DETERMINANTS OF ADHERENCE TO IRON-FOLIC ACID SUPPLEMENTATION DURING PREGNANCY AMONG MOTHERS SEEKING MATERNAL AND CHILD HEALTHCARE 0-6 MONTHS POST-DELIVERY AT KAKAMEGA COUNTY REFERRAL HOSPITAL

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Determinants of adherence to iron-folic acid supplementation during pregnancy among mothers seeking Maternal and Child Healthcare 0-6 months post-delivery at Kakamega County Referral Hospital

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2022

DECLARATION

This thesis is my original work and has not been presented for a degree in any other University.

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DEDICATION

I dedicate this work to my beloved parents, Zachariah Batala and Rose Khavayi, for their unwavering support throughout my academic journey. A special feeling of gratitude to my all-time friends: Irene Muhonja, Marion Kaila and Breenah Zawadi for being a source of motivation amid the challenges of graduate school and life.

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ABBREVIATIONS AND ACRONYMS

ANC	Antenatal Care
DHS	Demographic Health Survey
FANC	Focused Antenatal Care
FGD	Focus Group Discussion
GLM	Generalized Linear Model
Hb	Haemoglobin
HBM	Health Belief Model
IDA	Iron-Deficiency Anaemia
IFAs	Iron and Folic Acid Supplementation
KDHS	Kenya Demographic Health Survey
KEMRI	Kenya Medical Research Institute
KIIs	Key Informant Interviews
LBW	Low Birth Weight
LMICs	Low and Middle-Income Countries
MCH	Maternal and Child Healthcare
MMR	Maternal Mortality Rate
MoH	Ministry of Health
NCPD	National Council for Population and Development

PNC	Postnatal Care
RBC	Red Blood Cells
REDCap	Research Electronic Data Capture
SDG	Sustainable Development Goals
SSA	Sub-Saharan Africa
UNDP	United Nations Development Programme
UNFPA	United Nations Population Fund
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WHO	World Health Organization

DEFINITION OF TERMS

Adherence	The act of taking iron and folic acid supplements strictly as per the healthcare provider's recommended dosage and timing. The word has been used interchangeably with 'compliance' in this context.
Anaemia	This is a condition where the hemoglobin levels of the blood are less than 11g/dl hence reducing the oxygen-carrying capacity for the Red Blood Cells.
Antenatal Care	It is the preventive care provided by skilled health care professionals to pregnant women to ensure healthy pregnancy outcomes.
Determinants	This term has been used to refer to the factors influencing IFAs adherence. The two terms are used interchangeably.
Multigravida	A woman who has been pregnant at least twice.
Parity	Refers to the number of times that a woman has given birth to a fetus with a gestational age of at least twenty-four weeks, regardless of whether the child was born alive or dead.
Postnatal care	This refers to care provided to the mother and her baby after delivery
Primigravida	A woman who is pregnant for the first time
Supplements	Artificially manufactured micro-nutrients in the form of tablets that are used to complement respective micro-nutrients in the body.

ABSTRACT

Maternal anaemia is a significant contributor to pregnancy-related mortalities worldwide, and its aetiology has been linked to iron deficiency. To meet the increased nutritional demand in pregnancy, supplementation of iron and folic acid is vital. The supplements are provided freely to pregnant women during antenatal visits at public health facilities but their uptake in Kenya remain unacceptably low. We sought to identify the prevalence of self-reported Iron and Folic Acid supplementation (IFAs) adherence during pregnancy and its determinants among mothers seeking Maternal and Child Healthcare (MCH) 0-6 months post-delivery at Kakamega county hospital. To achieve this, an institution based cross-sectional study incorporating a mixed-method study design was conducted between May to August 2020. Both qualitative and quantitative data were collected. Quantitative data were collected through face-to-face interviews with eligible mothers of 0-6 months post-delivery using semi-structured questionnaires. Qualitative data were obtained through Key Informant Interviews (KIIs) with Community Health Volunteers (CHVs) and healthcare providers. During data collection, a systematic random sampling technique was used, and a total of 241 mothers of 0-6 months post-delivery were interviewed. The qualitative data collected were transcribed in Microsoft word 2016 and organized into themes using NVIVO 12. The quantitative data were analyzed using R statistical software version 3.5.2. The findings of the descriptive analysis, Chi-square tests and logistic regression were presented through tables and figures. Inferences were made at a 95% Confidence Interval (CI). The results showed a moderate adherence to IFAs (60.6%) during pregnancy among mothers seeking MCH at Kakamega county hospital. Some of the reasons for non-adherence stated by the respondents included: IFAs related side effects (41.3%), forgetfulness (37.3%) and bad smell of the supplements (10.3%). Higher IFAs adherence was noted among the primigravida participants (OR=2.704; 95% CI: 1.262, 5.793; p=0.010) compared to multigravida participants and those with a higher knowledge level of anaemia (OR=3.215; 95% CI: 1.346, 7.68; p=0.009) compared to their counterparts of low anaemia knowledge. Health system-related factors found to influence IFAs compliance positively were: having had pregnancy counselling before conception (OR=2.086, 95% CI: 1.071, 4.255; p<0.01) and having received education on IFAs during ANC visits (OR=2.372, 95% CI: 1.109, 5.218; p=0.028). Also, KIIs with CHVs linked IFAs adherence to socio-cultural factors such as strong religious beliefs, misconceptions and old age pregnancies. The study concluded that there is a moderate adherence to IFAs during pregnancy among mothers seeking MCH at Kakamega county hospital. The greatest impediments of IFAs compliance during pregnancy are IFAs related side effects, forgetfulness, and the bad smell of the IFAs tablets. We recommend that the MCH department of Kakamega county hospital intensify counselling on IFAs among all the mothers seeking ANC, especially on home-based remedies of IFAs related side effects. Supposedly, little incentives such as issuing a card or certificate to mothers who complete more than 4 ANC visits could boost ANC adherence.

CHAPTER ONE

INTRODUCTION

1.1 Background

Maternal anaemia remains a public health problem worldwide (WHO, 2018a). The World Health Organization (WHO) defines anaemia among pregnant women as having hemoglobin levels of less than 11.0g/dl (WHO, 2020). Anaemia in pregnant women has been attributed to iron deficiency (WHO, 2020). The condition is exacerbated by the high nutrient demand during pregnancy (WHO, 2018d). Globally, almost 40% of pregnant women have been reported to be anaemic with the highest burden being in Africa (WHO, 2022). A recent systematic review of pregnancy related anaemia in Africa showed that 35.6% of the pregnant women in Sub Saharan Africa (SSA) were anaemic (M. Fite et al., 2021). In Kenya, it is estimated that 55.1% of pregnant women have Iron-deficiency anaemia (MoH, 2016). A study conducted at Kakamega county referral hospital noted a 38.9% anaemia prevalence among pregnant women seeking Antenatal Care (ANC) at the facility (Siteti et al., 2014).

To reduce incidences of anaemia among pregnant women, the WHO recommends Iron and Folic Acid supplementation (IFAs) to all pregnant women (WHO, 2016). According to WHO guidelines, daily 30mg-60mg of iron and 0.4 mg of folic acid supplements are essential to all pregnant women and their uptake should be commenced as early as possible once pregnancy has been confirmed (WHO, 2016). However, strict adherence to these supplements is required for better outcomes (Kiwanuka et al., 2017). Evidence suggests that Iron and Folic Acid (iron-folic acid) uptake during pregnancy reduces the chances of Iron-deficiency anaemia to a great extent (Daru et al., 2018). Moreover, adequate iron and folic acid supplements ensure the wellness of the developing fetus by reducing incidences of neural tube defects, puerperal sepsis, preterm birth, congenital heart defects, and low birth weight (Moreno-fernandez et al., 2019; WHO, 2016).

To ensure equitable access, the government provides iron-folic acid supplements to all pregnant women seeking antenatal care (ANC) in public health facilities at no cost (USAID, 2017). However, despite all these efforts, adherence to IFAs among pregnant women in Kenya remains poor (Kamau et al., 2018; USAID, 2017). Although there has been a gradual national upward trend in self-reported IFAs adherence from 2.5% in 2010 (KDHS, 2010) to 8% in 2014, it is clear that this adherence is way below par. In western Kenya where Kakamega hospital is located, IFAs adherence is even lower compared to the national prevalence. The recent national survey reports that only 6.9% of pregnant women in Western Kenya consumed iron-folic acid supplements for at least 90 days of their gestation period (KDHS, 2014).

The causes of poor adherence to iron-folic acid supplement uptake in Kenya are multidimensional. However, inaccessibility to antenatal care services could be the leading contributor to this poor trend (Jinga et al., 2019). Surprisingly, poor adherence has also been confirmed among pregnant women who regularly visit health facilities for ANC (Kassa et al., 2017; Kiwanuka et al., 2017; Niguse & Murugan, 2018). Inadequate knowledge on the importance of IFAs, frequent stock-outs of iron-folic acid tablets in health facilities, forgetfulness, side effects of iron-folic acid consumption and socio-cultural beliefs against use of iron-folic acid supplements in pregnancy have been linked as key barriers to IFAs adherence in various studies (Agegnehu et al., 2018; Digssie et al., 2019; Kiwanuka et al., 2017). The persistently high prevalence of maternal anaemia coupled with poor adherence to IFAs calls for a need for more understanding of the possible causes of the poor adherence trend. This study, therefore, sought to investigate the possible determinants of IFAs adherence during pregnancy among mothers seeking Maternal and Child Healthcare (MCH) 0-6 months post-delivery at Kakamega county referral hospital.

1.2 Problem statement

Although recent reports show that there has been a decline in maternal mortalities world-wide, there is no doubt that the prevalence is still high basing on the SDG target of less than 70 maternal deaths for every 100,000 live births (UNDP, 2016).

According to the WHO, 295,000 maternal mortalities were recorded globally in the year 2017 (WHO, 2019a). Africa and Asia account for disproportionately larger share of this burden of about 86% of the global mortalities. Approximately 20% of the global maternal mortalities occurred in Southern Asia, 5% in South-Eastern Asia and 66% in SSA (WHO, 2019a). Maternal Mortality Rate (MMR) remains unacceptably high in Kenya with 342 maternal deaths being reported for every 100,000 live births (UNFPA, 2022). Kakamega is one of the 15 counties that account for 98.7% of the total maternal mortality in Kenya. It is estimated that approximately 800 maternal deaths occur in this county for every 100,000 live births (UNFPA, 2016). This MMR in Kakamega is more than two-fold compared to national statistics. Although there are several causes of maternal mortality such as early pregnancies (MoH Kakamega county, 2020), maternal anaemia is a significant contributor to this mortality (Khaskheli et al., 2016). Approximately, 55.1% of Kenyan pregnant women have anaemia (MoH, 2016). A study conducted among pregnant women seeking ANC at Kakamega county referral hospital showed that 38.9% of them were anaemic (Siteti et al., 2014).

