate quantities of iron and folic acid supplementation in the initial periods of gravidity have a remarkable effect on the fetus growth on women with both sufficient and insufficient iron status(Okube et al., 2015).

If a pregnant woman is diagnosed with malaria give daily iron of 120 mg for three months and check for progress after two weeks whereby the client's biochemical are

taken and compliance to the drugs checked, women with severe anemia should be referred for further management or with respiratory distress or cardiac abnormalities like anemia (Peña-Rosas et al., 2015; WHO, 2006). The WHO (2016) recommends that IFA supplements ought to be available in capsules or tablets that are soluble, dissolvable, or are modified release tablets. A well-established quality assurance system with a guarantee of standards in the manufacturing and packaging process.

2.2 Theoretical Framework

The Health Belief Model (HBM) was the initial, and still is one of the best-known social cognition models. It is a psychological and health behavior alteration model developed in 1966 by Irwin M. Rosen stock. It was meant for learning and promoting the acceptance of health services. Becker and colleagues advanced the model in the 1970s and 1980s. The heath belief model was established to describe the importance of public involvement in health deterrence and screening programs (Jones et al., 2015). The most important factors of the health belief model include probable disease severity, the individual's vulnerability to a disease, the advantages of going for a preventive strategy, hurdles to adopting that action, cues to action, and self-efficacy. advantages and limitations are usually resilient forecasters of the appropriate behavior, whereas vulnerability and severity may not (Carpenter, 2010).

The Health Belief Model helps clarify why any patients may take or refute preventative health services or take up healthy behaviors (Ogden, 2007). Social psychologists originally developed the Health Belief Model to foretell the probability of uptake of a recommended preventative health action and to understand a person's motivation and

decision-making about looking for health services. According to Glanz et al., (2002) the Health Belief Model suggests that the publics will respond best to messages about health promotion or disease deterrence when the following four conditions for change occur: the person considers that he or she is at risk of developing a specific condition; the person believes that the threat is serious and the consequences of developing the condition are undesirable; the person believes that the risk will be reduced by a specific behavior change. the person believes that hurdles to the behavior change can be overcome and managed.

The Health Belief model is used as a theoretical frame work to guide the study as it focuses matters regarding perceived susceptibility to anemia, observed severity of the disease, thought out advantages of looking for preventive plans and complying to IFA supplementation as well as perceived challenges to pursuing the preventive actions. The model suggests that perceptions of the vulnerability to ailment and the perceived severity of the illness affect whether an individual denies having the ailment, involves in primary prevention, or pursues timely disease management. Illness in the setting of this study may be taken as the complications of pregnancy and childbirth.

2.3 Prevalence Of Non-compliance Among Pregnant Women

According to World Health Organization, 2 billion individuals globally accounting to about 30 percent of the world's populace are anemic primarily as a result of iron deficiency, accounting for around 60,534 deaths in the year 2010 in reproductive women. Females are usually at threat of iron deficiency anemia owing to augmented requirements in gravidity(Kassa et al., 2019). A deficiency of folate has been linked to anemia with

other health effects like neural tube defects in pregnancy and efforts to supplement Folic acid and food fortification are known to help curb such health outcomes (Taye et al., 2015) .

In a study conducted in Kenya by Kamau et al., (2018), it was established that only 32.7% of the participants were compliant to iron and folic acid supplements, while 40.9per cent recorded averagely on the knowledge levels on iron and folic acid supplements insinuating that there is noncompliance. In an Ethiopian study by Neguse et al., (2016), it showed that 3.7% and 24.3% had a history of birth complications that is still birth and abortions correspondingly, where as 96.3% and 75.7% did not have history of the queried complications. It was also found out that a huge number of respondents that is 90.9% and 94.6% of mothers did not experience anemia neither in previous nor in current gravidity.

World Health Organization defines anemia as a disorder where there is less than 11gram per deciliter hemoglobin concentration in the expectant woman, thus reducing oxygen-ferrying capability with concentrations for the expectant woman at Hb< 11gram per deciliter. Severe anemia is defined as having Hb concentrations of less than 7.0 grams per deciliter; they have further defined it as an illness in which the amount of erythrocytes or their oxygen-ferrying capability is deficient to meet physiologic needs, which vary by age, gender, pregnancy status. Altitude and smoking. Anemia has been linked with diminished mental and motor development hence loss of productivity from reduced work capacity, and also augmented infection susceptibility (Peña-Rosas et al., 2015).

Iron deficiency anemia hardly results to deaths although the effects on human health is significant though it's a public health concern that impacts the low, middle and high income nations and has challenging health concerns and impacts on economic and economic development (Miller, 2013a; WHO, 2011b;). Generally, the deterrence and effective treatment for iron deficiency anemia remains sadly inadequate globally, especially among poor women and children (Miller, 2013). The adverse effects of low hemoglobin levels in the blood are usually high in pregnant mothers and infants though effects are also felt by other groups including adolescents, older persons, and men(Stevens et al., 2013) A deficiency of Iron is known to be a major cause of anemia globally affecting more than half of anemia cases in pregnancy(Mithra et al., 2013).

In the rural districts of Ethiopia, a cross sectional study was done on 414 expectant women who had delivered their infants in the previous year. The study was looking at the assessment of iron and folic acid coverage, compliance and associated factors. It was found out that 35.4% had received prenatal iron and folic acid supplements in the index gravidity and amongst them the compliance level was at 74.9%(Asmare, 2016). Iron supplements compliance is an important factor in deterrence and management of IDA. Complying with supplementation of iron plays a important part in the deterrence and management of IDA mostly among expectant women whose iron needs commence at the second trimester and advances to the last three months of gravidity (Taye et al., 2015).

In an Ethiopian study conducted by Taye et al. (2015) showed that compliance of oral IFA supplementation remained low in the areas that the study was conducted. It could not meet the World Health Organization recommendations notwithstanding the significance

of such a program to curb Iron deficiency anemia. Iron and Folic acid deficiency comes in as a result of increased requirements for the said nutrients during pregnancy, this is due to increased needs and if supplementation is not done a deficiency usually comes in (Agegnehu et al., 2019; Ibrahim et al., 2011).

Efforts have been made to give pregnant women iron and folic acid supplements though the effectiveness of such programs have been in adequate in reducing maternal anemia, reduced compliance with iron usage like refusal to ingest the pills is the possible drive for the ineffectiveness of such strategies (Ibrahim et al., 2011), Compliance to IFA supplements has been proven to effectively prevent anemia in pregnancy (Gebreamlak et al., 2017). An Ethiopian study by Taye et al., (2015) notes that complying to IFA supplementation plays an significant function in treatment and deterrence of iron and folic acid inadequacy more so in expectant women whose iron body demands goes up from the beginning of the second trimester and advances to the end of the gravidity.

Compliance in prim gravidas was high with iron and folic acid supplements when issued separately as iron tablets and folic acid tablets, this was related to the fact that mothers who were pregnant for the first time were more cautious and therefore keen to follow their health care provider's advice for a health birth outcome(Abdullahi et al., 2014). Mothers who took IFA supplements during the previous pregnancy and experienced side effects could make them hesitant ingest iron and folic acid supplements throughout their subsequent gravidities. Mothers who might have had difficulties during their previous pregnancies could be keen to take iron and folic acid supplements during their consequent pregnancies (Kamau et al., 2018). This scores the need to persistently educate

the expectant moms on the benefits of iron and folic acid supplements in all the visits to health facilities and the need to employ other helpful strategies like peer counseling (Mithra et al., 2013).

2.4 Influence of Non-compliance to Child mortality

Globally, Anemia in pregnancy continues to be the top cause of the health burden with greater than 50% tied to IDA. And the mostly found form of malnutrition and the predominant nutritional deficiency causing substantial diseases and deaths around the World (Kamau et al., 2018). Iron deficiency anemia and child deaths calls for public health responsiveness even though the intense in which iron deficiency anemia leads to child deaths is not known (Scott et al., 2014) though it is categorized as the 3rd foremost cause of disability globally and 13th top threat for the global disability adjusted life years(Habib et al., 2016).

In a study carried out by Dibley et al. (2014), in Nepal and Pakistan IFA supplementation was seen to considerably reduce the adjusted risk of early neonatal mortality by 23% in Pakistan and 51% in Nepal. The study found out that there was a sparing effect on early neonatal mortality the highest existing in infants whose mothers initiated ingestions of iron and folic acid supplements at the start or before the fifth month of gravidity or swallowed greater than 90 IFA supplements throughout their gravidity in both Nepal and Pakistan. A study conducted in Malawi by Brabin et al., (2003) found that between increasing hemoglobin levels and declining case death rate in children. A greater risk of mortality was found in children with exceptionally little Haemoglobin levels of below 50 grams per liter relative to those with higher Hemoglobin levels.

IFA supplementation decreases risk of anemia in gravidity and iron deficiency though the positive effects are unknown, giving iron and folic acid supplements as recommended produce heterogeneous results subject to individual's contextual threat for low birth weight and anemia, as well as the level of compliance to the strategy (Peña-Rosas et al., 2015). The World Health Organization guidelines endorses giving of a prophylactic oral prescription of iron 30–60 milligrames and folic acid 400 micro grammes to all expectant women per day, starting as early as possible during gravidity, birth asphyxia is a risk that is brought about by anemia in pregnancy and is usually linked with neonatal and childhood mortality, hence iron and folic acid recommendation to reduce such risks (Nisar et al., 2016).

Globally, early neonatal fatalities amount to about 75% of all neonatal deaths, Use of iron and folic acid during gravidity have been seen to significantly decrease the risk of early neonatal deaths (Birhanu et al., 2018). A cross sectional study carried out in Ethiopia by Taye et al, (2015) showed that women who were pregnant and visited the clinic antenatally for 2- 3 times for examination were 0.38 times expected to follow the iron and folic acid regimen than women who were pregnant and had visited the ante natal clinic for 4 or more times, the study also shows that those with 0,1,2, and 3 visits had 0.04. 033, 0.50 and 0.60-times odds of iron and folic acid supplements utilization respectively.

2.5 Mother's understanding on benefits of Iron and folic acid supplementation.

In a Nepal study, Sing et al., (2014) found that the understanding on the significance of IFA supplementation amongst expectant women was among the predictors of compliance to the supplements. The knowledge on some challenges like side-effects, obtainability

and forgetfulness-were the main elements of poor compliance. Perception of support from family members in the form of reminders to take IFA supplements was moreover the main reinforcing factor for good.

In a study conducted in the rural areas of Ethiopia by Neguse et al., (2016), showed that having information on anemia and iron and folic acid tablets, anemia history in a previous gravidity were significantly tied with compliance to iron and folic acid supplements. Some of the challenges identified to adherence of IFA supplements include pregnant women not having enough knowledge on anemia and lack of accessibility to antenatal health care services. If the mothers thought that iron and folic acid supplements were boost their blood volume they would have a 16% more chance to taking the supplements as compared to others who did not have the same knowledge, this depended on the information about iron and folic acid given by health care providers on the benefits (Gebreamlak et al., 2017)

In a Nepal study, Rai et al. (2016) it showed that participants lacked knowledge and were not aware of anemia (56%) and iron deficiency. In iron and folic acid supplementation coupled with advocacy in social support and perception of disease severity and reduction in associated barriers may help increase compliance to the program of iron and folic acid supplementation. In a study carried out in Senegal, Compliance was found to have increased when pregnant women were educated on the health importance of IFA supplements and instructions were clear on how to take them (Seck et al., 2008), In another study pregnant mothers who knew the significance of taking iron and folic acid

supplements had a 6 times higher chances of compliance than women who didn't not know(Kassa et al., 2019)

In an Ethiopian study, Sadore et al., (2015) found that the average age of the study respondents was 29.07 (SD ± 6.0) years. Among the variables keyed in to multivariable logistic regression, the mother's age was significantly related with compliance with iron-folate supplement during gravidity. Age of the mother was significantly associated with compliance to iron folate supplementation in Taye et al., (2015) study. No relationships were found between compliance and age by Dinga (2013). Young age was linked to lower consumption iron supplements in Brazil (Niquini et al., 2016).

The level of education of the mother was significantly linked with compliance to iron folate supplementation in Taye et al., (2015) study. No associations were found between compliance and education level by Dinga (2013). Niquini et al., (2016) found that of the women with a high level of education had a prevalence of not consuming of iron supplements 1.72 times even higher in the groups of women with high level of literacy but low socio-economic status (PR= 2.369). Titaley et al., (2010) the results indicated that the role of low socio-economic status, plus household wealth index and parental education in not using, having a late start or under-consumption of IFA supplements

In Niguse and Murugan (2018) study, mothers who finished at least secondary school were more likely in adherence to the supplement than those less educated. Abebaw (2016) found that that women's educational level had a substantial association with compliance to IFA supplementation. Expectant women who were having primary education were 4 times further expected to comply with Iron and folic acid

supplementation compared to those expectant women who cannot read and write. The likely cause is that educated mothers have better knowhow about anemia and Iron and folic acid supplementation, and give better emphasis for adherence to IFAS by anticipating pregnancy outcomes.