Chances of birth complications are always higher among anaemic women. To curb this, the WHO advocates for daily supplementation of Iron and folic acid throughout pregnancy. Although there is a paucity of data on global prevalence of IFAs compliance, studies conducted in various countries have shown disparities in IFAs adherence during pregnancy. Unlike the LMICs, IFAs acceptability is quite higher in high-income countries with compliance prevalence ranging from 77% in Denmark to 85% in Sweden (Ba et al., 2019). In SSA, adherence to IFAs is still low with the number of pregnant women compliant to IFAs ranging from 28%-39% (Ba et al., 2019; M. B. Fite et al., 2021). Only 8% of pregnant women in Kenya consumed iron-folic acid supplements for at least 90 days while 30% of them did not take them at all (KDHS, 2014). In western Kenya, iron-folic acid supplementation adherence is low with only 6.9% of pregnant women having reported taking iron-folic acid supplements for at least 90 days of their gestation period while almost 40% admitted not to have used these enhancements at all (KDHS, 2014). The high prevalence of anaemia (38.9%) among pregnant women seeking ANC in Kakamega hospital is a possible cue of the sub-optimal IFAs within this cohort. Although the information on

high anaemia prevalence among pregnant women seeking ANC at Kakamega county referral hospital exists, there is very little data on IFAs compliance rate during pregnancy at Kakamega hospital and county as a whole.

1.3 Justification

Iron is a very essential micro-nutrient during pregnancy as it helps in haemoglobin synthesis. Generally, expectant women have almost 50% more blood than usual, making iron a very important dietary intake. Pregnant women need at least 27 milligrams of iron daily (WHO, 2016). It therefore follows that pregnant women should adhere to IFAs to meet the high demand for iron and folic acid exacerbated by pregnancy (WHO, 2016). Partly, the study aims to establish the prevalence of IFAs adherence among mothers seeking MCH at Kakamega county hospital. Information on the existing prevalence of IFAs adherence will be useful to relevant county stakeholders in assessing the effectiveness of the current IFAs interventions. We reason that understanding the barriers or enablers of IFAs adherence is likely to prompt review of IFAs communication strategy policy especially the second strategy that intends to empower pregnant mothers to adopt appropriate health practices and health seeking behavior regarding ANC and IFAs through behavior change (MoH, 2016).

Exploring the socio-demographic related determinants of IFAs adherence during pregnancy will reveal the key characteristics of women that either enhance or hinder IFAs adherence. This will provide information to key stakeholders in the health sector on which population to target in their interventions. Similarly, understanding the socio-cultural determinants of IFAs adherence will help to identify the myths and misconceptions pertaining to IFAs in the society. Understanding such myths provides an opportunity for targeted behavioral change strategies intended to stop such myths and improve the uptake of good health seeking behaviors. Separately, the study will establish some of the health system enhancers and hindrances of IFAs adherence. This will create insights on the weaknesses and strengths of the current health systems especially with focus on ANC. Unmasking the MCH related strengths and weaknesses of the existing health systems will enable the MoH to come up with ways of utilizing the available limited resources to ensure effective ANC services.

Attaining appropriate IFAs adherence will help mothers achieve sufficient iron and folic acid levels which will reduce the prevalent instances of maternal anaemia amid other birth-related complications. In so doing, the high MMR is likely to reduce. Lowering maternal mortality is one of the vital indicators towards the attainment of the third Sustainable Development Goal (SDG) of good health and wellbeing by reducing maternal mortality to less than 70 deaths for every 100,000 live births (UNDP, 2016). There is, therefore, a need to investigate on IFAs adherence and its associated determinants during pregnancy among mothers seeking MCH 0-6 months post-delivery at Kakamega County Referral Hospital.

1.4 Objectives

1.4.1 General objective

To determine factors influencing adherence to Iron-Folic Acid Supplementation during pregnancy among mothers seeking Maternal and Child Health care 0-6 months post-delivery at Kakamega county referral hospital.

1.4.2 Specific objectives

1. To determine the prevalence of self-reported adherence to Iron-Folic Acid supplementation during pregnancy among mothers seeking Maternal and Child Health care 0-6 months post-delivery at Kakamega county referral hospital.
2. To determine the socio-demographic related factors influencing adherence to Iron-Folic Acid supplementation during pregnancy among mothers seeking Maternal and Child Health care 0-6 months post-delivery at Kakamega county referral hospital.
3. To determine health system-related factors influencing adherence to Iron-Folic Acid supplementation during pregnancy among mothers seeking Maternal and Child Health care 0-6 months post-delivery at Kakamega county referral hospital.
4. To determine the socio-cultural factors influencing adherence to Iron-Folic Acid supplementation during pregnancy among mothers seeking Maternal and Child Health care 0-6 months post-delivery at Kakamega county referral hospital.

1.5 Research questions

1. What is the prevalence of self-reported adherence to Iron-Folic Acid supplementation during pregnancy among mothers seeking Maternal and Child Health care 0-6 months post-delivery at Kakamega county referral hospital?
2. What are the socio-demographic related factors influencing adherence to Iron-Folic Acid supplementation during pregnancy among mothers seeking Maternal and Child Health care 0-6 months post-delivery at Kakamega county referral hospital?
3. What are the health system-related factors influencing adherence to Iron-Folic Acid supplementation during pregnancy among mothers seeking Maternal and Child Health care 0-6 months post-delivery at Kakamega county referral hospital?
4. What are the socio-cultural factors influencing adherence to Iron-Folic Acid supplementation during pregnancy among mothers seeking Maternal and Child Health care 0-6 months post-delivery at Kakamega county referral hospital?

1.6 Conceptual Framework

The conceptual framework shows how IFAs adherence is determined by the interplay of various factors including socio-demographic related factors, health system-related factors and socio-cultural factors. Intervening factors such as iron-folic acid related side effects and distance to the ANC facility also play a crucial role in the model as shown below.

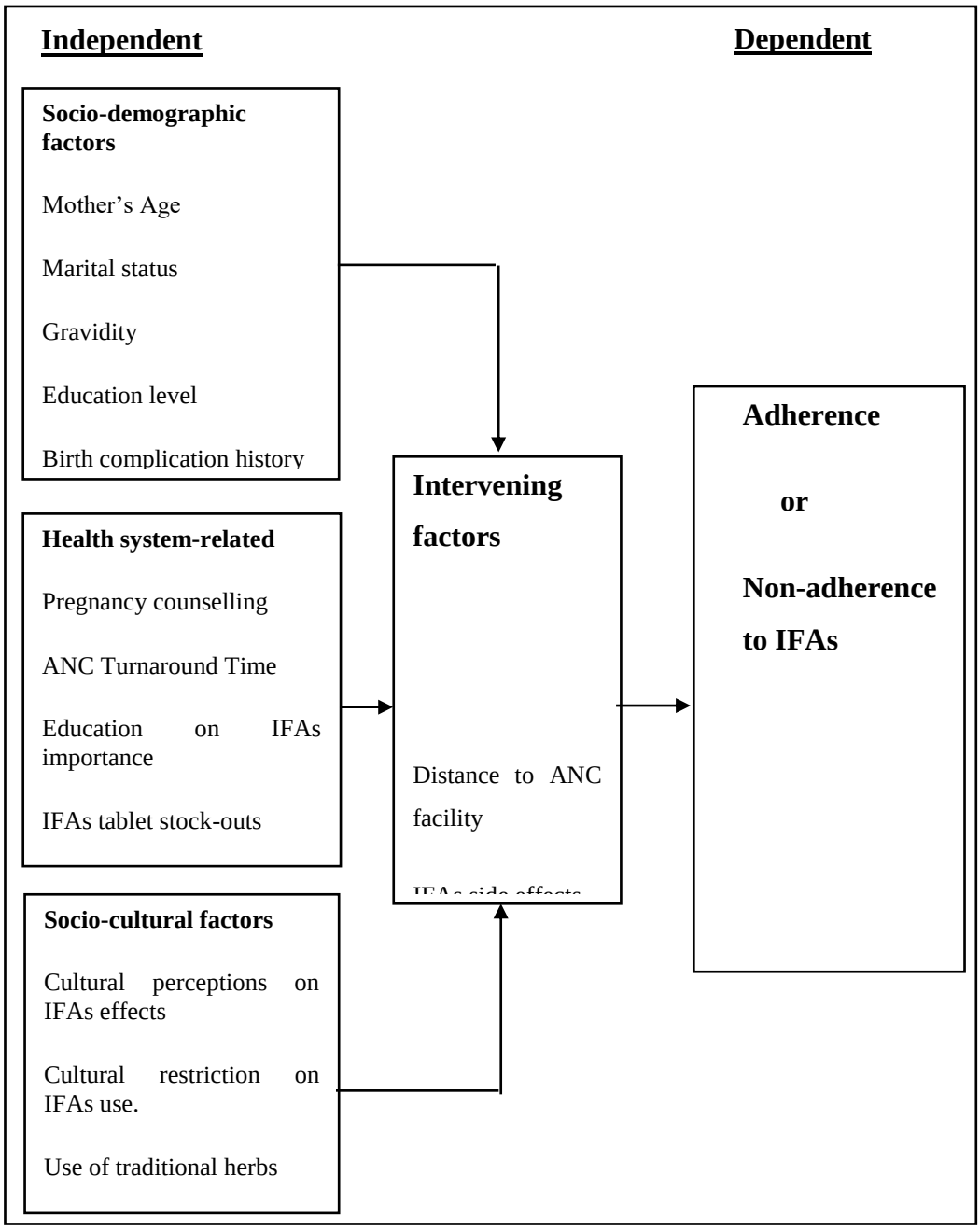

Figure 1.1: Conceptual framework

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This section explores the existing literature about IFAs uptake. The prevalence of IFAs uptake was explored at global level, regional and local level. Most importantly, the existing barriers and enablers of IFAs adherence in various parts of the world were highlighted and critiqued. Also, the methodologies employed in the various studies were of great interest in this chapter. The chapter is concluded by synthesizing important findings from these past studies consequently culminating in a critical knowledge gap that the current study intents to fill.

2.2 Iron-folic acid utilization and adherence in pregnancy

The contribution of Iron and Folic Acid supplements in ensuring healthy pregnancies has been emphasized in various studies including WHO reports (WHO, 2018b). However, strict adherence is key for one to gain maximum benefit from these supplements. The WHO recommends a daily dose of 30-60 mg of iron and 0.4 mg of folic acid for any pregnant woman (WHO, 2016). The supplements have to be initiated as early as possible after conception has been confirmed and then used throughout pregnancy. Not all countries have adopted these guidelines in their health policies though. For instance, China has no health policy on IFAs. Chinese pregnant women are singly supplemented with folic acid for three months before and after pregnancy. In the USA, only iron supplements are provided in low doses of 30 mg per day while Mexico has no guidelines on the standard dosage of antenatal iron (WHO, 2018d). In many countries, health facilities provide avenues for free distribution of supplements to pregnant mothers seeking ANC. Nevertheless, IFAs coverage and compliance remain heterogeneous throughout the world. However, poor coverage and compliance is rampant in the LMICs where the highest maternal mortalities are reported almost every year (Ba et al., 2019).

Sweden and Denmark are some of the developed countries whose IFAs compliance among pregnant women has been ranked highly; 87% and 77% (Ba et al., 2019). In

South Asia, IFAs compliance is diverse within the countries in the region. Precisely, Nepal has experienced an upward trend in IFAs adherence having progressed from 6% in the year 2001 to 71% in 2016. This positive trend has been attributed to the high number of ANC visits recorded in the country (UNICEF, 2018). Equally, other countries in South Asia have registered varied coverage of Iron-folic acid. According to the conference report by UNICEF, the IFAs compliance rates in Afghanistan, India, and Pakistan were 6.8%, 38.8%, and 22.1% respectively as of the year 2016 (UNICEF, 2018). Nonetheless, some regions of India have IFAs adherence as high as 71% while others are way below the national compliance levels (Manasa et al., 2019). Variations in IFAs adherence have also been witnessed in Latin America. Pregnant women in Haiti self-reported an IFAs adherence of 42%. The compliance was not uniform across the country though. The highest adherence was noted in urban areas (58%) as compared to 40% in rural areas (Wang et al., 2019). Niquini and Leal investigated the use of Iron supplements among pregnant women seeking ANC in Rio de Janeiro hospitals in Brazil. The investigators noted that 65% of the studied mothers used iron supplements. However, the study did not explore whether the dosage and consistency of use met the threshold of the guidelines (Niquini & Leal, 2016). In southeast Europe, DHS data in Albania showed low IFAs compliance. Although 63% of women in the country admitted having used IFAs during pregnancy, only 19% of them were compliant to these supplements (Albania Institute of Statistics, 2019).

Poor IFAs coverage and adherence have also been reported in SSA. It is estimated that only 28.7% of pregnant women in SSA are compliant with IFAs (Ba et al., 2019). Although some countries have reported IFAs adherence levels that are slightly higher than the region's 28.7%, other countries like Rwanda have registered as low as 1% compliance (Ba et al., 2019). In South Africa, 51% of pregnant women are compliant with IFAs while 9% do not use iron-folic acid supplements at all (S.Africa DHS, 2019). Senegal has the highest IFAs compliance in SSA with 73% of pregnant women having used iron-folic acid supplements as recommended (Ba et al., 2019). Wang and colleagues reported an IFAs compliance of 35% among pregnant women in Malawi. Nevertheless, the researchers described the adherence as non-homogenous. High compliance (44%) was noted in the urban setting as compared to

32% in the studied rural area (Wang et al., 2019). Several studies in Ethiopia have also reported different adherence levels in various parts of the country. Assefa et al reported an IFAs adherence of 47.6% in Northwest Ethiopia while Demis and colleagues noted a 43% adherence in almost the same region of Northern Ethiopia (Assefa et al., 2019; Demis et al., 2019). In Southern Ethiopia, Kassa et al reported an adherence of 38.3% with the majority of the users being mothers who had knowledge of IFAs (Kassa et al., 2019). However, these regional compliance rates in Ethiopia are very high as compared to the national IFAs adherence level of 5% reported by the Central Statistical Agency of Ethiopia (CSA, 2017).

Nationally, 8% of pregnant women in Kenya are IFAs compliant. The lowest adherence was noted in North-Eastern (1.2%) and Rift valley regions (4.3%) (KDHS, 2014). Studies conducted in some counties of Kenya have shown great disparities in levels of adherence. Juma et al reported an IFAs adherence of 18% in the rural part of Machakos county while Kamau and others noted a 32.7% adherence in Kiambu (Juma et al., 2015; Kamau et al., 2018). Specifically, the western part of Kenya has an IFAs adherence of 6.9% which is slightly below the national adherence level (KDHS, 2014).

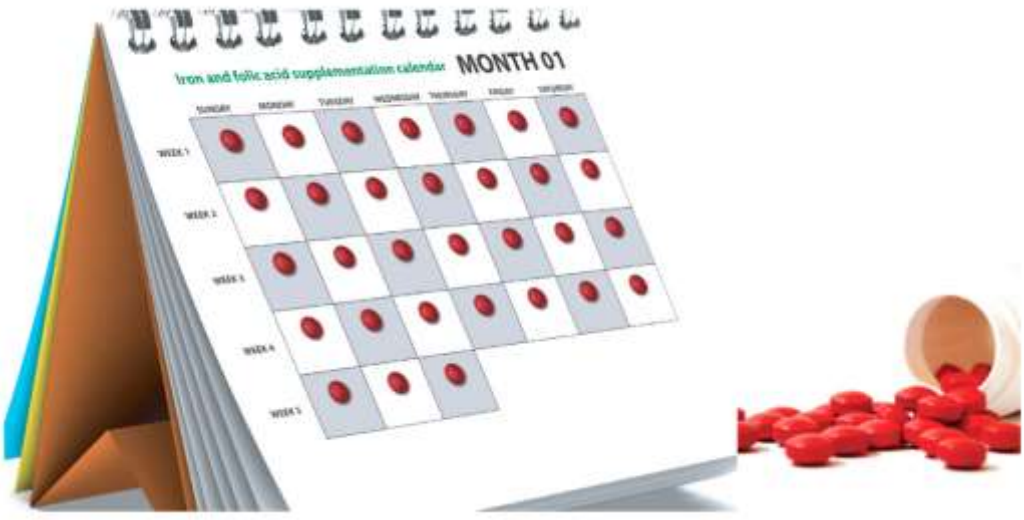

Figure 2.1: Iron-folic acid supplements taken daily from conception to birth.

2.3 Consequences of iron and folic acid deficiencies in pregnancy

2.3.1 Anaemia

The WHO defines anaemia condition among pregnant women as having haemoglobin levels of less than 11.0g/dl at sea level (WHO, 2018c). It is estimated that 38.2% of all pregnant women globally have iron deficiency anaemia (WHO, 2014). This translates to about 32 million cases of maternal anaemia worldwide. The greatest burden of this problem has been reported in South East Asia (48.7%) followed by Africa (46.3%) while the Western Pacific region has the lowest prevalence of 24.3% (WHO, 2014). Although this morbidity poses a threat to both maternal and neonatal lives, recent statistics show a downward trend in many parts of the world. For instance, cases of maternal anaemia reduced from 48 million in South-East Asia in the year 2008 to about 11 million in the year 2011. The same trend was also noted in Africa with cases reducing from 17 million as reported in 2008 to about 9 million cases in 2011(WHO, 2014). Recent reports on maternal anaemia in SSA indicate that approximately 46.3% of the pregnant women in this region are anaemic, a great reduction compared to 57.1% noted in the year 2008 (Adam et al., 2018). Cases of severe maternal anaemia have been reported in countries such as Congo DRC, Angola, Benin and Burkina Faso.

The prevalence of anaemia among pregnant women in Kenya is still high. Approximately, 55.1% of Kenyan pregnant women are anaemic (MoH, 2016). Okube et al recorded an anaemia prevalence of 57% among pregnant women who sought ANC services at Pumwani hospital in Nairobi city (Okube et al., 2016). A similar study among pregnant women in Mbagathi district hospital, however, recorded a slightly lower prevalence of 40.7% (Ndegwa, 2019). At Kakamega county referral hospital, almost 40% of the pregnant women seeking ANC services at the facility are anaemic (Siteti et al., 2014).

2.3.2 Maternal mortalities

Maternal mortality refers to deaths resulting from a pregnancy related complication or childbirth. Although a decline in maternal mortality has been reported in the past

years, the current prevalence is still far from the target of less than 70 deaths for every 100,000 live births. Recent statistics show that 295,000 pregnancy related deaths occurred in the year 2017 (WHO, 2019a). This simply translates to 211 deaths for every 100,000 live births, a 38% decrease as compared to the year 2000. Unlike higher-income countries, maternal deaths are very pronounced in LMICS. The WHO, world bank and UNICEF reports estimate that 415 mothers die in LMICs for every 100, 000 live births. These mortality rates are by far higher as compared to countries in developed continents such as Europe, Australia and New Zealand. In SSA, 542 pregnancy related deaths occur for every 100, 000 live births translating to 66% maternal mortality (WHO, 2019b). In Kenya, 342 maternal deaths are reported for every 100,000 live births. Counties such as Mandera, Wajir and Turkana have the highest maternal mortality rates of 3795, 1687 and 1594 respectively. In Kakamega county, at least 800 maternal lives are lost for every 100,000 live births. Surprisingly, 44% of these maternal deaths are associated with haemorrhage, a condition that is exacerbated by iron deficiency (KDHS, 2014; NCPD, 2015; UNFPA, 2016). It's however worth acknowledging that the high prevalence of maternal mortalities in counties such as Kakamega may not be unidirectional. Evidence suggests that other factors such as early pregnancies and overall poor health seeking behaviours contribute to these maternal mortalities (MoH Kakamega county, 2020).

Maternal mortalities have several causes ranging from abortion, hypertension, preeclampsia, haemorrhage and unsuccessful caesareans. Nevertheless, maternal anaemia contributes a significant percentage of these mortalities. It is estimated that 20% of the total global maternal deaths can be attributed to anaemia, independent of postpartum haemorrhage. Moreover, 50% risk of mortality has been reported among pregnant anaemic women world-wide. Asia is the leading continent with the highest number (12%) of maternal deaths attributable to maternal anaemia (Khaskheli et al., 2016). A multilevel regression analysis conducted in a Lancet series noted an association between maternal anaemia and death. The analysis involved data from 29 countries across Latin America, Africa, East Mediterranean, West Pacific and South East Asia. In the series, Daru and colleagues noted that mothers with severe anaemia had an increased risk of mortality compared to their fellow pregnant women who were not severely anaemic (Daru et al., 2018). This finding concurred with another

study in Pakistan where researchers investigated the risk of mortality among anaemic pregnant women referred for treatment in a higher tier hospital. It was noted that the risk of maternal mortality was even higher among pregnant mothers who had anaemia and its related co-morbidities (Khaskheli et al., 2016). There are three main reasons that can account for the anaemia related deaths among pregnant women. Usually, mothers with low Hb levels are prone to bad pregnancy outcomes. The situation gets even worse in the case of postpartum haemorrhage which results in severe anaemia. Pregnant women with severe anaemia have reduced resistance to infections. Besides being susceptible to infections, these women are prone to chronic conditions such as cardiac arrest which may lead to deaths during delivery (Khaskheli et al., 2016).

2.3.3 Low birth weight and preterm birth

Low birth weight (LBW) and preterm birth have been described as some of the consequences of iron deficiency during pregnancy. Low birth weight babies are babies born weighing less than 2500g. Conversely, preterm birth refers to instances where babies are born without having fully completed their gestational age of at least 37 weeks. Many instances of either preterm birth or LBW have been reported during cases of iron deficiency anaemia. Pregnant mothers with iron deficiency anaemia have very low Hb levels especially when the condition is severe. Reduced Hb levels trigger placental angiogenesis which limits oxygen supply to the foetus. This causes restricted intrauterine growth as well as low birth weight (Figueiredo et al., 2018).

A prospective cohort study conducted in Brazil revealed an association between low Hb levels and low birth weight. Specifically, women diagnosed with anaemia had higher chances of giving birth to LBW babies (Figueiredo et al., 2019). Similarly, some systematic reviews showed that mothers who were anaemic in the first and second trimesters were more likely to experience preterm birth as well as LBW babies (Rahman et al., 2016; Young et al., 2019). This relationship was also replicated by Rahmati et al who noted that being anaemic within the first trimester of pregnancy had a non-protective influence on pregnancy outcomes such as LBW and preterm birth. The association was only plausible in the first trimester though (Rahmati et al., 2017). Interestingly, some studies have reported contradicting

findings on the relationship between maternal anaemia and LBW. Precisely, a longitudinal study conducted among pregnant women in Papua New Guinea showed that low iron deficiency was associated with high birth weights (Fowkes et al., 2018).