The participants living the rural areas constituted the highest proportion (91.2%) in Sadore et al., (2015) study where 39.2% of pregnant mothers were compliant. In Kenya, Dinga (2013) found a positive noteworthy association between compliance and the place of dwelling. Nisar et al. (2014) found that the highest number of mothers knew the perceived importance of IFA supplements. Nevertheless, the women living in the rural areas had less information about the importance of IFA supplements than the urban women. A study Conducted by Taye et al., (2015) revealed that only 27.4 per cent of women had higher level of knowledge for anemia and 24.8 per cent of the women were aware of iron and folate tablets.

In a study carried out in South Ethiopia by Tenaw et al., (2019) illustrated well that women who had information about the benefits of iron and folic acid had six times greater odds of compliance with iron and folic acid than their counterparts. These results are alike to a study conducted in Ethiopia by Niguse and Murugan (2018), where a majority of the interviewed mothers 76% and 50% had information on iron and folic acid while 49. 3% of the interviewed mothers were unable to give the right answers.

In an Ethiopian study by Taye et al., (2015), it was found out that clinician instructions on consumption of Iron and folic acid supplements had an influence on compliance (65.6%), fear of getting ill if missed (57%) and the thoughts that the supplements

increased blood 44.5%. Some pregnant mothers thought that too countless pills would harm the infant (58%) side effects and others thought that they would make the fetus bigger (Taye et al., 2015). In a Kenyan study conducted by Kamau et al., (2018) in Kiambu, it showed that younger women had a better compliance as compared to older women, by the fact that the younger women had a better knowledge on iron and folic acid and anemia. It's also worth noting that younger women being primi gravidas would be keener on advice given.

The WHO (2016), notes that the least educated members of the public, who are also poor and in rural set up experienced the highest maternal, infant and child mortality, a similar study done by Rai et al., (2016) found out that 19.7% of the respondents were illiterate and had received no formal education and could be the reason why they performed so low. In an Ethiopian study by Ibrahim et al., (2011), only 45.6% of the respondents had correct information on folate, whereas merely 37.8% identified the rewards of folic acid and 46.7% had satisfactory knowhow about folate. Around 68.5% had adequate information on iron and anemia.

2.6 Health Care Systems and Non-Compliance To IFA Supplementation

Other challenges also included scanty counseling and supply of iron tablets, difficult accessibility and poor use of health care services during pregnancy. In Lacerte et al., (2013) study, the distance to ANC clinics was identified as an central environmental factor of accessing IFA supplements. Ease of obtainability of iron and folic supplements

was correlated with higher compliance in Rai et al., (2014) study. According to Raina *et al.* (2013) study, IFA coverage is much lower in rural areas (54%) than in urban areas (81%). Infrequent unobtainability of IFA pills, lack of knowledge, and casual programme implementation were other important issues raised in Priya et al.,(2016). The essence of access to health care services in utilization of iron and folate supplements was also revealed. In Titaley et al. (2010) study showed low utilization of the supplements amongst women who reported distance to health care services was a main challenge.

In a study conducted in Ethiopia by Niguse and Murugan (2018), it was revealed that there was a positive health and related factors that promoted adherence of iron and folic acid supplementation in that they trusted the health care providers and the availability of supplements, the unavailability of supplements encouraged noncompliance. The consumption was found to be 82.4% among pregnant mothers who were explained to by health care providers and 51.5% in those who were not counseled.

Antenatal care (ANC) is care accorded to a expectant woman before child birth. The drive of ANC is to prepare the mother for delivery of the infant in order to enhance a favorable outcome for the mother and the neonate. Iron and folate consumption and antenatal care enhanced the gravidity outcome considerably (Singh et al.,2012). Titaley et al. (2010) study established the benefits of antenatal care as a supply line of the supplements. Kakati et al., (2016) found that, timing of registration and frequancy of ante natal visits was found significantly associated with IFA intake.

Studies have demonstrated that easy convenience, freely given supplements or even the availability of supplements that were cheaper enhanced the use of antenatal IFA

supplements. Non-affordability of iron supplements was found to be a major barrier to compliance to iron supplementation in Ugwu et al., (2014) study. Mithra et al., (2013) also established that the participants who got the IFA pills at no cost had considerably higher compliance (p=0.029) in comparison with those from the private hospital who had to spend money for it. In disparity, availability of costs that were affiliated with ante natal services did not show effect on compliance (P > .05) in Lacerte et al., (2013) study. In an Ethiopian study by Asmare et al., (2016), it was found out that that the adherence rate was 59.8% which was consistent with some cross sectional study conducted at Mangalore in India which was also 62%, another study done in India shown a 61.7% compliance these could be attributed to the fact that the health centers were accessible.

Studies have generally demonstrated inadequate knowledge of anemia among expectant mothers and that when consumers are conversant, the compliance level for consumption iron tablets went up. Sadore et al., (2015) found that mothers' awareness of anemia, information about iron and folate supplement and counseling on iron-folate supplement was significantly linked with compliance to IFA supplement. Gebremedhin et al., (2014) found that women lacking ample knowledge of anemia and those who weren't given information about the significance of iron supplementation during the gravidity had significantly lower utilization. A qualitative study about IFA pills consumption from West Java Province in Indonesia has also shown a shortage of health psychotherapy on iron and folate supplementation by nurses during antenatal care services. Furthermore, this study showed a nonexistence of publicity activities through printed information, communication and education materials in health care facilities including leaflets,

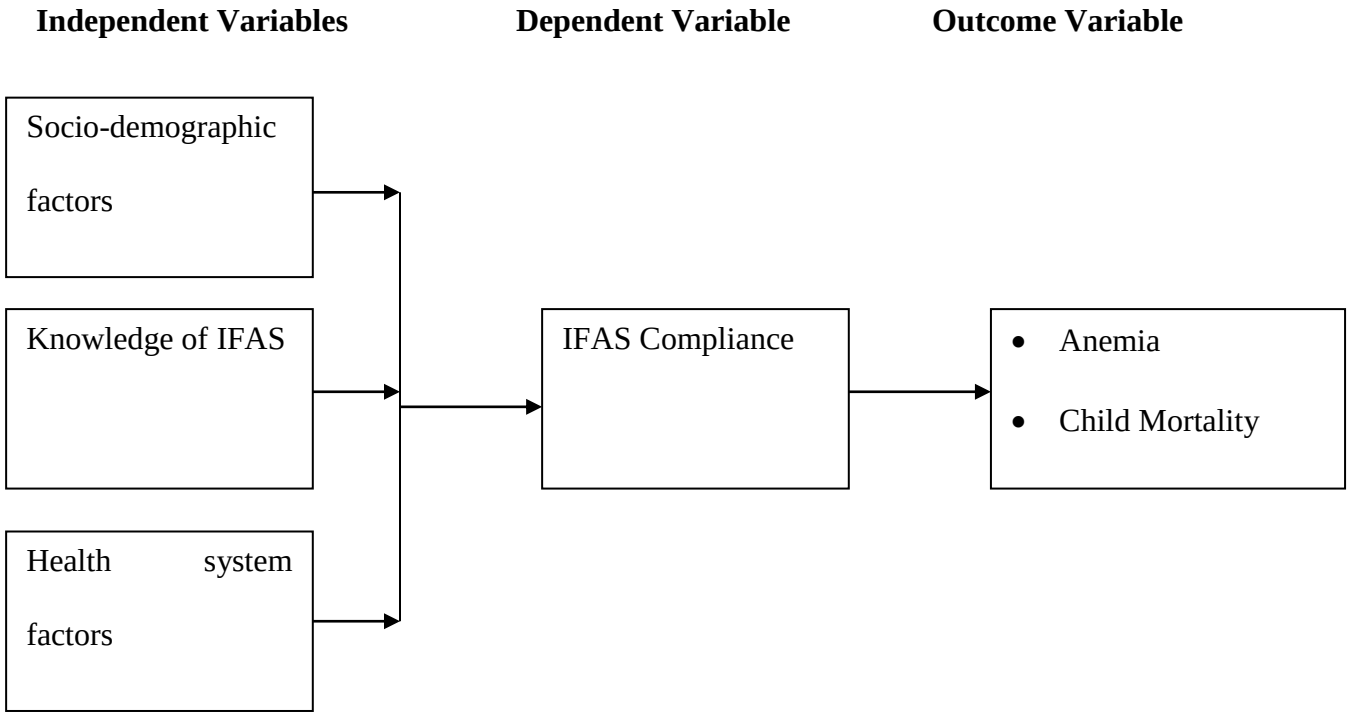
pamphlets or posters; or via mass media to inspire women using iron and folate supplements during gravidity.

A study conducted by Niguse and Murugan (2018) in the rural areas of Ethiopia showed that prim parity and use of antenatal health care were the common factors that increased compliance to iron and folic acid during gravidity, participants who had visited the health care facility for more than 4 days were more probable to show improved compliance to iron and folic acid for more than 90+ days.

2.7 Conceptual Framework

Figure 2.2

Conceptual framework



The aim of this study was to establish determinants of non-compliance to iron folic acid supplementation during pregnancy in Nyeri County. As shown in Figure 2.1, demographic factors, knowledge and health system factors were the independent variables while IFAS compliance was the dependent variable.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The description of this chapter is on how the study was conducted. It comprises the research design, study site, sampling techniques, data collection methods and data analysis procedures.

3.2 Research Design

This was a mixed methods study. According to Shorten and Smith (2017), 'Mixed methods' is a research approach whereby researchers collect and analyze both quantitative and qualitative data within the same study. The basic premise of this methodology is that such integration permits a more complete and synergistic utilization of data than do separate quantitative and qualitative data collection and analysis. This method was therefore best suited to systemically give an exhaustive analysis of the situation as it determines and reports the way things are in that it attempts to study the effects of non-Compliance to Iron and folate supplementation during pregnancy in Nyeri County.

3.3 Study site

The study was conducted in Nyeri County; the County covers an area of 2,361 km² and is located in the central region of Kenya. It borders Kirinyaga and Meru County to the East, Laikipia to the North, Nyandarua to the West and Murang'a to the South. Nyeri County

has four level 4 facilities and 1 County referral hospital which offer services like antenatal, postnatal, surgical, basic emergency and first aid, gynecological and obstetric care, Nutrition, Intensive care services, treatment, out-patient and in-patient services, family planning and growth monitoring among others.

3.4 Target Population

Pregnant women attending antenatal care in level 4 and level 5 facilities were targeted. The study targeted this population of the expectant women aged 18- 49 years of age coming for antennal services in the level 4 and level 5 public health facilities in Nyeri County. The information was collected in the maternal child health clinic. Nyeri County (2013) estimated that in the year 2018 the number of pregnant women would be 19,248 and as per Sub County was as follows, Kieni Sub County 4879, Mathira Sub County 4031, Othaya Sub County 2425, Nyeri Central Sub County 3311, Tetu Sub County 2173 and Mukurwe ini 2329.

3.5 Inclusion Criteria

The study selected participants based on these criteria:

i. Expectant women aged 18 years and above.
ii. Expectant women willing to participate in the study

3.6 Exclusion criteria

Participants who met the below criteria were not included in the study:

i. Expectant women below the age of 18 years because consent from parent or guardian is required and they (parent or guardian) may not be available.

ii. Expectant women unwilling to participate in the study

3.7 Sampling Procedure And Sample Size

The sample size was determined by using the modified formulae by Fisher *et al.,*. 1998;

$$n = \frac{z2p(1-p)}{e2}$$

z = is the Z value for the corresponding confidence level (i.e., 1.96 for 95% confidence);

e = is the margin of error (i.e., 0.05 = ± 5%) and

p = is the estimated value for the proportion of a sample that have the condition of interest.

P= 30% (the most conservative estimate) = 0.34 (Miller, 2013). $n = \frac{1.96 \times 1.96 \times 0.34 (1- 0.3)}{0.05 \times 0.05} = 385$

The 385 respondents were distributed as shown in Table 3.1 according to the expectant women projections by the county hence the identified number of individuals in different high volume facilities in the County. The sample was randomized relative to the average ANC attendance of the facility.

Table 3.1

Sampling Frame

Facility	Number Of Respodents
Othaya Sub County Hospital	49
Mukurwe-Ini Sub County Hospital	47
Mt Kenya Hospital	67
Karatina Sub County Hospital	81
Nyeri County Referral.	141
Total	385

3.8 Data Collection

3.8.1 Data Collection Instruments

The study employed the use of a structured researcher administered questionnaire. Questionnaires were used to collect information form the expectant mothers. A sample of the questionnaire was submitted to researcher's supervisor for review. This was to ensure the validity of the data collection instrument. The questionnaire had 5 parts A-D. Socio-demographic information was collected in section A, prevalence of non-compliance was section B. Section C comprised questions relating to IFAS non-compliance and child mortality. Section D collected information on Mothers Understanding on Benefits of IFAs while health system factors were assessed in Section E.

A pretest study was carried out in the hospital prior to the main study. The purpose of the pretest was to ensure reliability of the questionnaire. The pretest involved the researcher administering the questionnaire to women who met the inclusion criteria a week before the study. According to Orodho (2005) the population of a pilot study should be equal to 10% of the sample. Therefore, the study involved 39 (0.10*385) participants who were

interviewed. The data was analyzed using SPSS; Cronbach's alpha for internal consistency was used to measure reliability. A coefficient of 0.73 was achieved in analysis. According to Orodho (2005) a Cronbach's alpha of 0.7 and above indicates good reliability.