2.3.4 Congenital malformations

Iron and folic acid deficiency have been reported to play a significant role in congenital abnormalities which may occur at any time of gestation (WHO, 2016). Cases of foetal neural tube defects, cleft lips, spina bifida, club foot and cardio vascular malformations are common in cases of iron and folic acid deficiencies (Safi et al., 2012; WHO, 2016). Studies have also reported on the protective effect of these supplements against foetal anencephaly, spina bifida and reduced limb (De-regil et al., 2014). Usually, iron and folic acid play a critical role during certain stages of foetal development. For example, the two supplements play a big role during the first trimester when the neural tube of the foetus begins to differentiate into the brain and the spinal cord. Any intermittent shortage in the supply of these two micronutrients, therefore, may lead to abnormal development process consequently resulting in congenital malformations (WHO, 2018b). A meta-analysis conducted by Kozuki et al involving 12 studies investigating the relationship between low haemoglobin levels and intrauterine growth retardation showed that moderate and severe anaemia played a huge role on this perinatal condition (Kozuki et al., 2012). The intrauterine growth retardation restricts the growth of the unborn baby which eventually leads to delayed growth of the foetus. Babies with delayed growth are vulnerable to health problems during pregnancy, births and even after births.

2.4 The aetiology of anaemia

The causes of anaemia are multifactorial. However, Iron deficiency has been reported as the leading cause of this morbidity, especially during pregnancy. Iron is an important micronutrient that plays many roles in the body. Usually, 65-80% of the iron in the blood is in the form of haemoglobin which is a vital protein concerned with transportation of oxygen to body tissues. Moreover, iron is involved in some physiological reactions that produce energy for the body. There are two types of iron; the heme iron and the non-heme. Heme iron is derived from haemoglobin and

therefore exists in foods that initially contain heme. Such foods include; Red meat, poultry, liver, and seafoods. In most cases, the body absorbs non-heme iron from plant products such as beans, green vegetables among others.

In some instances, however, it becomes difficult to obtain sufficient iron from the foods. Pregnant women from poor families hardly get enough iron from foods due to limited diet diversification. This is because poor families may not have enough resources to acquire a balanced diet to nourish the body with sufficient iron. The situation gets even worse when cultural beliefs set in. Qualitative studies have reported on some communities where women are restricted from consuming some foods during pregnancy (Chakona & Shackleton, 2019; Lennox et al., 2017; Monchari et al., 2017). Unfortunately, some of the restricted foods could be common sources of iron. The practice is rampant in LMICs countries though. Commonly, poor families have a higher number of children. Women who have many children especially at shorter intervals are prone to anaemia. This is because their iron stores get depleted faster than they can be replenished due to shorter recovery time from the previous pregnancy. Nevertheless, there cases where iron may not be absorbed into the circulatory system besides the consumption of iron-rich foods. The bioavailability of iron can be influenced by other nutrients such as vitamin A and folic acid.

At puberty, women lose blood through menstruation. Although menstruation is a normal physiological process, there is a need to replenish the iron lost through blood loss in this process. Adolescent ladies who do not get a good balanced diet may experience iron deficiency anaemia during pregnancy due to depleted iron stores. Cases of heavy menstrual bleeding have also been reported on some contraceptives. Specifically, women on Intrauterine devices (IUDs) experience heavy menstrual flows (Sanders et al., 2018). It is estimated that 0.5mg of iron is lost for every 1ml of blood that leaves the circulatory system. This, therefore, implies that women who experience heavy menstrual flow lose large amounts of iron.

Save for iron deficiency, there are some genetic conditions that lead to anaemia. The conditions are not selective to pregnant women but their impact may be severe if they occur in this cohort. Conditions such as thalassemia, sickle cell anaemia and

aplastic anaemia affect the bone marrow stem cells and therefore interfere with erythropoiesis. Under such conditions, abnormal erythrocytes may be formed. Abnormal erythrocytes are not useful to the body and are therefore destroyed frequently resulting to anaemia.

Blood and intestinal parasites can also contribute to anaemia. When the infective stage of malaria parasites enters the circulatory system after a mosquito bite, the red blood cells get infected. The parasite continues to grow and multiply and by the time the development cycle gets completed, the infected erythrocytes raptures. The raptured erythrocytes are destroyed from the system and this reduces the number of erythrocytes in the circulatory system. The reduced number of red blood cells leads to anaemia and if treatment is not administered early enough, malaria may lead to severe anaemia. Besides malaria, intestinal parasites such as hookworms, schistosomes and roundworms may cause anaemia, especially in pregnancy. Hookworms attach themselves to the villi within the small intestines of their hosts and feed on the host's blood. Pregnant mothers with inadequate iron intake often develop anaemia due to infestation with such parasites. A study conducted in a municipal hospital in Ghana noted a positive correlation between malaria infection status and anaemia among pregnant mothers (Anlaakuu & Anto, 2017). In their study in which anaemia prevalence of 40% was reported, Anlaakuu and Anto noted that malaria-infected mothers where seven times likely to have anaemia compared to their counterparts who were malaria negative. In the coastal region of Kenya, McClure and colleagues reported a correlation between high-intensity hookworm and P. *falciparum* comorbidity and anaemia (Mcclure et al., 2014). However, the study did not establish a significant correlation between maternal anaemia and infestation with other intestinal parasites such as *S. haematobium* and *T. trichura.* Likewise, Bolka and Gebremedhin conducted such a study in Southern Ethiopia. They noted that pregnant women infected with any type of intestinal parasite were six times likely to have anaemia (Bolka & Gebremedhin, 2019). An overall anaemia prevalence of about 31% was reported.

Generally, the body needs for iron goes up during pregnancy. This is because most of the iron in the body is used to enhance the expanding RBC mass, foetal growth and

other pregnancy-related requirements. It is estimated that iron demand goes up to three times during the gestation period. It is due to this significant role of iron that the WHO came up with guidelines on iron supplementation. A systematic review conducted by Bhutta et al showed that supplementation of iron through IFAs resulted to increase in haemoglobin levels to up to 12g/dl. The systematic review further suggested that mothers who used IFAs had approximately 73% reduced risk of maternal anaemia (Bhutta et al., 2008). Equally, a review conducted by Imdad and others confirmed that IFAs could reduce up to 69% incidences of maternal anaemia (Imdad & Bhutta, 2012).

2.5 Prevention and treatment of iron deficiency anaemia

2.5.1 Iron and Folic Acid Supplementation.

Most women do not seem to be aware of their nutritional status prior to conception. In some instances, women have become pregnant oblivious of their anaemic status (Gopinath et al., 2016). The anaemic condition is likely to be exacerbated by the pregnancy since their nutritional requirements are higher during such a gestation period. However, with the adoption of IFAs, these conditions could be reversed such that pregnant mothers have sufficient iron, folic acid and haemoglobin levels suitable for the growth of the developing embryo levels and birth. Although these supplements could be offered in various formats including intravenous injections and syrups. Ferrous sulphate, Folic acid tablets and a combination of iron-folic acid tablets are commonly used in Kenya. These tablets have 30-60 mg of iron and 0.4 mg of folic acid. Adherence is said to have been achieved completely if a pregnant mother takes these tablets on a daily basis right from conception to birth (WHO, 2016). Sometimes, the WHO advises any mother planning to conceive should be put on folic acid supplements prior to conception as a prophylactic measure. As much as this idea of providing supplementation for these two key nutrients seems helpful to pregnant mothers, adherence remains the greatest challenge.

2.5.2 Diet with proper nutrients

Proper diet consumption prior and during pregnancy is vital for pregnancy sustenance (WHO, 2016). Pregnant women are advised to consume foods that are rich in iron, folic acid, vitamin C, vitamin B12 among others. Foods that could help boost iron levels of pregnant mothers include; dark leafy greens, nuts, poultry, fish and fruits. Plant products provide nonheme iron while animal products provide heme iron. Pregnant women who do not consume properly balanced diets are more likely to develop iron deficiency anaemia.

2.5.3 Red Blood Cell transfusion

Red Blood Cell transfusion remains the main option in cases of severe anaemia. The main principle behind the transfusion is that the newly transfused Red Blood Cells will help in the transportation of oxygen to tissues thus relieving them from tissue hypoxia (Buelvas, 2013). However, this method has its own challenges such as the risk of infections, immune suppression and errors in administration could be fatal (Ackfeld et al., 2022; Khan & Gupta, 2022). In most cases, health care providers try to reverse the anaemia cases while still in a mild and moderate stage. Nevertheless, there are cases where Blood transfusion becomes inevitable especially in cases of spontaneous blood loss such as haemorrhage and uncontrolled bleeding.

2.5.4 Food fortification

Food fortification refers to the addition of nutrients to food at higher levels such that it supersedes the level of nutrients that the initial food contained. Various nutrients and micronutrients have been added to foods just to ensure that the targeted consumer gets the right amount of nutrients. Through food fortification, folate levels can be improved in foods. For example, some studies have emphasized the effectiveness of fortifying wheat flour with folic acid. A meta-analysis of randomized control trials on providing folic acid fortification among mothers with a birth history of neural tube defects showed a 70% reduction in recurrence of this congenital malformation (UNICEF, 2014). Moreover, another investigation revealed that folic acid fortification could reduce about 46% of incidences of neural tube

defects (Blencowe et al., 2010). Besides, some reports have shown that all countries that made it mandatory for folic acid fortification on wheat have reduced cases of neural tube defects (UNICEF, 2014).

2.6 Factors influencing IFAs adherence

2.6.1 Socio-demographic factors influencing IFAs adherence

Studies conducted in the recent past have demonstrated the interaction between socio-demographic related factors and IFAs adherence. Mother's knowledge of IFAs and anaemia plays a role on IFAs compliance. According to Kamau et al, pregnant women who had adequate knowledge of anaemia and IFAs in Kiambu were more likely to be IFAs compliant (Kamau et al., 2018). A similar study conducted among ANC seeking women at a general hospital in Ethiopia also noted this correlation between the mother's knowledge of IFAs and IFAs adherence. The study noted that mothers with adequate IFAs knowledge were three times more likely to be IFAs compliant, unlike their counterparts who were less knowledgeable (Digssie et al., 2019). This concurred with Kassa et al who investigated IFAs compliance in Ethiopia through pill count. The study noted that women with higher knowledge of IFAs were six times more likely to be IFAs compliant (Kassa et al., 2019). The same finding was also replicated by Ugwu et al in Nigeria (Ugwu et al., 2014). However, Rai and others had a different finding from this. In their study conducted in one of the biggest hospitals in Nepal, the researchers noted that pregnant women who had insufficient knowledge of IFAs were more likely to be IFAs compliant as compared to those who had sufficient knowledge (Rai et al., 2016).

Although in varying magnitudes, mother's education level has shown to have a great influence on IFAs compliance. In many studies, mothers with higher education levels have had higher chances of adhering to IFAs. A study conducted among the third trimester and postal mothers seeking MCH in six government hospitals in a sub-city in Ethiopia showed that mothers who had attained secondary school education and beyond were compliant to IFAs (Gebreamlak et al., 2017). This was consistent with Taye et al who investigated IFAs adherence through a community-based survey in Western Amhara. The survey reported that literate mothers were four times more

likely to be IFAs compliant as compared to their fellow women who could not read or write (Taye et al., 2015). In India, Wendt and others noted a similar trend where women who had received education for at least 5 years had higher chances of consuming 90 tablets of iron-folic acid during pregnancy. This trend could be attributed to the fact that educated women have access to health information. Women who have access to information are in a better position to know the importance of IFAs as well as the consequences of Iron deficiency anaemia.

In some instances, mothers' efforts to comply with IFAs adherence have been affected by forgetfulness. Mothers who forget to take iron-folic acid tablets at intervals stipulated by the health care provider are less likely to meet the high physiological demands of iron and folic acid during pregnancy. This problem has been revealed in various studies. The FGD conducted by Getachew and his colleagues among pregnant women in Eritrean refugee camps revealed that forgetfulness was a great impediment to IFAs compliance. Some women quoted during the FGD said that they had a tendency of forgetting to take the iron-folic acid tablets, a practice that made them fail to achieve the recommended dosage (Getachew et al., 2018). Mithra et al reported that almost half of the pregnant women interviewed in the urban section of South India failed to adhere to IFAs due to forgetfulness (Mithra et al., 2014). A study conducted in Asella town of Ethiopia also reported this finding (Niguse & Murugan, 2018). Suggestions have been made to improve on counselling so as to circumvent this problem. It is argued that mothers should be encouraged to correlate the consumption of iron-folic acid tablets with natural phenomena such as sunrise, lunchtime or even sunset. This is thought to be a good way of letting mothers remind themselves when to take the tablets (Getachew et al., 2018).

Although not deleterious, some side effects have been reported among pregnant women consuming IFAs tablets. Nevertheless, the magnitude of these side effects varies from one individual to another. Apparently, some women who consumed iron-folic acid tablets have reported on side effects such as; vomiting, dizziness, constipation, heartburn, stomach cramps, diarrhoea among others. The side effects are so diverse that there seems not to be a standard way of defining them, which

makes their management difficult at times (WHO, 2016). In the western part of Kenya, an FGD conducted within a group of pregnant women revealed that most of them experienced nausea, fatigue and constipation while on iron-folic acid supplements. Surprisingly, the women reported that they had not been informed on how to manage the side effects by their health care providers. Consequently, some of them came up with their own ways of managing the side effects while others stopped taking the tablets altogether (USAID, 2017). Kassa et al noted that IFAs related side effects affected women's compliance with these supplements to a great extent in Hawassa city, Ethiopia (Kassa et al., 2019). The researchers noted that most of the study participants complained of diarrhoea, nausea, heartburn and vomiting while on iron-folic acid supplements. A clinical trial conducted in Northern Vietnam reported fever, headache, vaginal discharge, dark coloured stool and nausea as some of the side effects among pregnant women consuming iron-folic acid supplements (Gonzalez-casanova et al., 2017). However, the study did not establish a significant correlation between IFAs adherence and its side effects. On the contrary, Gebreamlak et al reported a significant correlation between IFAs side effects and adherence among pregnant women in Addis Ababa. Their study noted that the incidence of consuming a higher number of iron-folic acid tablets decreased among mothers who reported on any side effect. The study further noted that heartburn was the most common side effect as it was mentioned by almost every mother who had experienced IFAs side effects (Gebreamlak et al., 2017). In Northern Ethiopia, the qualitative section of a mixed-method study conducted in a refugee camp revealed that most women did not comply with IFAs due to fear of side effects (Getachew et al., 2018). It is emerging that fear of side effects is a common problem among pregnant women on IFAs. However, this could be handled through rigorous counselling at the health facilities. Women seeking ANC need to be constantly reminded that the side effects are always mild and self-management could help alleviate them.

Many studies have investigated the role of maternal age with regard to IFAs compliance. A study conducted in Southern Ethiopia revealed a significant correlation between maternal age and IFAs compliance. Specifically, mothers aged 25 years and beyond had higher chances of adhering to IFAs compared to younger

mothers (Sadore et al., 2015). Sadore et al argued that older women were more concerned about their health and pregnancy outcomes as compared to young mothers. This concurred with Mithra et al who also noted that mothers aged 25 years and above in Southern India had higher odds of IFAs compliance (Mithra et al., 2014). In Khartoum, Abdullahi and his colleagues noted a good correlation between maternal age and IFAs compliance. The study reported that older mothers were three times more likely to use iron-folic acid supplements as compared to their younger counterparts (Abdullahi et al., 2014). As much the study does not explain the phenomena behind this trend, Abdullahi and others acknowledge that the trend is likely to vary from one setting to another. In Kenya, the findings by Kamau et al did not agree with the previous studies in Khartoum, Southern India and Southern Ethiopia. In their study, Kamau and others reported that younger mothers aged 18 years and below were more likely to be compliant with IFAs as compared to older mothers. The investigators attributed this finding to the fact that young mothers are fresh from school and therefore better placed to understand the importance of IFAs as well as the consequences of anaemia (Kamau et al., 2018). The other two studies conducted in Kiambu and Machakos counties of Kenya failed to establish this correlation between maternal age and IFAs compliance. In Machakos, Juma and other investigators reported that maternal age neither influenced the number of days of iron-folic acid use nor played a role in attaining optimum usage of IFAs (Dinga, 2013; Juma et al., 2015).

Chances of multi-gravidity tend to increase with the mother's age. Mothers who have given birth on two or more occasions may exhibit different maternal-health seeking behaviours as compared to mothers with a single birth. When it comes to IFAs compliance, various studies have established different relationships with regard to the mother's gravidity. In Ethiopia, Niguse and Murugan noted a higher possibility of IFAs compliance among multigravida mothers as opposed to the primigravida. Their study revealed that primigravida mothers were up to 66% less likely to be IFAs compliant as compared to their multigravida counterparts. The study investigators attributed this to the fact that multigravida mothers have experience with pregnancy and therefore understand the importance of IFAs adherence unlike the primigravida mothers (Niguse & Murugan, 2018). The findings of Niguse and Murugan concurred

with Digssie et al who also reported a strong association between mother's gravidity and IFAs adherence at a public hospital in Ethiopia. In the study, Digssie and other investigators noted that multi-gravida mothers were almost three times more likely to comply with IFAs unlike their primigravida counterparts (Digssie et al., 2019). The study attributed the high compliance among multigravida mothers to higher knowledge, experience and awareness of the consequences of maternal anaemia due to their frequent visits to the health facilities. In Kenya, a survey on IFAs compliance among pregnant women in Kiambu county showed that multigravida mothers were less likely to be IFAs compliant (Kamau et al., 2018).

2.6.2 Health system-related factors

One of the main aims of Focused Antenatal Care (FANC) is to ensure that iron-folic acid supplements are readily available to pregnant mothers who need them. The supplements are usually provided free of charge at public health facilities in many LMICs including Kenya. However, the main challenge has been the non-continuous supply of the supplements within the stipulated health facilities (MoH, 2016). Recent reports have highlighted instances where iron-folic acid supplements weren't prescribed to ANC seeking mothers due to stock out of the commodity (USAID, 2017). Most of the pregnant mothers understand public health facilities as avenues for affordable iron-folic acid supplements and therefore any stock out of the tablets at the facility contributes to low IFAs coverage and compliance. Although this seems to be a simple problem that could be fixed, the greatest challenges in Kenya and other LMICs have been the limited capital to acquire these supplements or sometimes the logistics in place may not be robust enough to guarantee a continuous supply (USAID, 2017).

All the same, the availability of iron-folic acid supplements in health facilities should not be confused with access to the commodity. Usually, women in need of these supplements have to access the health facility in order to acquire them. Access to health facilities could be a big challenge especially in some rural areas of LMICs. Factors such as long distances and geographical barriers discourage women from accessing health care (Wang et al., 2019). There is a need to make it convenient for women to access health facilities without much strain. Gage and colleagues noted

that physical barriers in the mountainous rural terrain of Haiti impacted negatively on the health care seeking behaviour of pregnant women (Gage et al., 2018). Interestingly, the women who resided in parts of Haiti with high-level availability of ANC services were two-fold likely to adhere to IFAs as compared to their fellow pregnant women who resided in areas with few ANC facilities (Wang et al., 2019). In other studies, conducted elsewhere, long distances to health facilities showed an inverse correlation with IFAs compliance. Precisely, women who need to cover longer distances to reach a health facility hardly adhere to IFAs (Museka et al., 2018).

The health care provider's behaviour could also influence IFAs adherence practices among ANC seeking mothers. Although most reports indicate that IFAs prescription is done to the majority of mothers seeking ANC, a significant percentage of mothers still do not get these supplements prescribed to them (Wang et al., 2019). Inadequate knowledge of the inventory, poor training and trimester guided prescriptions are some of the reasons attributed to this heterogeneous prescription of IFAs (Mallick et al., 2018; Siekmans et al., 2019). There are also cases where health workers do not prescribe iron-folic acid supplements to mothers whose laboratory results indicate Hb levels of the normal range. This is obviously against the WHO's guideline and such a trend is likely to impact negatively on IFAs compliance. The level and quality of counselling provided to mothers seeking ANC is very vital when it comes to IFAs compliance. Infrequent counselling of mothers regarding iron-folic acid supplements leave them with inadequate knowledge about the supplements. Pregnant mothers need to be counselled on the importance of taking iron-folic acid supplements as well as the dosage. Most importantly, iron-folic acid supplement users need to be informed on the anticipated side effects and possible ways of managing them. Although most ANC centres report on having offered counselling to all ANC seeking mothers, observational studies conducted in a few of these centres portray a different picture altogether. Out of the 57% of the Malawian health facilities that reported having counselled their ANC attendees adequately, direct observational study by Wang and colleagues showed otherwise. The observational study revealed that about 20% of the facilities did not offer counselling to the mothers at all while 17% only counselled half of the mothers (Wang et al., 2019). Probably, this could be a cue on

how the health care providers at ANC sections are overstretched with heavy workload. There are cases where the counselling offered is not sufficient to help the mothers appreciate the need for IFAs, its strict adherence and how to manage the side effects if any (Sununtnasuk et al., 2016).

Given that mothers are counselled and provided with relevant information pertaining to healthy pregnancy during ANC, there is a need for mothers to make often ANC visits as recommended. The new WHO guidelines recommend pregnant mothers to make at least eight ANC visits (WHO, 2018d), being an increment from the four stipulated in the old guidelines. Mothers who meet the optimum number of ANC visits experience healthy pregnancies. Compliance with IFAs also tends to increase with an increase in the number of ANC visits (Getachew et al., 2018). In their study conducted among pregnant women in refugee camps in Ethiopia, Getachew et al noted that a higher number of ANC visits had a positive influence on IFAs adherence as health care providers used the opportunity to encourage women to take the supplements. It is always recommended for mothers to seek ANC as early as possible once pregnancy has been confirmed. Past studies have also registered good IFAs compliance among pregnant women who sought ANC services at the early beginning of their first trimester (Niguse & Murugan, 2018).