3.8.2 Data Collection Procedure

On receiving authorization for the study, the researcher visited the nurse in charge of mother and child health clinic to inform her of the study. On the material day the researcher proceeded to the MCH clinic with the questionnaires. The first respondent was chosen randomly and simple random sampling was used to recruit other respondents. Simple random sampling was conducted using lottery method. The researcher proceeded to explain the purpose of the study to the potential participant and on providing consent; the researcher administered the questionnaire. The researcher hired and trained two nurses on placement who acted as research assistants to enable timely collection of data. The respondents were interviewed before they received services.

3.9 Data Analysis and Presentation

Descriptive statistics were used to analyze the quantitative data which was presented in form of frequency and percentage tables, bar graphs and pie charts. Chi-square tests were conducted to determine association of IFAS non-compliance on child mortality. Dichotomization was conducted to convert continuous variables into categorical data. Dichotomization is a procedure that is statistical by which a variable that originally was continuous is transformed into a categorical variable based on where people fall relative

to a cutoff point (Cohen, 1983). In this study, dichotomization enabled chi-square analysis for both continuous and categorical data. SPSS version 20 for windows was employed for data analysis. Tables were used to present findings.

3.10 Ethical Considerations

Ethical Approval was sought and granted from KeMU, authorization from National Commission for science Technology and Innovation was also sought and a letter given (NACOSTI/P/18/96063/23882). Authority to carry out the study in the County was sought from the Director of Health Services at the County and also from the Administrative Directors of the other facilities that the researcher was carrying out the study in. Consent from the potential respondents was sought and those who were not willing to participate in the interview were left out, the respondents were assured of confidentiality for the information provided. The researcher and his supervisors were the only two people who had access to the information collected. The data was stored in a password-protected computer.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the results and discussion of the study. It includes the response rate, socio-demographic characteristics of respondents and findings on the five study variables. A total of 385 expectant women aged 18- 49 years of age coming for antenatal services in the level 4 facilities and in level 5 facility in Nyeri County participated in the study. This means that the study achieved a maximum (100%) response rate.

4.2 Socio-Demographic Characteristics of Respondents

Socio-demographic characteristics assessed in the study include the age, marital status, level of education and occupation of the participating women in the study. The study also collected information on the women's parity, birth order of the child they were expecting and residence. The results are presented in Table 4.1

Results show that 44% of the participants were aged between 25 and 31 years while those aged between 32 and 38 years accounted for 30% of the participants. The average age was 31 years. These findings show that majority of women were aged between 25 and 30 years. This may be attributed to the fact that this is the age at which many women get married and have children in the study area as supported by findings in Table 4.1 whereby majority (66%) of the participants in the study were married.

The findings show that 47% of the respondents had acquired secondary education. The findings therefore show that respondents in the study were lowly educated since majority (86%) of them had not acquired postsecondary education. On religion, the findings show that majority (81%) of the respondents were Christians with 43% being protestants and 38% being Catholics.

On occupation, results in Table 4.1 show that 34% were self-employed, 18% were unemployed and 11% were housewives. The average monthly income for 25% of the participants earned between KES 10,001 and KES 25,000 while 21% earned below KES 10,0000. The mean income was KES 50,912. The lack of employment and low income among the respondents could be attributed to their lack of adequate education to enable them acquire high paying jobs.

On parity, results in Table 4.1 show that majority (69%) of the participants had between 1 and 3 children. The average parity was 1 child. Majority (56%) of the respondents were expecting their second child. This shows that majority of households had small families. Majority (64%) of respondents lived in rural areas.

Table 4.1

Socio-Demographic Characteristics of Respondents

Characteristic	Category	Frequency (%)	
Age (years)	<24	50	(13)
	25-31	169	(44)
	32-38	116	(30)
	39-45	39	(10)
	>46	11	(3)
Marital status	Married	254	(66)
	Single	131	(34)
Education	Primary	150	(39)
	Secondary	181	(47)
	College	46	(12)
	University	8	(2)
Religion	Christian (Catholic)	146	(38)
	Christian (Protestant)	166	(43)
	Muslim	46	(12)
	African traditional religion	27	(7)
Occupation	Employed	50	(13)
	Self-employed	131	(34)
	Farmer	58	(15)
	Casual laborer	35	(9)
	Housewife	42	(11)
	Unemployed	69	(18)
Income (KES)	<10,000	81	(21)
	10,001 - 25,000	95	(25)
	25,001 - 50,000	43	(11)
	50, 001 - 75,000	49	(13)
	75,001 - 100, 000	36	(9)
	>100,001	81	(21)
Parity	None	89	(23)
	1-3	266	(69)
	4-6	30	(8)
Birth order	1st	89	(23)
	2nd	216	(56)
	3rd	69	(18)
	4th	11	(3)
Residence	Urban	139	(36)
	Rural	246	(64)

4.4 Prevalence of IFAS Non-Compliance

4.4.1 Forgetting to Take Supplements

Majority (56%) of the respondents in the study indicated that they had at one time forgotten to take their IFAS supplements. In the previous one week prior to the study, 33% had forgotten to take their IFAS supplements. This shows that non-compliance to IFAS was high among the respondents. This is consistent with findings of Ibrahim et al. (2011), Taye et al. (2015) and Gebreamlak et al. (2017) who in studies conducted in Egypt, Amhara, Ethiopia and Addis Ababa, Ethiopia respectively found that compliance of prenatal iron and folic acid supplementation remained low in the areas that the study was conducted.

Table 4.2

Forgetting to Take Supplements

	Yes n(%)	No n(%)
Forgot to take IFA supplements	216(56)	169(44)
Forgot to take IFA supplements in previous 1 week	127 (33)	258(67)

4.4.2 Reason behind Forgetting to take Supplements

Results in Table 4.3 shows that among those who had at one time forgotten to take their IFAS supplements, 44% forgot due to being busy at work, 28% because of side effects and 26% simply forgot. This is in agreement with Nisar et al., (2014) whereby Pakistani women forgot to take the supplements. Nausea, diarhea and loss of appetite were the main side effects mentioned. The finding is also in agreement with findings of Vir et al.

(2008) where the main reported reason for noncompliance among Indian women was forgetting to take the tablets. This result is however in disagreement with Sadore et al.,(2015) whereby amongst Ethiopian women who missed the doses of IFA supplement, the leading underlying reason was side effects.

Table 4.3

Reason behind forgetting to take Supplements

Reason	Frequency (%)
Simply forgot	56 (26)
Side effects	60 (28)
Work commitments	95 (44)
Forgot to carry	39 (18)
Lost them	19 (9)
Others	6 (3)

*Multiple Responses (n=216)

4.5 IFAS Non-Compliance and Child Mortality

4.5.1 Hemoglobin Levels

Majority (55%) of the participants had hemoglobin levels of between 121 g/l and 150 g/l while 37% of the participants had hemoglobin levels of below 120 g/l. The mean hemoglobin level was 126 g/l. The results therefore show that majority of participants had acceptable levels of hemoglobin (121 g/l and 150 g/l). The finding is consistent with findings of Araujo et al. (2013) finding that there was low prevalence of anemia affecting pregnant women. This finding is however in contrast to findings of Ononge et al.,(2014),

Ayub et al. (2009) and Dika et al. (2018) who found that the mean Hb was below recommended levels in studies conducted in Uganda, Pakistan and Tanzania respectively.

Table 4.4

Hemoglobin Levels

Hemoglobin Level (g/l)	Frequency (%)
<120	142 (37)
121-150	212 (55)
>151	31(8)
Total	385(100)

The researcher also analyzed hemoglobin levels per study site and compared it with prevalence of IFAS non-compliance. Results in Table 4.5 show that Nyeri County Referral hospital had the lowest mean hemoglobin levels (118.3 g/l) while Mukurweini had the highest (123.4 g/l). Results also show that there was no statistical significance (P>0.05) between study site and prevalence of IFAS non-compliance

Table 4.5

Relationship between Study Site and Prevalence of IFAS Non-Compliance

Hospital	Mean Hemoglobin Level (g/dl)	Chi-square	p-value
Nyeri	118.3	8.4505	0.210
Karatina	118.7		
Mukurweini	123.4		
Othaya	115.3		

4.5.2 Child Mortality

Results in Table 4.6 show that only 11% of respondents had ever lost a pregnancy. Of those who had ever lost a pregnancy, majority (82%) had initiated antenatal care. In addition, of those who had ever lost a pregnancy, majority (77%) of them had taken IFAS tablets during their pregnancy. The findings therefore show that the prevalence of child mortality in the sample was low as very few pregnant women had ever lost a pregnancy.

Table 4.6

Child Mortality

	n (%)	n(%)
Respondent ever lost a pregnancy	42 (11)	343 (89)
If yes, respondent had taken IFAS tablets	32 (77)	10 (23)
If yes, respondent had initiated antenatal care	34 (82)	8 (18)

4.6 Mothers Understanding on Benefits of IFAs

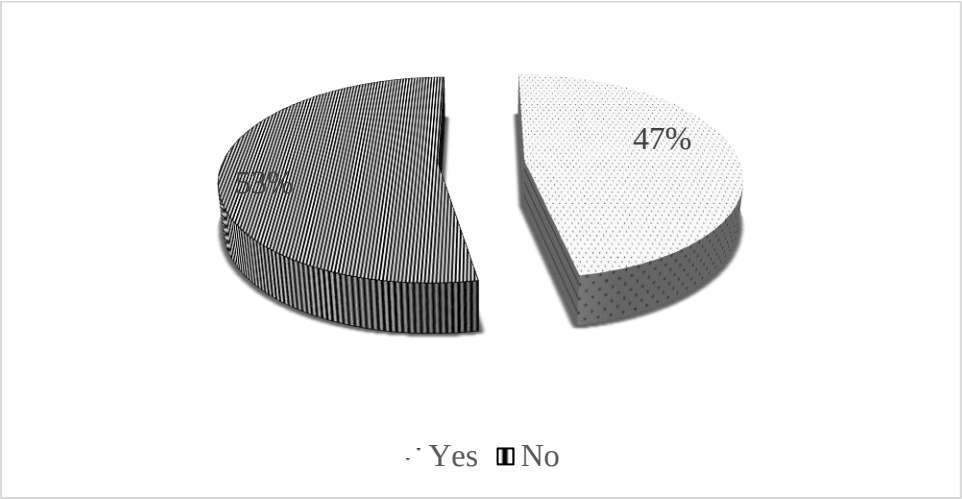
4.6.1 Mother counselled on IFAS

Findings in Figure 4.1 show that majority (53%) of the respondents indicated that they were not explained to the benefits of IFAS. This shows gaps in counseling of pregnant women on iron and folic acid supplements. This is consistent with findings of a Kenyan study by Kamau et al., (2018), in spite of the universal provision of IFA pills to all pregnant women, they were not informed about the causes, features or consequences of anaemia. Furthermore, counseling the mothers on; the enhancers and inhibitors of folate and iron assimilation, and the fact that there is augmented nutritional needs during

gravidity, was not provided in any of the health facilities. Similar findings were found in studies by Rai et al., (2018), Malhotra et al., (2014) and Kavle and Landry (2018) in Nepal and India.

Figure 4.1

Mother counselled on IFAS



4.6.2 Knowledge on Benefits of IFAS

Results in Table 4.7 show that 34% indicated that IFAS promotes health of the baby while 26% indicated that IFAS Increases blood volume. The results also show that 27% did not know any benefit of IFAS. This shows that knowledge on benefits of IFAS was poor. Sing et al. (2014) also found that the understanding on the importance of iron and folic acid supplementation among expectant mothers was inadequate. Similar results were found in studies by Nechitilo et al. (2016), Birhanu et al. (2018), Shewasinad and Negash (2017) and Tinago et al. (2017) in Vietnam Ethiopia Ethiopia and Zimbabwe respectively.

Table 4.7

Respondents Knowledge about the Benefits of IFAS

Benefit*	n(%)
Increases blood volume	100 (26)
Promotes health of baby	131 (34)
Promotes health of mother	131 (34)
Increases weight	65 (17)
Reduces complications	54 (14)
Others	23 (6)
Don't know	104 (27)

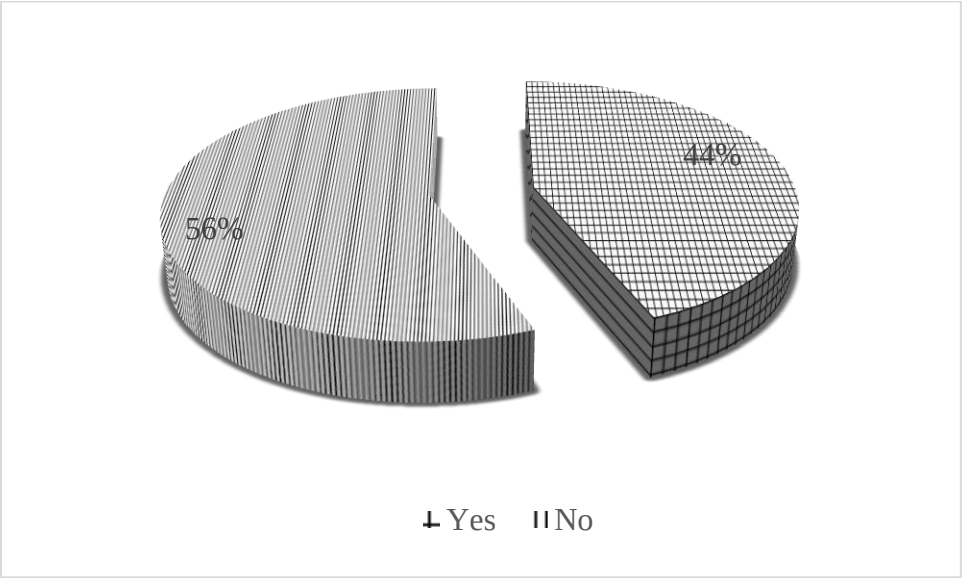
*Multiple Responses (n=385)

4.6.3 Mother Counselled On Dietary Sources Of Iron And Folic Acid

Majority (56%) of the respondents showed that they had not been counselled on the dietary sources of iron and folic acid. This is consistent with findings of a Norwegian study by Garnweidner and Pettersen (2013) that mothers experienced that they were inadequately enlightened with nutrition-related information in antenatal care. The information was perceived as presented in very general terms and focused on food safety. This finding is however in contrast to findings of Bookari et al. (2017) that for most Australian pregnant women, health care providers are at the top of the dependability hierarchy, which suggests a considerable potential for their promotion of healthy dietary behavior among pregnant women.

Figure 4.2

Mother Counselled on Dietary Sources of Iron and Folic Acid



4.6.4 Foods Mothers Advised to Take

Results show that 96% indicated that they were advised to take fruits while 86% indicated that they were advised to take green vegetables. This shows that pregnant women in the study had good knowledge of their dietary needs. This result is similar to that of a Nigerian study by Oluleke et al. (2016) who found that overall, respondents were knowledgeable about dietary intake. This result differs with findings of a Nepalese study by Shah et al. (2017) that although every expectant mother had little knowledge on nutrition, still there is lack of adequate knowledge on dietary patterns during expectancy and some wrong perceptions following diet consumption during gravidity was found. The result also differs with that of Nagi et al. (2016) who found that knowledge regarding sources of carbohydrates/proteins, iron, zinc, vitamin A and iodine was low in Yemen.

Table 4.8

Foods Mothers Advised to Take

Food	Frequency (%)
Fruits	162 (96)
Green vegetables	145 (86)
Water	91 (54)
Others	22 (13)

*Multiple responses (n=215)

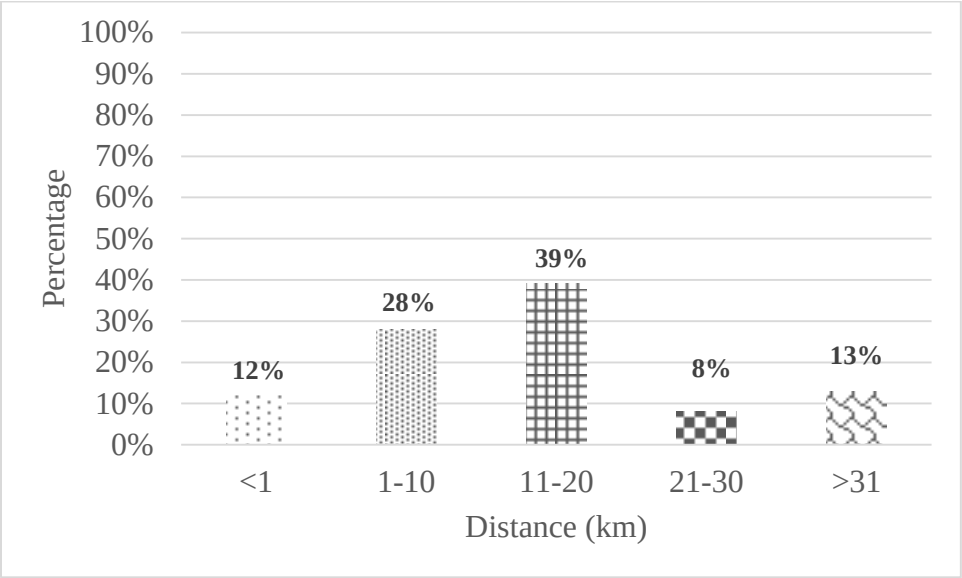
4.7 Health Care Support System Factors

4.7.1 Distance to Health Facility

Results in Figure 4.3 show that 39% of the respondents lived between 11 and 20 kilometers from the health facility while 28% lived between 1 and 10 kilometers from the health facility. This shows that majority of respondents lived close to the health facility in question as the average distance was 16 kilometers. The findings are in contrast to those of studies by Kyei et al., (2012), Gupta et al., (2014), Fisseha et al., (2017), Akowuah et al., (2018) who found that distance to the nearest health facility for pregnant women was far (>30 Kms) in studies conducted in Zambia, India, Ghana and Ghana respectively.

Figure 4.3

Distance to Health Facility



4.7.2 Availability of IFAS

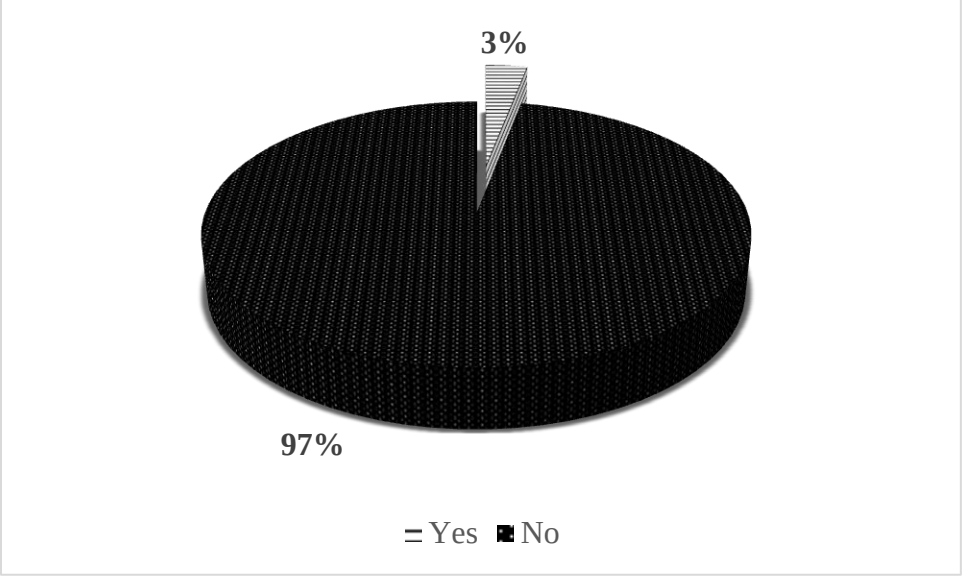
All respondents agreed that IFAS supplements were available at their health facility when they needed them. This result supports findings of Mbhenyane and Cherane (2017) where there was good availability of the pills in the health facilities and thus suggesting access for the expectant women of the supplementation pills all the time. Iron and folate supplements were available in all antenatal health facilities and were provided to all pregnant women. The finding is however in contrast to findings of Priya et al., (2016) finding that occasional unavailability of IFA tablets was a barrier to compliance.

4.7.3 Purchasing of IFAS

The vast majority (97%) of respondents indicated that they had never bought IFAS supplements. This can be attributed to the fact that IFAS supplements are freely given to pregnant women in public health facilities. This result is in concurrent with findings of Begum et al., (2018) who found that 11.7% purchased or otherwise acquired IFA. However it is in disagreement with findings of Diamond-smith et al.(2016) finding that stock-outs of folate and iron tablets in health facilities often pushed women to purchase IFA from private chemists.

Figure 4.4

Purchasing of IFAS

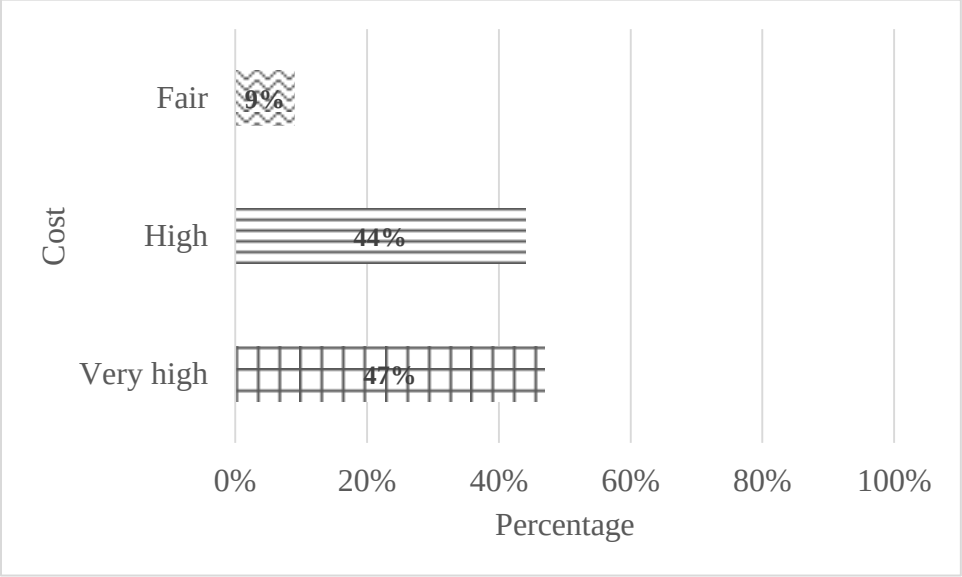


4.7.4 Cost of IFAS supplements

Among those who had ever bought IFAS supplements, the vast majority (91%) indicated that the cost was high. This lends support to findings of Nisar (2014) that non-availability or limited monetary funding to procure the IFA pills after receiving prescriptions from healthcare workers was one of the challenges to the consumption of antenatal IFA supplements in the women we interviewed

Figure 4.5

Perceived Costliness of IFAS



4.7.5 Respondent Ever Missed IFAS from the Hospital

All (100%) respondents indicated that they had never missed IFAS supplements from their hospital. This shows that accessibility and availability of IFAS was high. This result supports findings of a South African study by Mbhenyane and Cherane (2017) study

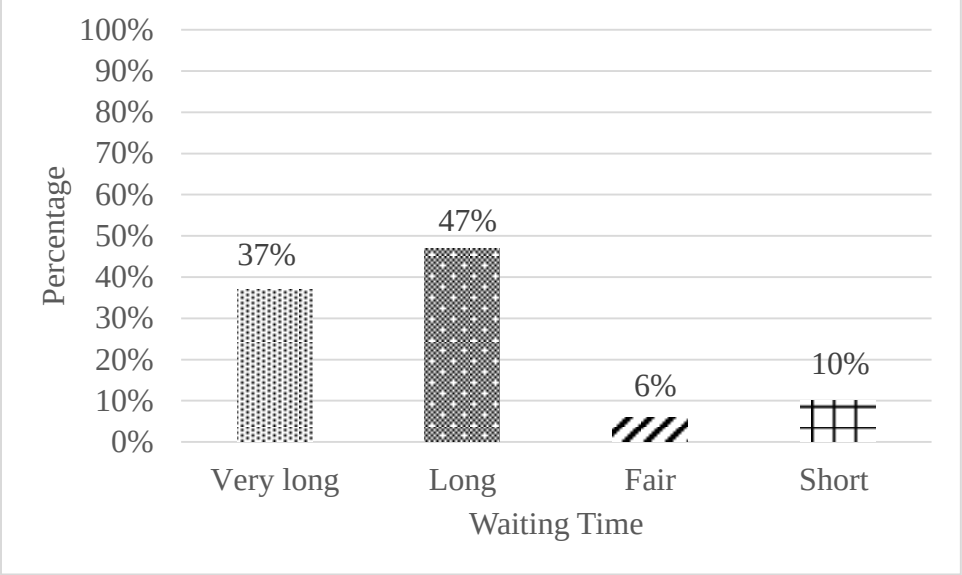
whereby about 95% of the expectant mothers responded that they were issued with supplements while 100% of health workers said they issued supplements all the time.

4.7.6 Waiting Time When Getting IFA Supplements

Majority (80%) of the respondents indicated that the waiting time when getting IFA supplements was high (> Ihr). Studies by Monica (2011), Jallow *et al.* (2012), Paudel, Thepthien and Hong (2016) and Nsibu (2016) in Kenya, Gambia and Nepal respectively also registered pregnant women's dissatisfaction with waiting time for ANC services.