In some countries, a lot of efforts have been made to ensure that men also take part in ensuring healthy pregnancies of their spouses. Although the idea seems promising as pregnant women are likely to receive support from their male counterparts, some regions have felt the negative impact of this. Sometimes, health care providers become so strict that they turn away pregnant women who seek ANC without the company of their male spouses (Peneza & Maluka, 2018). The implication of this has been a reduced number of ANC visits consequently leading to low IFAs adherence. The situation becomes even worse in instances where the male counterparts do not get time to accompany their women to the ANC at all (Museka et al., 2018). Preliminary findings have however shown almost full IFAs compliance among women whose husbands understand and support them on how to ensure healthy pregnancies (Siekmans et al., 2019).

2.6.3 Socio-cultural factors influencing IFAs adherence

Cultural beliefs have been used to study health-seeking behaviours in various communities. In regard to IFAs, cultural factors have been identified as key barriers to compliance in many of the studies conducted. In some communities, pregnant women are discouraged from consuming iron-folic acid tablets for fear of getting big babies or 'too much blood' that would supposedly make it difficult during delivery (Mithra et al., 2014; UNICEF, 2014). Similarly, some cultures prohibit pregnant women from using any kind of medication for fear of harming the foetus. In Bangladesh and Nigeria, pregnant women reported having been discouraged against using iron-folic acid tablets by fellow adult women (Siekmans et al., 2019). This was consistent with another study conducted in two districts of Pakistan. Through FGDs and In-depth interviews, Nisar and colleagues noted that pregnant women in Swabi and Islamabad districts were discouraged from taking iron-folic acid supplements by their husbands and mothers-in-law. The women reported that those who discouraged them from using the supplements thought that they were birth contraceptives (Nisar et al., 2014).

Some cultural norms prohibit women from leaving homes without other people's company. Such cultures make it almost mandatory for women to be accompanied by male members of their family any time they need to run an errand away from home (Museka et al., 2018; Siekmans et al., 2019). Regardless of the kind of benefits that this practice may have in the community, its impact on IFAs compliance has been negative. Women have reported on how they have to depend on male members of their families so as to make antenatal visits (Siekmans et al., 2019). The fact that these male members of their families are their husbands in most cases shows how the women are less likely to attend ANC if this culture is anything to go by. This is because the men are the family breadwinners and therefore busy on other roles as defined by their culture. There is no guarantee that they will create some time to accompany their pregnant wives to the health facilities.

In some communities, culture discourages pregnant women from revealing their pregnancy status until when the pregnancy starts to show (Museka et al., 2018). In such communities, women within the first trimester of pregnancy are very secretive

such that they may not be willing to seek ANC services for fear that people will come to know of their pregnancy. According to such communities, exposing one's pregnancy status at such an early stage puts the foetus' life at 'risk'. This, therefore, implies that pregnant women only visit health facilities at later stages of pregnancy consequently resulting to delay in seeking ANC. Museka et al noted this practice among pregnant women in one of the rural districts of Malawi (Museka et al., 2018). In some instances, pregnant women give up on seeking ANC from health facilities completely and revert to traditional medicines which they regard as superior compared to ANC (Museka et al., 2018). This habit not only contributes to missed IFAs opportunities but also leads to almost zero IFAs compliance.

2.7 Filling the research gap

The literature reviewed in this chapter has shown the importance of iron-folic acid supplements in the prevention of anaemia and poor pregnancy outcomes. Both qualitative and quantitative studies reviewed have confirmed that women's adherence to iron-folic acid supplements during pregnancy is still low. The objective of this mixed-method study is thus to contribute both qualitative and quantitative findings on the socio-demographic, socio-cultural and health system-related factors that influence IFAs at Kakamega county referral hospital. Through the elucidation of the experience of healthcare providers and PNC seeking mothers, this research will explore a comprehensive understanding as to why pregnant women do not adhere to the iron-folic acid regimen.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study site

The study was conducted at the MCH and maternity section of Kakamega County Referral Hospital which is classified as level 5 in the Kenyan health system. The hospital is located just adjacent to Kakamega town in Kakamega county. This facility was purposively selected because it is the main referral hospital within Kakamega county and serves a population of about 2 million people (Siteti et al., 2014). The hospital has a bed capacity of 448 and offers a variety of health care services including both ANC, Postnatal Care (PNC) and MCH.

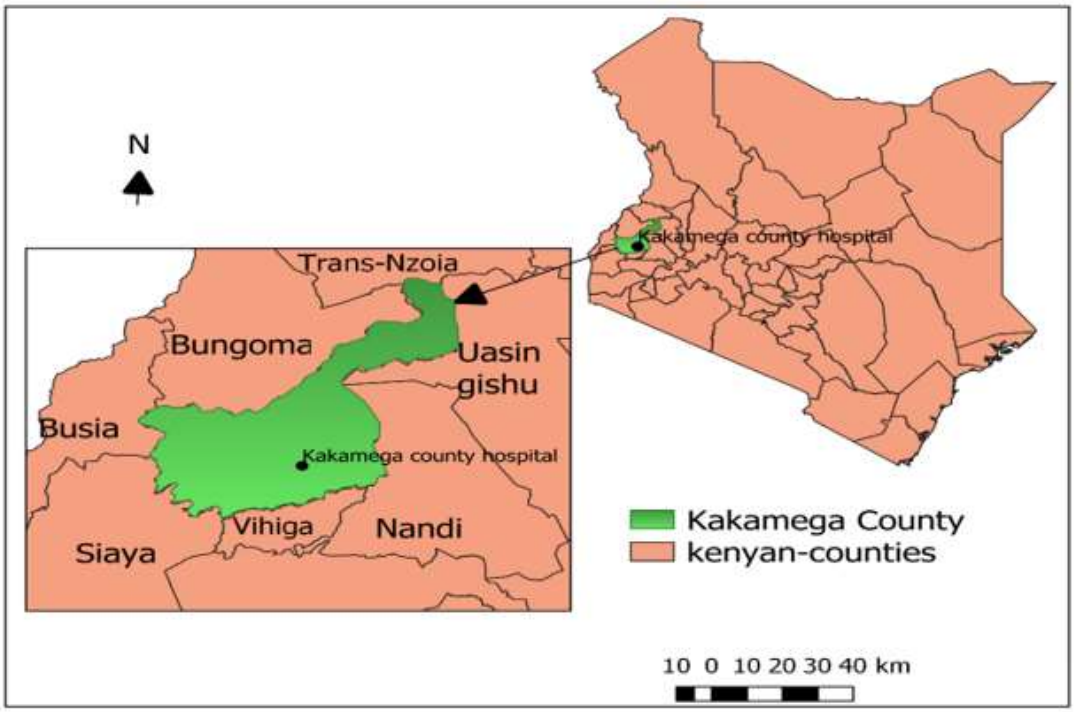

Figure 3.1: Location of Kakamega County Referral Hospital in Kakamega county.

3.2 Study Design

An institution based cross-sectional study design involving mixed methods research was adopted. An interviewer-administered questionnaire was used to collect data from eligible mothers of 0-6 months post-delivery while Key Informant Interviews (KIIs) were used to collect data from healthcare providers and CHVs.

3.3 Study variables

3.3.1 Dependent variables.

Adherence to IFAs was the dependent variable in this study. The WHO defines IFAs adherence as a daily intake of 30-60 mg of iron and 0.4 mg of folic acid supplements from the onset of conception to birth (WHO, 2016). However, in this study, IFAs adherence was defined as having taken iron-folic acid supplements for at least 5 days per week throughout pregnancy, (Kamau et al., 2018; Lyoba et al., 2020; Sadore et al., 2015; Taye et al., 2015). Notably, pregnant women commence ANC visits at different weeks during gestation. We did not classify women who started seeking ANC services with less than 3 months due to delivery as compliant. This was because such respondents had accessed and used the supplements for a shorter duration compared to their counterparts who sought ANC services in early gestation period.

3.3.2 Independent variables.

The independent variables studied were classified into socio-demographic related factors, health system-related factors, and socio-cultural factors. The socio-demographic related factors comprised of; mother's age, marital status, gravidity, level of education, knowledge of anaemia, birth complication history, and the number of ANC visits made. Health system-related factors consisted of iron-folic acid stock-outs, pregnancy counselling, mother's attitude towards ANC healthcare provider, IFAs related education and turnaround time (TAT) of ANC services. Key informant interviews were used to provide a deeper understanding of the health system-related factors that influence IFAs as well as the socio-cultural factors. The respondents who provided feedback to key informant interviews included; the heads

of the ANC and PNC sections, the pharmacist in charge at the PNC, the nutritionist in charge of MCH and the Community Health Volunteers (CHV) attached to the hospital.

3.4 Study Population

The study was conducted among mothers of 0-6 months post-delivery aged 15-49 years seeking MCH at Kakamega county hospital. This was complemented by KIIs from PNC and ANC heads, PNC pharmacist in charge, MCH nutritionist in charge and CHVs attached to the facility.

3.4.1 Inclusion criteria

Only mothers of 15-49 years seeking MCH 0-6 months were interviewed. The post-delivery period of 0-6 months was chosen to minimize the effect of recall bias. Evidence shows that in salient events such as pregnancy, mothers can recall some of the healthcare indicators experienced for even a year and above. A good example is the study conducted by Chang et al where mothers comfortably remembered the birth weight of their babies up to 20 months post-delivery (Chang et al., 2018). As for KIIs, the respective in-charges of PNC, ANC, nutrition and pharmacy that were on duty during the data collection day were interviewed.

3.4.2 Exclusion criteria

We excluded mothers who were critically ill such that they were not able to speak to us comfortably. Equally, the young mothers of 18 years and below who were not accompanied by an adult guardian were not eligible for this study.

3.5 Sample size determination

The sample size was calculated based on Cochran's formula (1977) as shown:

$$n = \frac{\mathbf{Z^2 P(1-P)}}{\mathbf{d^2}}$$

$$n = \frac{Z^2 Pq}{d^2}$$

Where:

n = the desired sample size

Z = the standard normal deviation usually set at 1.96 and corresponds to the 95% confidence interval.

P= prevalence of self-reported IFAs adherence according to Kamau et al (32.7%) (Kamau et al., 2018)

But **1-p=q**

d= Level of accuracy, which is 5.0% (0.05).

$$n = \frac{[1.96]^2 0.327(1 - 0.327)}{0.05^2}$$

n **=339**

Table 3.1: Maternity and PNC attendance frequency at Kakamega county hospital for 0-6 months (DHIS2 2019)

Month (2019)	Jan	Feb	March	April	May	June	July	**Aver**
PNC attendance	482	20	120	158	659	480	17	277

Since the population of mothers anticipated to seek MCH services 0-6 months post-delivery at Kakamega referral hospital during the study period was less than 10,000, the sample size was adjusted as shown below.

$$nf = \frac{\mathbf{n}}{\mathbf{1 + n/N}}$$

Where:

nf= The desired sample size when the population is less than 10,000

n= The desired sample size when the population is more than 10,000 (which is 339)

N=Total population (approximate total number of women that were anticipated to seek PNC services during the 3 months of data collection in Kakamega hospital). The average number of women (with children aged 0-6 months) who seek MCH services at this facility every month was 277. This was calculated from KDHS data of January-July 2019. The expected total population that was to be encountered during the 3 months of data collection, therefore, was as shown below:

N=277 x 3=831

$$nf = \frac{339}{1+339/831} = \mathbf{241}$$

The investigator catered for nonresponse by proceeding on to another respondent until when the required sample size was achieved.

3.6 Sampling technique

Systematic random sampling was used where the total number of mothers with children of 0-6 months seeking MHC care at Kakamega county referral hospital was divided by the sample size to get the n^{th} term as shown;

$nth = \frac{831}{241} = 3.4$ which was rounded off to every **3rd** woman

On every data collection occasion, the first woman to be recruited was selected randomly after which every 3rd woman was selected until the sample size was reached.

3.7 Data collection tools

An electronic version of a semi-structured questionnaire and KII guides were used in this study. Both the questionnaire and KII guides were prepared in Research Electronic Data Capture (REDCap) (Harris et al., 2009). However, only the quantitative data ware entered in REDCap while the qualitative data from the KIIs were captured using an audio recorder and later transcribed verbatim. The REDCap application was downloaded from the google play store and installed on a tablet for convenience during data collection. The KII interview guides and the questionnaire were developed in English and then translated to Swahili just in case some of the respondents were not conversant with either of the languages.

3.8 Data Collection

Data were collected at the MCH section of Kakamega county hospital from May to August 2020 except on weekends. We collected the data in two sessions every day; the morning session and the afternoon session, with an average of about 10 participants interviewed each day. Study participants were recruited after obtaining MCH. The purpose of the study was explained to each potential participant and their consents were sought. Each respondent who consented to the study was directed to a separate room where a face-to-face interview was conducted. However, interviews with mothers who had just delivered were conducted at their respective bedsides in the maternity ward.

Qualitative data were collected through KIIs with healthcare providers and CHVs. As for the healthcare providers, we targeted the various in-charges of the PNC, ANC, pharmacy and the nutrition department through purposive sampling approach until theme saturation was achieved. In case the in charge was not available, the healthcare provider in charge on the day of data collection was interviewed. Our KIIs with the healthcare providers were flexible and only spoke to each one of them at the time

that seemed convenient for them. This was to ensure that the interviews did not compromise their service provision to the patients. Unlike the KIIs with healthcare providers, KIIs with CHVs either happened at their respective homes or Kakamega county referral hospital. All the 11 CHVs attached to Kakamega hospital were interviewed. Generally, a maximum of two KIIs with either CHVs or healthcare providers were administered each day. All the KIIs were audio-recorded using an audio recorder, after which they were transferred to a password-protected computer every day. Overall, a total of 16 KIIs were conducted in this study of which 11 were among the CHVs while 5 were from the healthcare workers (Table 3.2).

Table 3.2: Showing the number of respondents who provided feedback to the KIIs

Participant	Number interviewed
Community Health Volunteers	11
PNC in charge	1
MCH nutritionist in charge	1
ANC in charge	1
ANC nurse	1
PNC pharmacist in charge	1
Total	**16**

3.9 Pre-Testing of data collection tools

The study questionnaire was pre-tested two weeks before the actual data collection using 25 (10% of 241) participants seeking MCH at Vihiga county hospital. Vihiga and Kakamega counties are in Western Kenya adjacent to each other and the population residing in this area has similar characteristics. The pilot study aimed to examine the consistency and dependability of the research instruments. We used the findings obtained in the pre-test exercise to measure the internal validity of the questionnaire items by calculating the Cronbach's alpha to determine the reliability of the study. We used the psych package of R statistical software to check for the questionnaire's internal validity and a Cronbach's alpha of 0.824 was obtained. According to Taber, a study instrument with a reliability of 0.7 and above is considered reliable to measure the intended outcome (Taber, 2018). Based on this, we were confident that the items on our tool guaranteed the internal validity of the

study and that the tool was reliable. We also presented the semi-structured questionnaire and the KII guides to the MCH experts of Vihiga county hospital for their review and advice. The experts consisted of one obstetrician, two paediatricians and four MCH nurses of diploma qualification. Any questions on the tools that seemed unclear to the respondents as noted during the pre-test were reviewed afterwards and necessary adjustments were made. Close attention was also given to the REDCap tool to ensure that the branching logic and other features worked as expected.

3.10 Trust worthiness of the qualitative research

Trustworthiness of a study refers to the degree of confidence that the findings of a qualitative research are of the expected quality, truthful and authentic (Cypress, 2017). Scholarly debates on the significance of trust worthiness in qualitative research are not new (Yin, 1994). Trust worthiness provides a set of criteria to ensure that a research process is carried out correctly, a feature that makes it analogous to internal and external validity, objectivity and reliability in quantitative research (Cypress, 2017; Shenton, 2004). Having adopted mixed methods in this study, the researcher guaranteed trust worthiness by striving to ensure that the findings were: credible, dependable, transferable, and confirmable.

3.10.1 Credibility

Credibility is a measure of whether the findings of a qualitative research are correct and accurate. In other words, credibility helps qualitative researchers to examine how congruent the findings are with the reality (Merriam, 1998). To achieve credibility, the researcher employed four mechanisms: Firstly, preliminary visits to the study site were made prior to study commencement. The researcher attended two CHV weekly meetings and one Continuing Medical Education (CME) at Kakamega county hospital in which MCH related topics were discussed. This was to help familiarise with the study environment, create rapport with potential respondents, and book appointments for the anticipated KIIs. Secondly, the researcher conducted KIIs with all the 11 CHVs attached to this hospital consequently providing an opportunity for adequately saturated themes. Although, KIIs with healthcare workers were based on

purposive sampling, we are confident that adequately accurate information was collected and only stopped after theme saturation was confirmed. Thirdly, we ensured honesty among the participants by creating rapport, encouraging the respondents to speak frankly and frequently reminded them that they could exit the study at any point without consequences. We also ensured accuracy of the feedback by probing the respondents, rephrased some responses and posed them as questions and made comparisons of themes that came up in various responses. Lastly, as part of the strengths of mixed method study design, we triangulated the findings from the MCH mothers, CHVs, MCH health workers and even made comparisons where necessary.

3.10.2 Dependability

Dependability in qualitative research is used to demonstrate the reliability and consistency of the findings. According to Shenton, qualitative researchers should adopt methods that prove that if the study was to be repeated, with the same participants, in the same context, with identical methods then same findings would be observed (Shenton, 2004). We remain confident that the findings of this study are dependable, especially based on the adequate information provided about the study methods. Most importantly, we describe our KII methods, the location and context under which data were collected. The rigorous analysis methods described under the Data management and analysis section of this thesis also guarantees replicability of this study. As already mentioned, we also subjected our data collection tools for expert review during the pretesting exercise.

3.10.3 Transferability

Just like external validity in quantitative research, transferability measures the extent to which the findings of a qualitative study can be applied to other contexts, settings or circumstances. As already highlighted in other sections of the methodology section, we made our findings transferable by adopting a ‘thick description’ (Shenton, 2004) about the study participants, study site and data collection methods. We describe the number of respondents in each cadre, the location where interviews took place, the number of sessions and the number of interviews conducted each day.

Besides, the researcher has carefully discussed the limitations or boundaries under which this study was conducted.

3.10.4 Confirmability

Confirmability helps qualitative researchers to prove that their research is neutral and free from the biases or assumptions of the investigators (Cypress, 2017; Shenton, 2004). Confirmability measures the objectivity of a research. It is however, worth acknowledging that it might be difficult to achieve real objectivity because even the data collection instruments are prepared by human and biases are inevitable (Shenton, 2004). Nonetheless, investigators should strive to reduce objectivity biases as much as possible. This study achieved confirmability in two ways: 1) Summarizing the content of each feedback we received for each KII question as this helped to showcase the overlapping themes, and 2) triangulation of the findings reported.

3.11 Data Management and analysis

The data collected within a day were synced to the KEMRI Wellcome Trust server after all the expected study participants had been interviewed. During analysis, the quantitative data were exported from the server to a Microsoft Excel CSV file after which data cleaning process followed. Responses to the ten questions assessing knowledge level of anaemia were scored. Each of the ten questions answered correctly was awarded a score of '1' while a wrong response or admitting not being aware was awarded a score of '0'. The total expected score of anaemia knowledge was 10 and this was used to calculate the percentage score of each participant. The respondents with a score that was equal to or greater than 50% were assumed to have a higher knowledge of anaemia while those with a score below 50% were treated as having low knowledge of anaemia (Ahamed et al., 2018).

We also established the attitude of the respondents towards ANC health care provider using a Likert scale. Five questions were asked on attitude, with responses ranging from strongly disagree, disagree, neutral, agree and strongly agree. The responses were scored in an ascending order, with strongly disagree being scored a

'1' while strongly agree was scored a '5'. The scores were summed up and later converted into percentages. Respondents were considered to have a positive attitude towards ANC healthcare provider if they scored at least 70%, while those who scored below 70% were assumed to have a negative attitude towards ANC healthcare provider (Kamau et al., 2019).

The cleaned verified data were then imported to R statistical software version 3.5.2 for analyses. The socio-demographic related characteristics of the respondents and the prevalence of IFAs compliance were summarized using descriptive statistics such as means, proportions and percentage frequencies. Some variables were also re-grouped into categories based on certain set thresholds. For example, mothers' age was re-categorized into groups, IFAs adherence classified as adherent or non-adherent, gravidity as primigravida and multigravida while the education level of the mother was categorized into primary, secondary and college levels. Equally, the number of ANC visits attained by the mother were segregated into two and below ANC visits and at least 3 ANC visits. Associations between adherence to IFAs and its putative determinants were investigated through Pearson's Chi-square tests. The strength of the associations between IFAs adherence and its putative determinants was assessed through logistic regression. The logistic regression models were fitted separately for socio-demographic related factors and health-system related factors. In each of the cases, fitting of the logistic regression models began with univariable analysis after which all the variables with $p<0.2$ were fitted to a multivariable model. All the P values of less than 0.05 were interpreted as significant, (Table 3.3).

Qualitative data analysis began with the importation of the transcribed data into NVIVO 12 software (QSR International, Australia) for coding and analysis. To ensure anonymity and still have a more informed analysis, each transcript was assigned a participant identifier, a code and a date. We used a thematic approach to identify key issues. A codebook was developed and after refinement of the codes, final themes were derived. Data for each of the KII participants were interpreted by identifying key concepts separately and then brought together to identify any relationships.

Table 3.3: Methods of data analysis according to the objectives.

Objectives	Independent Variables	Dependent variables	Analysis
Objective 1 Self-reported prevalence	N/A	N/A	• Descriptive statistics
Objective 2 Socio-demographic related factors	Mother's age Marital status Gravidity Education level Anaemia knowledge Birth complication Number of ANC visits	**IFAs adherence** (at least 5 tablets per week throughout gestation period)	• Pearson's chi-square • Logistic regression (Univariate & Multivariable)
Objective 3 Health system-related factors	Iron-folic acid stock-outs Pregnancy counselling Mother's attitude towards ANC healthcare provider ANC Turnaround time Education on IFAs importance		• Pearson's chi-square • Logistic regression (Univariate & Multivariable) • Thematic analysis (NVIVO 12)
Objective 4 Socio-cultural factors	Restrictions on IFAs Strong religious beliefs Permission for ANC visits Use of traditional herbs Other themes derived from KIIs		• Descriptive statistics • Thematic analysis (NVIVO 12)

3.12 Ethical clearance

The study was granted permission to collect data from the Board of Post-graduate Studies of Jomo Kenyatta University of Agriculture and Technology. Ethical clearance for the study was then sought from the Ethical Review Board of Daystar University (Appendix 11). The National Commission for Science, Technology and Innovation (NACOSTI) granted the research permit (Appendix 12). Approvals were also obtained from the Hospital in-charge of Kakamega county hospital and the head of the PNC section. We provided the potential study participants with sufficient information to understand the implications of taking part in the study, and making a fully informed decision, free from any coercion. The participants were reminded only to provide information that they felt comfortable sharing and that they were free to withdraw from the study at any stage without being victimised in any way.