Figure 4.6

Waiting Time When Getting IFA Supplements



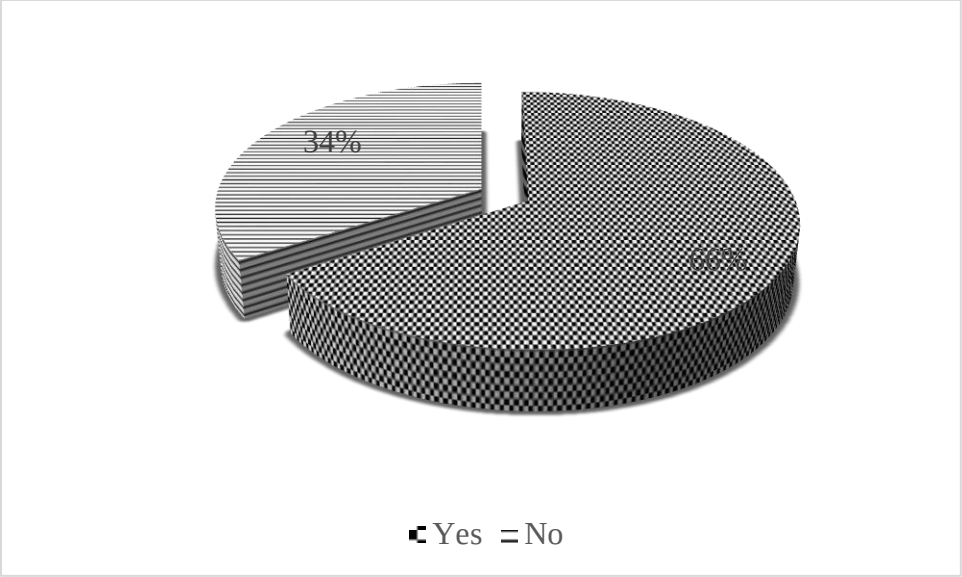
4.7.7 Respondent Informed About IFA Supplements and Where to Get Them

Majority (66%) of respondents indicated that they were informed about IFA Supplements and where to get them. This result differs with findings of studies by Uganda's Senoga

(2015) and Kenya's Kimiywe et al., (2017) finding that women were not informed about IFAS.

Figure 4.7

Respondent Informed About IFAS and Where to Get Them



4.8 Relation between Variables

Forgetting to take supplements in one week was compared to residence (Rural/urban). There was no significant relationship (p=0.273) between residence and compliance and residence. This finding differs from findings of a Pakistani study by Nisar and Dibley (2016), a Kenyan study by Kamau et al., (2018) who found there was a significantly high non-compliance to IFAS among rural women. Sub county of residence was compared to forgetfulness in consumption of IFA supplements. There was no significant relationship (p=0.210) and compliance to IFAS.

Forgetting to take supplements in one week was compared to hemoglobin levels. Chi-square tests showed a significant relationship (p=0.018) between compliance to IFAS and prevalence of Anemia. This is consistent with findings of Sing et al., (2014), Taye et al. ,(2015) and Niguse and Murugan (2018) in studies conducted in Nepal and Ethiopia found that iron supplements compliance is an important factor in prevention and treatment of iron deficiency anemia.

Forgetting to take supplements was also compared to mortality. Chi-square tests showed no significant relationship (p=0.606) between compliance to IFAS and child mortality. This is in contrast to finding of Nisar and Dibley (2016) Pakistan study which established that adjusted risk of childhood deaths indicators for all four progressively longer cumulative time periods was significantly reduced in children whose mothers reported taking IFA supplements during gravidity.

Table 4.9

Relationship between Residence and Compliance to IFAS

	Chi-square ($\chi 2$)	Degree of freedom (df)	(*P-value*)
Residence * IFAS Compliance	1.203	1	0.273
IFAS Compliance * Anemia	10.118	3	0.018
IFAS compliance * Child Mortality	0.265	1	0.606

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary and discussion of the findings of the study. The researcher's conclusion and recommendations for policy, practice and future researcher are also presented.

5.2 Summary

The study explored and evaluated the determinants of non-compliance to Iron and Folic acid Supplementation among pregnant women in Nyeri County. Specifically, the study sought to determine the prevalence of non-compliance among pregnant women in Nyeri County and determine if IFAS non-compliance influences child mortality. The study also assessed the Mothers understanding on the benefits of IFAS and investigated the current health care support System for the IFAS Program.

Majority (56%) of the respondents in the study indicated that they had at one time forgotten to take their IFAS supplements. In previous one week prior to the study, 33% had forgotten to take their IFAS supplements. among those had at one time forgotten to take their IFAS supplements, 44% forgot due to being busy at work, 28% because of side effects and 26% simply forgot. Majority (55%) of the participants had hemoglobin levels of between 121 g/l and 150 g/l. Only 11% of respondents had ever lost a pregnancy. There was a significant relationship ($p=0.018$) between compliance to IFAS and

prevalence of IFAS. However there was no significant relationship (p=0.873) between compliance to IFAS and child mortality.

Majority (53%) of the respondents indicated that they were not explained to the benefits of IFAS. 34% indicated that IFAS promotes health of the baby, an equal number (34%) indicated that IFAS promotes health of the baby while 26% indicated that IFAS Increases blood volume. The results also show that 27% did not know any benefit of IFAS. Majority (56%) of the respondents indicated that they had not been counselled on the dietary sources of iron and folic acid. The vast majority (96%) indicated that they were advised to take fruits while 86% indicated that they were advised to take green vegetables.

The study found that 39% of the respondents lived between 11 and 20 kilometers from the health facility while 28% lived between 1 and 10 kilometers from the health facility. All respondents agreed that IFAS supplements were available at their health facility when they needed them. Majority (80%) of the respondents indicated that the waiting time when getting IFA supplements was high. Majority (66%) of respondents indicated that they were informed about IFA Supplements and where to get them.

5.3 Conclusions

The study concludes that the prevalence of non-compliance among expectant mothers in Nyeri County was high. Majority of respondents had missed taking their tablets. This is a concern as IFAS supplementation is only effective when adhered to religiously. The study concludes that IFAS non-compliance does not influence child mortality. The study

concludes that mothers understanding on the benefits of IFAS is poor. Majority of mothers knew that IFAS promotes the health of the mother and the bay but they could not name how or other benefits. A fair number of women could not name any benefit and others erroneously believed that consumption of IFAS adds weight. This can be attributed to poor counselling of pregnant women by health workers on the need and benefits of IFAS supplementation.

The study also concludes that the current health care support system for the IFAS program is good. Promotive factors included distance and availability of IFAS. The health facilities were close to the residence of the respondents and pregnant women did not have to go far to get IFAS. IFAS tablets were highly available and pregnant women never missed tablets when they needed them. However, pregnant women were dissatisfied with the time it takes to get the supplements and the quality of information given to them by health workers.

5.4 Recommendations

5.4.1 Recommendations on Research Findings

Pregnant women should be sensitized on the benefits of complying to iron and folic acid supplements. The women can be trained on setting reminders and having someone such as spouse remind them of taking the supplements to reduce forgetfulness. Health workers and especially nurses working in health facilities in the MCH should be given refresher courses to enhance their counselling skills. This will enable them counsel women better on the need and importance of complying with IFAS. IFAS supplements should be given to pregnant women at the MCH and not at the pharmacy to reduce waiting time.

Use of mass media campaigns, outreach education are some of the strategies that can be employed to create demand for ante natal services and compliance to the prescribed regimen, mothers who are employed should be given ample time to attend ante natal clinics and referred to nutritionists for dietary advice on foods that are rich in iron and folic acid.

5.4.2 Recommendations for Further Research

A study should be conducted to assess how health workers counsel pregnant women on IFAS since majority of women were found to have little knowledge on benefits of IFAS. A similar study should be conducted with health workers as participants to give more information on health system factors affecting compliance with IFAS.

REFERENCES

Abdullahi, H., Gasim, G. I., Saeed, A., Imam, A. M., & Adam, I. (2014). Antenatal iron and folic acid supplementation use by pregnant women in Khartoum, Sudan. *BMC Research Notes*, 7(3), 498-503. https://doi.org/10.1186/1756-0500-7-498

Abu-Ouf, N. M., & Jan, M. M. (2015). The impact of maternal iron deficiency and iron deficiency anemia on child's health. *Saudi Medical Journal*, 3(3), 4-19. https://doi.org/10.15537/smj.2015.2.10289

Agegnehu, G., Atenafu, A., Dagne, H., & Dagnew, B. (2019). Adherence to Iron and Folic Acid Supplement and Its Associated Factors among Antenatal Care Attendant Mothers in Lay Armachiho Health Centers, Northwest, Ethiopia, 2017. *International Journal of Reproductive Medicine, 2*(1), 1–9. https://doi.org/10.1155/2019/5863737

Akowuah, J. A., Agyei-Baffour, P., & Awunyo-Vitor, D. (2018). Determinants of Antenatal Healthcare Utilisation by Pregnant Women in Third Trimester in Peri-Urban Ghana. *Journal of Tropical Medicine, 4*(6), 1–8. ttps://doi.org/10.1155/2018/1673517

Araújo, C. R. M. A., Uchimura, T. T., Fujimori, E., Nishida, F. S., Veloso, G. B. L., & Szarfarc, S. C. (2013). Níveis de hemoglobina e prevalência de anemia em gestantes atendidas em unidades básicas de saúde, antes e após a fortificação das farinhas com ferro. *Revista Brasileira de Epidemiologia, 16*(2), 535–545. https://doi.org/10.1590/S1415-790X2013000200027

Asmare, W. N. (2016). Adherence and associated factors to iron and folic acid supplements among pregnant women attending antenatal clinic in Asella Town, South East Ethiopia. In *EPHA 28th Annual Conference 28th Annual conference, 2016.* https://etpha.org/conference/index.php/28thConference/28thConference/paper/view/719

Auerbach, M. (2018). Commentary: Iron deficiency of pregnancy - A new approach involving intravenous iron. *Reproductive Health, 15(1), 96-100.* https://doi.org/10.1186/s12978-018-0536-1

Ayub, R., Tariq, N., Iqbal, M., & Jaferry, T. (2009). Low haemoglobin levels, its determinants and associated features among pregnant women in Islamabad and surrounding region. *Journal of the Pakistan Medical Association, 59(2), 13-27.* http://www.jpma.org.pk/full_article_text.php?article_id=1617

Begum, K., Ouédraogo, C. T., Wessells, K. R., Young, R. R., Faye, M. T., Wuehler, S. E., & Hess, S. Y. (2018). Prevalence of and factors associated with antenatal care seeking and adherence to recommended iron-folic acid supplementation among pregnant women in Zinder, Niger. *Maternal & Child Nutrition, 14*(3), 124-144. https://doi.org/10.1111/mcn.12466

Birhanu, Z., Chapleau, G. M., Ortolano, S. E., Mamo, G., Martin, S. L., & Dickin, K. L. (2018). Ethiopian women's perspectives on antenatal care and iron-folic acid supplementation: Insights for translating global antenatal calcium guidelines into

practice. *Maternal & Child Nutrition, 14(3), 110-145.* https://doi.org/10.1111/mcn.12424

Bookari, K., Yeatman, H., & Williamson, M. (2017). Informing Nutrition Care in the Antenatal Period: Pregnant Women's Experiences and Need for Support. *BioMed Research International*, *12(4),* 1–16. https://doi.org/10.1155/2017/4856527

Bothwell, T. H. (2000). Iron requirements in pregnancy and strategies to meet them. *The American Journal of Clinical Nutrition*, *72*(1), 257S-264S. https://doi.org/10.1093/ajcn/72.1.257S

Boti, N., Bekele, T., Godana, W., Getahun, E., Gebremeskel, F., Tsegaye, B., & Oumer, B. (2018). Adherence to Iron-Folate Supplementation and Associated Factors among Pastoralist's Pregnant Women in Burji Districts, Segen Area People's Zone, Southern Ethiopia: Community-Based Cross-Sectional Study. *International Journal of Reproductive Medicine*, *12*(5), 13-44. https://doi.org/10.1155/2018/2365362

Brabin, B. Prinsen-Geerligs, P. Verhoeff, F. & Kazernbe, P. (2003) Anaemia prevention for reduction of mortality in mothers and children, *Transactions of The Royal Society of Tropical Medicine and Hygiene*, 91(1), 36–38. doi: 10.1016/s0035-9203(03)90014-9.

Carpenter, C. J. (2010). A Meta-Analysis of the Effectiveness of Health Belief Model Variables in Predicting Behavior. *Health Communication*, *25*(8), 661–669. https://doi.org/10.1080/10410236.2010.521906

Chimatiro, C. S., Hajison, P., Chipeta, E., & Muula, A. S. (2018). Understanding barriers preventing pregnant women from starting antenatal clinic in the first trimester of pregnancy in Ntcheu District-Malawi. *Reproductive Health*, *15*(1), 158. https://doi.org/10.1186/s12978-018-0605-5

Cohen, J. (1983). The cost of dichotomization. *Applied Psychological Measurement*, 7 (3), 247–253. doi:10.1177/014662168300700301

Dessie, M. A., Zeleke, E. G., Workie, S. B., & Berihun, A. W. (2017). Folic acid usage and associated factors in the prevention of neural tube defects among pregnant women in Ethiopia: Cross-sectional study. *BMC Pregnancy and Childbirth*, *17*(1), 17-29. https://doi.org/10.1186/s12884-017-1506-2

Dev, S., & Babitt, J. L. (2017). Overview of iron metabolism in health and disease. *Hemodialysis International*, 21(3), S6–S20. https://doi.org/10.1111/hdi.12542

Diamond-Smith, N. G., Gupta, M., Kaur, M., & Kumar, R. (2016). Determinants of Persistent Anemia in Poor, Urban Pregnant Women of Chandigarh City, North India: A Mixed Method Approach. *Food and Nutrition Bulletin*, *37*(2), 132–143. https://doi.org/10.1177/0379572116637721

Dibley, M. J., Titaley, C. R., D'Este, C., & Agho, K. (2012). Iron and folic acid supplements in pregnancy improve child survival in Indonesia. *American Journal of Clinical Nutrition*, *95*(1), 220–230. https://doi.org/10.3945/ajcn.111.022699

Dibley, M. J., Titaley, C. R., d'Este, C., Agho, K., Wall, S., Ali, N.,& Stephen, C. (2012). Iron and folic acid supplements in pregnancy improve child survival in Indonesia. *American Journal of Clinical Nutrition*, *95*(1), 220–230. https://doi.org/10.3945/ajcn.111.022699

Digssie. G. A., Abebaw, T, S., Abebe A. B., Tadege, E, M., & Tesfa, A, D. (2019). Adherence to iron with folic acid supplementation and its associated factors among pregnant women attending antenatal care follow up at Debre Tabor General Hospital, Ethiopia. *PLoS ONE*, 14(1), 11-23. https://doi.org/10.1371/journal.pone.0210086

Dika, H., Masawe, E., Iddi, S., & Rumanyika, R. (2018). Plasma hemoglobin concentration among pregnant and non-pregnant women in Mwanza: are we using correct reference values to diagnose anemia in pregnancy? *Pan African Medical Journal*, *30*(5), 23-54 https://doi.org/10.11604/pamj.2018.30.93.11954

Dinga, L. (2013). *Factors associated with adherence to iron/folate supplementation among pregnant women attending antenatal clinic at Thika District Hospital in Kiambu County, Kenya* [Masters Dissertation, University of Nairobi]. http://erepository.uonbi.ac.ke/bitstream/handle/11295/56442/Dinga_adherence to Iron/Folate.pdf?sequence=3

Engmann, C., Garces, A., Jehan, I., Ditekemena, J., Phiri, M., Mazariegos, M. & Thorsten, V. (2012). Causes of community stillbirths and early neonatal deaths in

low-income countries using verbal autopsy: an International, Multicenter Study. *Journal of Perinatology*, *32*(8), 585-592. DOI:10.1038/jp.2011.154

Erbe, R. W., & Wang, J. C. C. (1984). Folate metabolism in humans. *American Journal of Medical Genetics*, *17*(1), 277–287. https://doi.org/10.1002/ajmg.1320170120

Fisher A., Laing, J., Stoeckel, J., & Townsend, J. (1991). *Handbook for family planning operations Research Design.* Operations Research, Population Council.

Garnweidner, L. M., & Pettersen, K. S. (2013). Experiences with nutrition-related information during antenatal care of pregnant women of different ethnic backgrounds residing in the area of Oslo, Norway. *Midwifery, 29* (3), 130–137. https://doi.org/10.1016/j.midw.2012.12.006

Gebreamlak, B., Dadi, A. F., & Atnafu, A. (2017). High adherence to iron/folic acid supplementation during pregnancy time among antenatal and postnatal care attendant mothers in Governmental Health Centers in Akaki Kality Sub City, Addis Ababa, Ethiopia: Hierarchical negative binomial poisson regression. *PloS one*, *12*(1), 13-30. https://doi.org/10.1371/journal.pone.0169415

Getachew, M., Abay, M., Zelalem, H., Gebremedhin, T., Grum, T., & Bayray, A. (2018). Magnitude and factors associated with adherence to Iron-folic acid supplementation among pregnant women in Eritrean refugee camps, northern Ethiopia. *BMC Pregnancy and Childbirth*, 18(5), 93-100. https://doi.org/10.1186/s12884-018-1716-2

Greenberg, J. A., Bell, S. J., Guan, Y., & Yu, Y.-H. (2011). Folic Acid supplementation and pregnancy: more than just neural tube defect prevention. *Reviews in Obstetrics & Gynecology*, *4*(2), 52–9. https://pubmed.ncbi.nlm.nih.gov/22102928/

Gupta, S., Yamada, G., Mpembeni, R., Frumence, G., Callaghan-Koru, J. A., Stevenson, R., … Baqui, A. H. (2014). Factors Associated with Four or More Antenatal Care Visits and Its Decline among Pregnant Women in Tanzania between 1999 and 2010. *PLoS ONE*, *9*(7), 101-118. https://doi.org/10.1371/journal.pone.0101893

Habib, M. A., Black, K., Soofi, S. B., Hussain, I., Bhatti, Z., Bhutta, Z. A., & Raynes-Greenow, C. (2016). Prevalence and Predictors of Iron Deficiency Anemia in Children under Five Years of Age in Pakistan, A Secondary Analysis of National Nutrition Survey Data 2011–2012. *PLOS ONE*, *11*(5), 155-201. https://doi.org/10.1371/journal.pone.0155051

Helmy, Elkhouly, N. I., & Ghalab, R. A. (2018). Maternal anemia with pregnancy and its adverse effects. *Menoufia Medical Journal*, *31*(1), 7-15. https://doi.org/10.4103/1110-2098.234258

Ibrahim, Z. M., El-hamid, S. A. B. D., Mikhail, H., & Khattab, M. S. (2011). Assessment of Adherence to Iron and Folic Acid Supplementation and Prevalence of Anemia in Pregnant Women. *The Medical Journal of Cairo University (MJCU)*, *79*(2), 115–121. https://doi.org/10.1186/s12884-020-2835-0

Janz, N. K., & Becker, M. H. (1984). The Health Belief Model: A Decade Later. *Health Education Quarterly*, *11*(1), 1–47. https://doi.org/10.1177/109019818401100101

Jin, J., Sklar, G. E., Min Sen Oh, V., & Chuen Li, S. (2008). Factors affecting therapeutic compliance: A review from the patient's perspective. *Therapeutics and Clinical Risk Management*, *4*(1), 269–86. http://www.ncbi.nlm.nih.gov/pubmed/18728716

Jones, C. L., Jensen, J. D., Scherr, C. L., Brown, N. R., Christy, K., & Weaver, J. (2015). The Health Belief Model as an explanatory framework in communication research: exploring parallel, serial, and moderated mediation. *Health Communication*, *30*(6), 566–76. https://doi.org/10.1080/10410236.2013.873363

Juarez-Vazquez, J., Bonizzoni, E., & Scotti, A. (2002). Iron plus folate is more effective than iron alone in the treatment of iron deficiency anaemia in pregnancy: a randomised, double blind clinical trial. *BJOG: An International Journal of Obstetrics and Gynaecology*, *109*(9), 1009–1014. https://doi.org/10.1111/j.1471-0528.2002.01378.x

Kakati, R., Barua, K., & Borah, M. (2016). Factors associated with the utilization of antenatal care services in rural areas of Assam, India. *International Journal of Community Medicine and Public Health***,** 3(10), 2799-2805. http://dx.doi.org/10.18203/2394-6040.ijcmph20163364

Kamau, M., Kimani, S., & Mirie, W. (2018). Counselling on iron and folic acid supplementation (IFAS) is associated with improved knowledge among pregnant women in a rural county of Kenya: a cross-sectional study. *AAS Open Research, 21(1), 14-27.* https://doi.org/10.12688/aasopenres.12891.1

Kassa, Z. Y., Awraris, T., Daba, A. K., & Tenaw, Z. (2019). Compliance with iron folic acid and associated factors among pregnant women through pill count in Hawassa city, South Ethiopia: A community based cross-sectional study. *Reproductive Health*, 16(1), 14.https://doi.org/10.1186/s12978-019-0679-8

Kavle, J. A., & Landry, M. (2018). Community-based distribution of iron–folic acid supplementation in low- and middle-income countries: a review of evidence and programme implications. *Public Health Nutrition*, *21*(02), 346–354. https://doi.org/10.1017/S1368980017002828

Kenya National Bureau of Statistics (KNBS) and ICF Macro. (2010*). Kenya Demographic and Health Survey 2008-09*. KNBS and ICF Macro. https://dhsprogram.com/pubs/pdf/fr229/fr229.pdf

Kenya National Bureau of Statistics (KNBS). (2015). *Kenya Demographic Health Survey 2014*. KNBS and ICF Macro. https://dhsprogram.com/pubs/pdf/fr308/fr308.pdf

Khan, K. M., & Jialal, I. (2018). *Folic Acid (Folate) Deficiency.* StatPearls Publishing: Treasure Island (FL).

Khaskheli, M.-N., Baloch, S., Sheeba, A., Baloch, S., & Khaskheli, F. K. (2016). Iron deficiency anaemia is still a major killer of pregnant women. *Pakistan Journal of Medical Sciences*, *32*(3), 630–634. https://doi.org/10.12669/pjms.323.9557

Kumari, R., Bharti, R. K., Singh, K., Sinha, A., Kumar, S., Saran, A., & Kumar, U. (2017). Prevalence of iron deficiency and iron deficiency anaemia in adolescent girls

in a tertiary care hospital. *Journal of Clinical and Diagnostic Research*, 11(8), 12-31. https://doi.org/10.7860/JCDR/2017/26163.10325

Kyei, N. N. A., Campbell, O. M. R., & Gabrysch, S. (2012). The influence of distance and level of service provision on antenatal care use in rural Zambia. *PloS One*, *7*(10), 46-75. https://doi.org/10.1371/journal.pone.0046475

Lacerte, P., Pradipasen, M., Temcharoen, P., Imamee, N., & Vorapongsathorn, T. (2013). Determinants of adherence to iron/folate supplementation during pregnancy in two provinces in Cambodia. *Asia-Pacific Journal of Public Health, 23*(3), 15-23. doi: 10.1177/1010539511403133.

Lin, L., Wei, Y., Zhu, W., Wang, C., Su, R., Feng, H., & Yang, H. (2018). Prevalence, risk factors and associated adverse pregnancy outcomes of anemia in Chinese pregnant women: A multicenter retrospective study. *BMC Pregnancy and Childbirth*, 18(4), 11-25. https://doi.org/10.1186/s12884-018-1739-8

Malhotra, N., Upadhyay, R. P., Bhilwar, M., Choy, N., & Green, T. (2014). The Role of Maternal Diet and Iron-folic Acid Supplements in Influencing Birth Weight: Evidence from India's National Family Health Survey. *Journal of Tropical Pediatrics, 60*(6), 454–460. https://doi.org/10.1093/tropej/fmu051

Mateti, U., Kanduri, K., Konda, S., & Medi, R. (2015). Medication adherence and determinants of non-adherence among south Indian diabetes patients. *Journal of Social Health and Diabetes, 3*(1), 48. https://doi.org/10.4103/2321-0656.140892

Mbhenyane, X., & Cherane, M. (2017). Compliance with the consumption of iron and folate supplements by pregnant women in Mafikeng local municipality, North West province, South Africa. *African Health Sciences*, *17*(3), 657–670. https://doi.org/10.4314/ahs.v17i3.8

Mgamb, E., Gura, Z., Wanzala, P., Githuku, J., & Makokha, A. (2017). Folate deficiency and utilization of folic acid fortified flour among pregnant women attending antenatal clinic at Pumwani Maternity Hospital, Kenya, 2015. *The Pan African Medical Journal, 28* (3), 8. https://doi.org/10.11604/pamj.supp.2017.28.1.9296

Miller, J. L. (2013). Iron deficiency anemia: a common and curable disease. *Cold Spring Harbor Perspectives in Medicine, 3*(7), 101-17. https://doi.org/10.1101/cshperspect.a011866

Milman, N. (2011). Anemia - Still a major health problem in many parts of the world! *Annals of Hematology*, 12(4), 11-14. https://doi.org/10.1007/s00277-010-1144-5

Ministry of Health (2013a). *National Iron and Folic Acid Supplementation Communication Strategy*. Government of Kenya, Nairobi.

Ministry of Health. (2013b). *National Policy guideline on Combined Iron and Folic acid*. https://www.k4health.org/sites/default/files/2013_kenya_signed_ifa_policy.pdf

Mithra, P., Unnikrishnan, B., Rekha, T., Nithin, K., Mohan, K., Kulkarni, V. & Agarwal, D. (2013). Compliance with iron-folic acid (IFA) therapy among pregnant women in

an urban area of south India. *African Health Sciences*, *13*(4), 880–885. https://doi.org/10.4314/ahs.v13i4.3

Monica, L. (2011). *Utilization of antenatal care services by pregnant women in the first trimester of pregnancy in Kosirai division, Nandi County, Kenya* [Unpublished Master's Thesis, Moi University]. http://ir.mu.ac.ke:8080/xmlui/handle/123456789/311

Mwaniki, E. W. (2009*). Nutrition Status and associated Morbidity Risk Factors among Children in Orphanages and Non Orphanage Children in selected Primary Schools within Dagoretti Division, Nairobi* [Unpublished Master's Thesis, Jomo Kenyatta University of Agriculture and Technology]. http://ir.jkuat.ac.ke/handle/123456789/1351

Mwaniki, E. W., Mokokha, A. N., & Muttunga, J. N. (2014). Nutrition status and associated morbidity risk factors among orphanage and non-orphanage children in selected public primary schools within Dagoretti, Nairobi, Kenya. *East African Medical Journal*, *91*(9), 289-297. https://www.ajol.info/index.php/eamj/article/view/111073

Nagi, R., Sahu, S., & Nagaraju, R. (2016). Oral health, nutritional knowledge, and practices among pregnant women and their awareness relating to adverse pregnancy outcomes. *Journal of Indian Academy of Oral Medicine and Radiology, 28*(4), 396. https://doi.org/10.4103/jiaomr.JIAOMR_246_15

Niguse, W., & Murugan, R. (2018). Determinants of adherence to iron folic acid supplementation among pregnant women attending antenatal clinic in Asella town, Ethiopia. *International Journal of Therapeutic Applications*, *35(3)*, 60-67. doi: https://doi.org/10.1101/535534

Niquini, R. P., Bittencourt, S. D., Lacerda, E. M., Saunders, C., & Leal, M. d. (2016). Factors associated with non-adherence to prescribed iron supplement use: a study with pregnant women in the city of Rio de Janeiro. *Revista Brasileira de Saúde Materno Infantil*, *16*(2), 189-199. https://doi.org/10.1590/1806-93042016000200007.

Nisar, Y. Bin, Dibley, M. J., & Aguayo, V. M. (2016). Iron-folic acid supplementation during pregnancy reduces the risk of stunting in children less than 2 years of age: A retrospective cohort study from Nepal. *Nutrients*, 8(2), 67. https://doi.org/10.3390/nu8020067

Nsibu, C. N., Manianga, C., Kapanga, S., Mona, E., Pululu, P., & Aloni, M. N. (2016). Determinants of Antenatal Care Attendance among Pregnant Women Living in Endemic Malaria Settings: Experience from the Democratic Republic of Congo. *Obstetrics and Gynecology International*, *8(3)*, 1–7. https://doi.org/10.1155/2016/5423413

Ogden, J., Morrison, K., & Hardee, K. (2014). Social capital to strengthen health policy and health systems. *Health Policy and Planning*, *29*(8), 1075–1085. https://doi.org/10.1093/heapol/czt087

Ogundipe, O., Hoyo, C., Østbye, T., Oneko, O., Manongi, R., Lie, R. T., & Daltveit, A. K. (2012). Factors associated with prenatal folic acid and iron supplementation among 21,889 pregnant women in Northern Tanzania: A cross-sectional hospital-based study. *BMC Public Health*, *12*(1), 481. https://doi.org/10.1186/1471-2458-12-481

Okube, O. T., Mirie, W., Odhiambo, E., Sabina, W., & Habtu, M. (2015). Prevalence and Factors Associated with Anaemia among Pregnant Women Attending Antenatal Clinic in the Second and Third Trimesters at Pumwani Maternity Hospital, Kenya. Kenya. *Open Journal of Obstetrics and Gynecology*, *6(4)*, 16–27. https://doi.org/10.4236/ojog.2016.61003

Oluleke, M. O., Ogunwale, A. O., Arulogun, O. S., & Adelekan, A. L. (2016). Dietary intake knowledge and reasons for food restriction during pregnancy among pregnant women attending primary health care centers in Ile-Ife, Nigeria. *International Journal of Population Studies*, *10*(20), 11-16. https://doi.org/10.18063/IJPS.2016.01.006

Ononge, S., Campbell, O., & Mirembe, F. (2014). Haemoglobin status and predictors of anemia among pregnant women in Mpigi, Uganda. *BMC Research Notes*, *7(10), 683*-712. https://doi.org/10.1186/1756-0500-7-712

Orodho, J. A. (2005). *Elements of Education and social science research methods.* Masola Publishers.

Ouédraogo, S., Koura, G. K., Accrombessi, M. M. K., Bodeau-Livinec, F., Massougbodji, A., & Cot, M. (2012). Maternal anemia at first antenatal visit: Prevalence and risk factors in a malaria-endemic area in Benin. *American Journal of Tropical Medicine and Hygiene*, *87*(3), 418–424. https://doi.org/10.4269/ajtmh.2012.11-0706

Paudel, R. K., Thepthien, B., & Hong, S. A. (2016). Factors Related to Regular Use of ANC Services among Mothers of Children under One Year of Age in Rural Communities of Banke District, Nepal. *Asian Pacific Journal of Health Sciences, 3*(3), 216–222. DOI: 10.21276/apjhs.2016.3.3.34

Peña-Rosas, J. P., De-Regil, L. M., Garcia-Casal, M. N., & Dowswell, T. (2015). Daily oral iron supplementation during pregnancy. In J. P. Peña-Rosas (Ed.), *Cochrane Database of Systematic Reviews*. John Wiley & Sons, Ltd. https://doi.org/10.1002/14651858.CD004736.pub5

Peña-Rosas, J. P., De-Regil, L. M., Malave, H. G., Flores-Urrutia, M. C., & Dowswell, T. (2015). Intermittent oral iron supplementation during pregnancy. *Cochrane Database of Systematic Reviews*, 21(10), 13-27. DOI:10.1002/14651858.CD009997.pub2

Poskitt, E. M. E. (2013). Historical Review early history of iron deficiency. *British Journal of Haematology, 122*, 554–562. doi: 10.1046/j.1365-2141.2003.04529.x.

Priya, S. H, Datta, S.S., Bahurupi, Y.A., Narayan, K. A., Nishanthini, N.,& Ramya, M. R. (2016) Factors influencing weekly iron folic acid supplementation programme

among school children: Where to focus our attention?. *Saudi Journal for Health Sciences, 33(5), 28-33.* https://www.saudijhealthsci.org/text.asp?2016/5/1/28/182863

Rai, S. S., Ratanasiri, T., Thapa, P., Koju, R., Ratanasiri, A., Arkaravichien, T., & Arkaravichien, W. (2014). Effect of Knowledge and Perception on Adherence to Iron and Folate Supplementation during Pregnancy in Kathmandu, Nepal. *Journal of the Medical Association of Thailand, 97(10),S67-S74*. https://europepmc.org/article/med/25816540

Raina, S.K., Mengi, V, &Singh, G. (2020). Differentials in iron folic acid supplementation among pregnant women in a rural area of North-West, India. *International Journal of Health & Allied Sciences, 10(2):9-12.* https://www.ijhas.in/text.asp?2013/2/1/9/110562

Ratanasiri, T., & Koju, R. (2014). Effect of knowledge and perception on adherence to iron and folate supplementation during pregnancy in Kathmandu, Nepal. *Journal of the Medical Association of Thailand, 97*(10), S67-74. https://home.kku.ac.th/cleft/research/JMAT_FINAL/JMAT%20Final%202014/JMAT%202014%20Vol%2097,%20No%2010-10.pdf

Rosenstock, I. M. (2005). Why People Use Health Services. *Milbank Quarterly*, *83*(4), 45. https://doi.org/10.1111/j.1468-0009.2005.00425.x

Roy, M., Singh, S,K., Singh, V,K., Sriivastava, A,K, M. U. (2013). Socio-economic determinants of adherence to iron and folic acid tablets among rural ante-natal

mothers in Lucknow, India. *National Journal of Community Medicine*, *4*(3), 386–391. https://www.bibliomed.org/?mno=266465

Sadore, A. A., Gebretsadik, L. A., & Hussen, M. A. (2015). Compliance with Iron-Folate Supplement and Associated Factors among Antenatal Care Attendant Mothers in Misha District, South Ethiopia: Community Based Cross-Sectional Study. *Journal of Environmental and Public Health, 10*(8), 11-20. doi: 10.1155/2015/781973.

Scott, S. P., Chen-Edinboro, L. P., Caulfield, L. E., & Murray-Kolb, L. E. (2014). The impact of anemia on child mortality: an updated review. *Nutrients*, *6*(12), 5915–32. https://doi.org/10.3390/nu6125915

Seck, B. C., & Jackson, R. T. (2008). Determinants of compliance with iron supplementation among pregnant women in Senegal. *Public Health Nutrition*, *11*(06), 596–605. https://doi.org/10.1017/S1368980007000924

Senoga, I. (2015*). Knowledge, attitudes and practices regarding iron-folic acid (IFA) supplementation in pregnancy: A case study of ANC clients attending KCCA health centres, Kampala* [Unpublished Masters Thesis, Makerere University]. http://makir.mak.ac.ug/handle/10570/5743

Shah, S., Sharma, G., Shris, L., Shah, S. K., Sharma, M., & Sapkota, N. K. (2017). Knowledge on dietary patterns among pregnant women attending antenatal care check-up in Narayani hospital, Nepal. *International Journal Of Community Medicine And Public Health*, *4*(5), 1466. https://doi.org/10.18203/2394-6040.ijcmph20171756

Shaw, A. G. (2012). *Deconstructing Adherence: Understanding patient and provider perceptions of iron and folic acid supplements to promote alternative solutions for maternal anemia in Ayacucho,* Peru [Unpublished Doctoral Dissertation, Emory University]. https://etd.library.emory.edu/view/record/pid/emory:bpsmk

Shewasinad, S., & Negash, S. (2017). Adherence and Associated Factors of Prenatal Iron Folic Acid Supplementation among Pregnant Women Who Attend Ante Natal Care in Health Facility at Mizan-Aman Town, Bench Maji Zone, Ethiopia, 2015. *Journal of Pregnancy and Child Health*, *04*(03), 1–15. https://doi.org/10.4172/2376-127X.1000335

Shorten, A. & Smith, J. (2017) .Mixed methods research: expanding the evidence base *Evidence-Based Nursing*, 20(3), 74-75. doi: 10.1136/eb-2017-102699.

Siabani, S., Siabani, S., Siabani, H., Moeini Arya, M., Rezaei, F., & Babakhani, M. (2018). Determinants of Compliance With Iron and Folate Supplementation Among Pregnant Women in West Iran: A Population Based Cross-Sectional Study. *Journal of Family & Reproductive Health*, *12*(4), 197–203. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/31239847

Sing, S. R., Ratanasiri, T., Thapa, P., Koju, R., Ratanasiri, A., Arkaravichien, T., & Arkaravichien, W. (2014). Effect of knowledge and perception on adherence to iron and folate supplementation during pregnancy in Kathmandu, Nepal. *Journal of the Medical Association of Thailand, 97(10),* 67–S74. https://pubmed.ncbi.nlm.nih.gov/25816540/

Soma-Pillay, P., Nelson-Piercy, C., Tolppanen, H., & Mebazaa, A. (2016). Physiological changes in pregnancy. *Cardiovascular journal of Africa*, *27*(2), 89–94. https://doi.org/10.5830/CVJA-2016-021

Stevens, G. A., Finucane, M. M., De-Regil, M., Paciorek, C. J., Flaxman, S. R., Branca, F. & Ezzati, M. (2013). Global, regional, and national trends in haemoglobin concentration and prevalence of total and severe anaemia in children and pregnant and non-pregnant women for 1995-2011: a systematic analysis of population-representative data. *The Lancet Global Health*, 13(*1*), 16–e25. https://doi.org/10.1016/S2214-109X(13)70001-9

Taye, B., Abeje, G., & Mekonen, A. (2015). Factors associated with compliance of prenatal iron folate supplementation among women in Mecha district, Western Amhara: a cross-sectional study. *Pan African Medical Journal*, *20(3), 14-57*. https://doi.org/10.11604/pamj.2015.20.43.4894

Thorand, B., Schultink, W., Gross, R., Sastroamidjojo, S., & Wentzel, S. (1994). Efficiency of the iron supplementation programme for pregnant women in Jeneponto, Sulawesi, Indonesia. *Asia Pacific Journal of Clinical Nutrition*, *3*(4), 211–5. http://www.ncbi.nlm.nih.gov/pubmed/24351332

Tinago, C. B., Annang Ingram, L., Blake, C. E., & Frongillo, E. A. (2017). Individual and structural environmental influences on utilization of iron and folic acid supplementation among pregnant women in Harare, Zimbabwe. *Maternal & Child Nutrition*, *13*(3), 123-127. https://doi.org/10.1111/mcn.12350

Titaley, C. R., Dibley, M. J., & Roberts, C. L. (2010). Factors associated with underutilization of antenatal care services in Indonesia: results of Indonesia Demographic and Health Survey 2002/2003 and 2007. *BMC public health*, *10*(1), 485. DOI:10.1186/1471-2458-10-485

Titaley, C.R. & Dibley, M.J. (2013), Factors associated with not using antenatal iron/folic acid supplements in Indonesia: the 2002/2003 and 2007 Indonesia Demographic and Health Survey. *The FASEB Journa*l, 27(1), 841. doi:10.1096/fasebj.27.1_supplement.841.6

Ugwu, E., Olibe, A., Obi, S., & Ugwu, A. (2014). Determinants of compliance to iron supplementation among pregnant women in Enugu, Southeastern Nigeria. *Nigerian Journal of Clinical Practice*, *17*(5), 608. https://doi.org/10.4103/1119-3077.141427

United Nations Children's Fund. (2015). *Nutrition Symposium and Launch of the GOK-EU-UNICEF Maternal and Child Nutrition Program Step up Commitment and Collaboration to scale up Nutrition in Kenya Ministry of Health*. https://www.unicef.org/kenya/Concept_Note_-_NS_2015.pdf

Vir, S. C., Singh, N., Nigam, A. K., Jain, & Ritu. (2008). Weekly iron and folic acid supplementation with counseling reduces anemia in adolescent girls: A large-scale effectiveness study in Uttar Pradesh, India. *The Food and Nutrition Bulletin (FNB),* 29(3):186-94. doi: 10.1177/156482650802900304.

White, N. J. (2018,). Anaemia and malaria 11 Medical and Health Sciences 1108 Medical Microbiology 11 Medical and Health Sciences 1103 Clinical Sciences. *Malaria Journal*, 17(5), 19-25. https://doi.org/10.1186/s12936-018-2509-9

World Health Organisation (2006). Standards *for Maternal and Neonatal Care Standards Integrated Management of Pregnancy and Childbirth (IMPAC).* https://www.who.int/reproductivehealth/publications/maternal_perinatal_health/a91272/en/

World Health Organisation (2008a). Conclusions of a WHO Technical Consultation on folate and vitamin B 12 deficiencies. *Food and Nutrition Bulletin*, 29(3), 15-25. https://doi.org/10.1177/15648265080292S129

World Health Organisation (2008b). *Worldwide Prevalence of Anemia*. http://www.who.int/reproductivehealth/publications/maternal_perinatal_health/iron_folate_supplementation.pdf

World Health Organisation (2011). *The global prevalence of anemia in 2011 WHO Library Cataloguing-in-Publication Data*. https://www.who.int/nutrition/publications/micronutrients/global_prevalence_anaemia_2011/en/

World Health Organisation (2012). *Guideline Daily iron and folic acid supplementation in pregnant women*. https://www.who.int/nutrition/publications/micronutrients/guidelines/daily_ifa_supp_pregnant_women/en/

APPENDICES

Appendix I: Informed Consent and Cover Page

Hallo, Am Henry Mburu Ng'ethe a Nutritionist Carrying out a survey on determinants of non-compliance to iron folic acid supplementation during pregnancy, as part of the requirement to graduate with master's degree in Human Nutrition and Dietetics from the University.

You have been selected by chance among other participants. I would like to ask you some questions related to this study.

Involvement in this survey is purely voluntary and you can decide not to participate.

There will be no injections, drawing of anybody fluid involved. All information you will give will be confidential and will be used to make a general report. No names will be included in the report and there will be no way to identify you as one of the people who gave information.

If you have any questions about the study kindly ask me.

Do you mind if we proceed?

Respondent agreed to be interviewed: Mark appropriately.

- ☐ Yes
- ☐ No

Appendix II: Questionnaire

Section A: Background information

1. How old are you?

…….

2. What is your marital status?

- ☐ Single
- ☐ Married
- ☐ Divorced/separated
- ☐ Widowed

3. What is your highest level of education?

- ☐ Primary
- ☐ Secondary
- ☐ College
- ☐ University

4. What is your religion?

- ☐ Christian catholic
- ☐ Christian protestant
- ☐ Muslim
- ☐ African traditional religion

Others (specify)…….

5. What is your occupation?

…….

6. What is your average monthly income?

Ksh…….

7. How many children do you have?

- ☐ None
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4 and above

8. What is the birth order of the child you are expecting?

- ☐ 1st
- ☐ 2nd
- ☐ 3rd
- ☐ 4th
- ☐ 5th
- ☐ 6th
- ☐ 7th

9. Where do you live?

- ☐ Urban

☐ Rural

B. Prevalence of Non-Compliance

10. Have you ever forgotten to take your IFA supplements?
    ☐ Yes
    ☐ No
11. Have you forgotten to take your IFA supplements this week?
    ☐ Yes
    ☐ No
12. If yes in Q.10 and Q.11, what made you forget to take the supplements?

……
……
……

C: IFAS non-compliance and child mortality

13. Hemoglobin levels (Check from booklet)

……

14. Have you ever lost a pregnancy?
    ☐ Yes

    ☐ No

15. If yes, were you taking IFAS tablets?
    ☐ Yes

    ☐ No
16. Had you started attending ANC clinics?
    ☐ Yes

    ☐ No

D: Mothers Understanding on Benefits of IFAs

17. Were you explained to what benefits are there when you take the pills?
    ☐ Yes
    ☐ No
18. What is the purpose of taking IFAS for pregnant women?

……
……

19. Were you taught on dietary sources of Iron and folic acid?
    ☐ Yes
    ☐ No
20. If yes, what foods were you advised to take?

……

……..…….

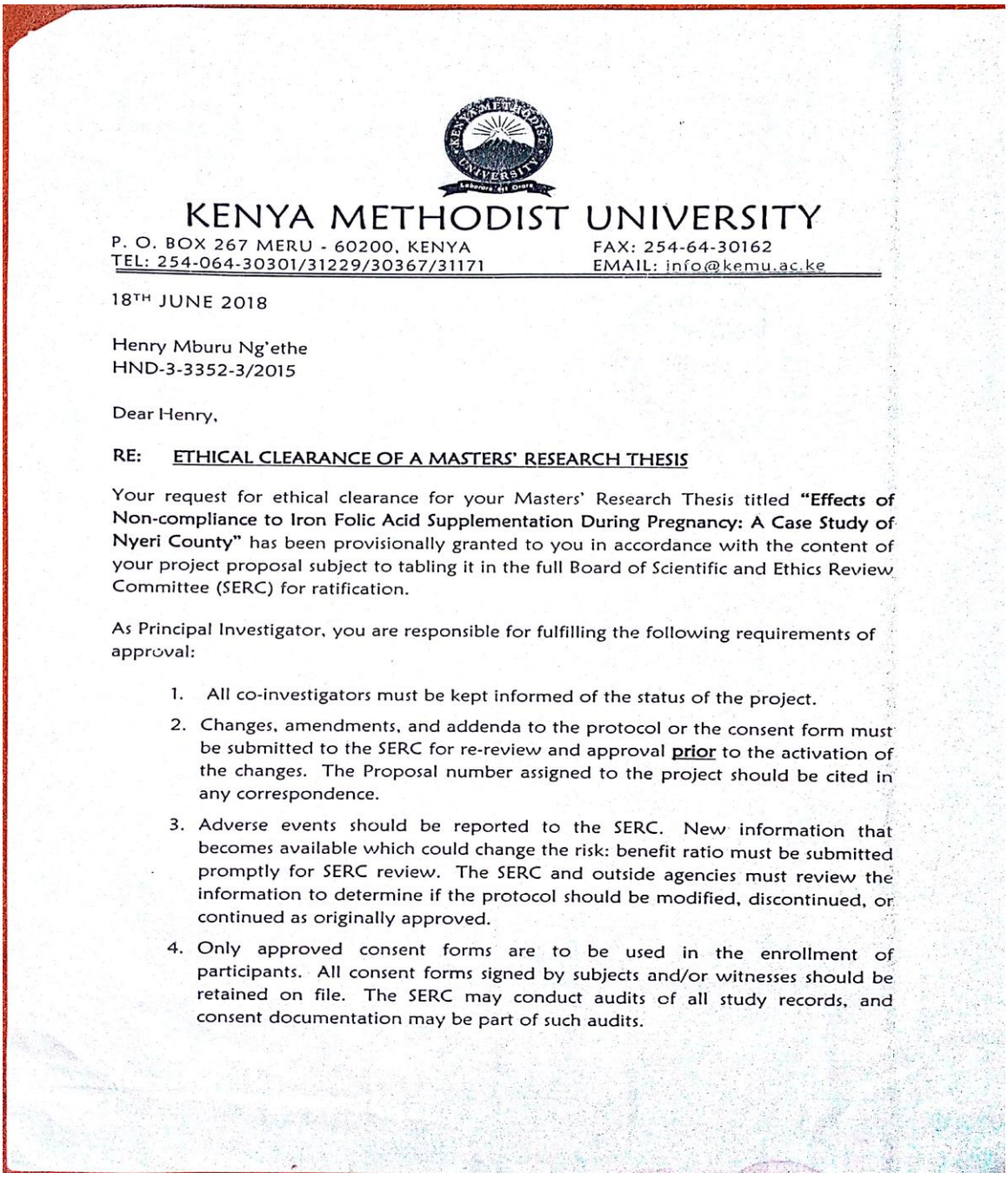
E: Health system

21. How far is your residence from the hospital?

……. Kilometers

22. IFA supplements are always available at the facility when I need them
    - ☐ Strongly agree
    - ☐ Agree
    - ☐ Uncertain
    - ☐ Disagree
    - ☐ Strongly disagree
23. Have you ever bought IFA supplements?
    - ☐ Yes
    - ☐ No
24. If yes in Q. 23 how would you rate the cost?
    - ☐ Very high
    - ☐ High
    - ☐ Fair
    - ☐ Low
    - ☐ Very low
25. Have you ever missed IFA supplements from the hospital?
    - ☐ Yes
    - ☐ No
26. How do you feel about the waiting time when getting IFA supplements?
    - ☐ Very long
    - ☐ Long
    - ☐ Fair
    - ☐ Short
    - ☐ Very short
27. I was informed about IFA supplements and where to get them
    - ☐ Yes
    - ☐ No

Appendix II: Authorization Letters



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18TH JUNE 2018

Henry Mburu Ng'ethe
HND-3-3352-3/2015

Dear Henry,

RE: ETHICAL CLEARANCE OF A MASTERS' RESEARCH THESIS

Your request for ethical clearance for your Masters' Research Thesis titled **"Effects of Non-compliance to Iron Folic Acid Supplementation During Pregnancy: A Case Study of Nyeri County"** has been provisionally granted to you in accordance with the content of your project proposal subject to tabling it in the full Board of Scientific and Ethics Review Committee (SERC) for ratification.

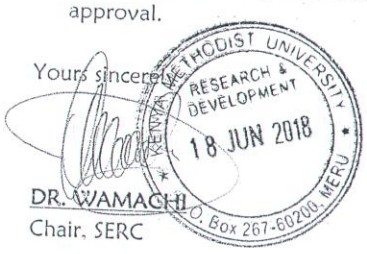
As Principal Investigator, you are responsible for fulfilling the following requirements of approval:

1. All co-investigators must be kept informed of the status of the project.
2. Changes, amendments, and addenda to the protocol or the consent form must be submitted to the SERC for re-review and approval **prior** to the activation of the changes. The Proposal number assigned to the project should be cited in any correspondence.
3. Adverse events should be reported to the SERC. New information that becomes available which could change the risk: benefit ratio must be submitted promptly for SERC review. The SERC and outside agencies must review the information to determine if the protocol should be modified, discontinued, or continued as originally approved.
4. Only approved consent forms are to be used in the enrollment of participants. All consent forms signed by subjects and/or witnesses should be retained on file. The SERC may conduct audits of all study records, and consent documentation may be part of such audits.

5. SERC regulations require review of an approved study not less than once per 12-month period. Therefore, a continuing review application must be submitted to the SERC in order to continue the study beyond the approved period. Failure to submit a continuing review application in a timely fashion will result in termination of the study, at which point new participants may not be enrolled and currently enrolled participants must be taken off the study.

Please note that any substantial changes on the scope of your research will require an approval.

Yours sincerely,



DR. WAMACHI
Chair, SERC

cc: Director, RI & PGS

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

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NAIROBI-KENYA

Ref: No. **NACOSTI/P/18/96063/23882**

Date: **1st August, 2018**

Henry Mburu Ngethe
Kenya Methodist University
P.O. Box 267- 60200
MERU.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Effects of non-compliance to iron folic acid supplementation during pregnancy. A case study of Nyeri County"*** I am pleased to inform you that you have been authorized to undertake research in **Nyeri County** for the period ending **30th July, 2019.**

You are advised to report to **the County Commissioner, the County Director of Education and the County Director of Health Services, Nyeri County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

BONIFACE WANYAMA
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Nyeri County.

The County Director of Education
Nyeri County.

COUNTY GOVERNMENT OF NYERI

P.O. BOX 110- 10100
Telephone
Fax No.
NYERI

Email: nyericountyhealth@yahoo.com

DEPARTMENT OF HEALTH SERVICES

OUR REF: CGN/HEALTH/HRM/5 VOL. II

24th August 2018

The Hospital Director

- Mukurwe-ini Hospital
- Karatina Hospital

The Medical Superintendent

- County Referral Hospital
- Othaya Hospital
- Mt. Kenya Hospital

RE: RESEARCH AUTHORIZATION

The bearer of this letter, **Henry Mburu Ngethe** is pursuing Ms Degree in Human Nutrition and Dietetics sub specializing in maternal infant and young child nutrition at Kenya Methodist University.

He is hence introduced to carry out data collection on **"effects of non – compliance to iron folic acid supplementation during pregnancy in Nyeri County".**

The student **must** deposit a copy of the final report with the department following completion of the study.

Kindly accord him the necessary assistance.

Dr. Nelson Muriu
County Director of Health Services
NYERI COUNTY

Approved
5/12/18

TRAINING AND ETHICS COMMITTEE
NYERI - P.G.H.
P. O. Box 27 - 10100, NYERI