Therefore, all the participants who took part in the study provided written consent and assent voluntarily. We only recruited participants of less than 18 years only if they assented and their accompanying guardian offered a written consent on their behalf. Confidentiality of the respondents' information was guaranteed by ensuring that the questionnaire was administered in a private room. When this was not possible, like in maternity wards, we ensured that no one else was close enough to follow the conversation. Besides, the participants' names were replaced with codes during data analysis, and any data accrued from the study was stored in a password-protected computer. All the hard copy documents were stored in cabinets under lock and key. Neither physical nor psychosocial harm was reported in this study because we ensured that the questions asked to the participants did not hurt their feelings or cause psychosocial distress. Finally, the researcher acknowledges that the work of other authors has been used in some sections of this thesis either to create a case or to put our findings in context of other studies. Nonetheless, under such circumstances, the researcher has fully acknowledged the original authors of the work.

CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter consists of the findings on the determinants of IFAs adherence during pregnancy among mothers seeking MCH 0-6 months post-delivery at Kakamega county referral hospital. The chapter begins by showing the prevalence of IFAs adherence among the respondents aggregated by the respective socio-demographic related characteristics. The determinants of IFAs adherence inferred from the fitted logistic regression models are shown in tables while those deduced from the qualitative work are presented in double quotes as captured verbatim.

4.2 Socio-demographic characteristics of the respondents.

This study recorded a 100% response rate from all the targeted participants including KII interviews. None of the KII targeted participants declined to take part in this study. However, some respondents for quantitative data declined to participate. Under such circumstances, the researcher moved on to the next participant until the target sample size was attained.

A total of 241 mothers seeking MCH at Kakamega county hospital were interviewed between May and August 2020. The average age of the mothers was 24.9 (SD ±5.3) years with an age range of 15-43 years. As shown in Table 4.1, the majority (68.1%) of the respondents belonged in the age category of 19-29 years. Only a few of the respondents had formal employment (19.9%) while 22.4% were students. Most of the mothers interviewed (41.1%) had attained a secondary school level of education. Also, all the respondents admitted to belonging to one religion or another with the majority being Christians (95.9%). More than three-quarters of the mothers (85.5%) resided at a distance greater than 30 minutes to their ANC facilities with motorcycles being the most preferred means of transport (62.2%). A large proportion of the mothers had a high knowledge of anaemia (85.5%). All the respondents admitted to

having been given iron-folic acid at any one point during ANC and out of these, slightly over half (51.0%) reported having experienced side effects as a result of iron-folic acid consumption.

Table 4.1: Socio-demographic related characteristics of the respondents, Kakamega county hospital, Kenya, 2020.

Variable	N	%	95% CI
Mother's age			
≤18	26	10.8	7.3, 15.6
19-29	164	68.1	61.7, 73.9
≥30	51	21.2	16.3, 27.0
Occupation			
Formal	48	19.9	15.2, 25.6
Non-formal	70	29.0	23.5, 35.3
Housewife	69	28.6	23.1, 34.9
Student	54	22.4	17.4, 28.3
Education level			
Primary	48	19.9	15.2, 25.6
Secondary	99	41.1	34.9, 47.6
College	94	39.0	32.9, 45.5
Marital status			
Married	172	71.4	65.1, 76.9
Single	69	28.6	23.1, 34.9
Religion			
Christian	231	95.9	92.3, 97.9
Muslim	10	4.1	2.1, 7.7
Distance to ANC facility			
>30 Minutes	206	85.5	80.2, 89.5
≤30 Minutes	35	14.5	10.5, 19.8
Transport mode to ANC facility			
Walking	73	30.3	24.6, 36.6
Motorcycle	150	62.2	55.8, 68.3
Matatu	18	7.5	4.6, 11.7
Anaemia knowledge			
Low	35	14.5	10.5, 19.8
High	206	85.5	80.2, 89.5
Iron-folic acid side effects			
No	118	49.0	42.5, 55.4
Yes	123	51.0	44.6, 57.5

4.3 Obstetric related characteristics of the respondents.

As shown in table 4.2, out of all the respondents interviewed, over two-thirds (73.9%) had completed at most 3 months post-delivery. Almost half of the mothers were multigravida (47.7%) and a few reported having had either a birth complication (12.1%) or miscarriage (4.6%). Most of the respondents (76.3%) had never had a pregnancy counselling session with a healthcare provider before getting pregnant. The majority of the mothers (71.8%) sought their first ANC services with a gestation period of more than 8 weeks and many of them attended ANC at least 3 times (92.9%).

Table 4.2: Obstetric related characteristics of the studied respondents, Kakamega county hospital, Kenya, 2020.

Variables	n	%	95% CI
Post-delivery period			
0-3 Months	178	73.9	67.8, 79.2
4-6 Months	63	26.1	20.8, 32.3
Gravidity			
Primigravida	126	52.3	45.8, 58.7
Multigravida	115	47.7	41.3, 54.2
Birth complication			
No	212	88.0	83.0, 91.7
Yes	29	12.1	8.3, 17.0
Miscarriage			
No	230	95.4	91.8, 97.6
Yes	11	4.6	2.4, 8.2
Counselling before pregnancy			
No	184	76.3	70.4, 81.5
Yes	57	23.7	18.5, 29.6
First ANC gestation			
≤8 weeks	68	28.2	22.7, 34.4
>8 weeks	173	71.8	65.6, 77.3
ANC visits			
≥3 Times	224	92.9	88.7, 95.7
≤2 Times	17	7.1	4.3, 11.3

Although most of the mothers interviewed in this study had visited the facility to obtain delivery care (33.9%), other MCH services sought included: child immunization (29.5%), child growth monitoring (28.2%), child treatment (6.4%) among others as shown in figure 4.1

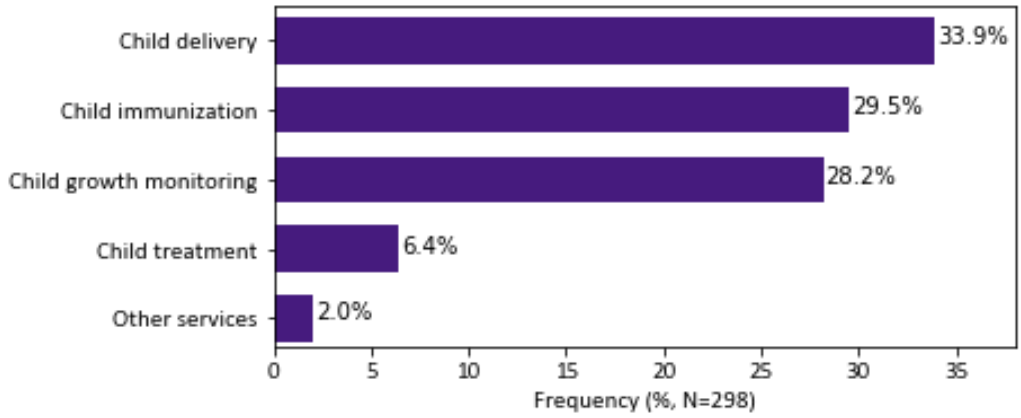

Figure 4.1: Maternal and Child Healthcare services sought by mothers 0-6 months post-delivery at Kakamega county hospital in the year 2020.

4.4 Respondents' knowledge of anaemia

Out of the respondents interviewed, 209 (86.7%) of them were able to identify the symptoms associated with anaemia. The total responses obtained from the 209 mothers regarding anaemia symptoms were 469. Body pallor (30.7%), fatigue (26.9%), dizziness (18.6%) and headache (9.6%) were the most frequently mentioned symptoms of anaemia as shown in figure 4.2

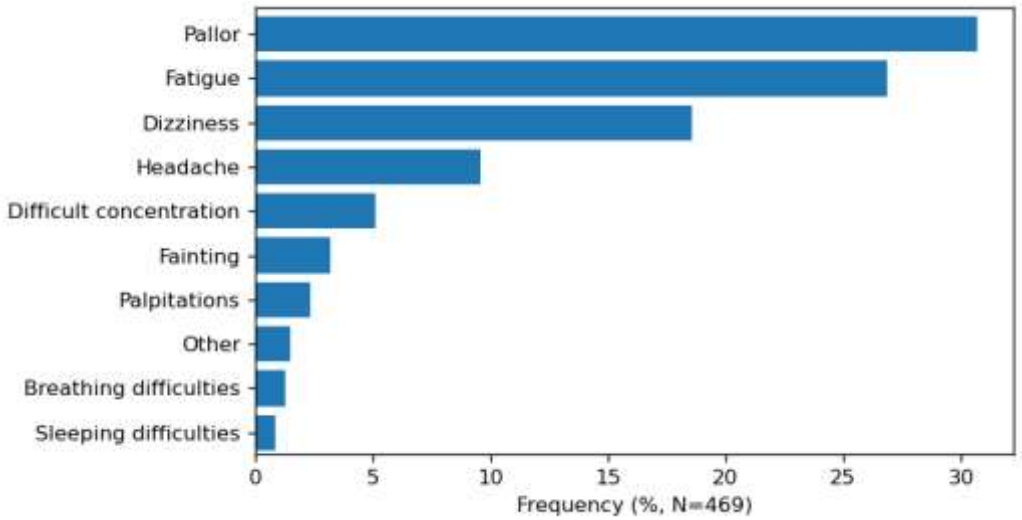

Figure 4.2: Symptoms of anaemia as mentioned by mothers of 0-6 months post-delivery at Kakamega county hospital in the year 2020.

When asked about the possible consequences of anaemia, 36.5% of the mothers were unable to mention any of the repercussions of anaemia during pregnancy. A total of 285 responses were obtained from the 153 mothers who mentioned the possible consequences of anaemia in pregnancy. Out of the 285 responses, almost half (47%) were on maternal mortality, 22.1% for preterm birth and 19.3% for low birth weight as shown in table 4.3.

Table 4.3: Consequences of anaemia as mentioned by mothers of 0-6 months post-delivery at Kakamega county hospital in the year 2020.

Consequences of anaemia	Responses	%	95% CI
Maternal mortality	134	47.0	41.13, 52.99
Preterm birth	63	22.1	17.52, 27.46
Low birthweight	55	19.3	14.98, 24.46
Congenital malformations	16	5.6	3.35, 9.13
Pre-eclampsia	13	4.6	2.55, 7.86
Cognitive impairment	3	1.0	0.27, 3.30
Perinatal infection	1	0.4	0.02, 2.25
Total	285	**100**	

4.5 Prevalence of IFAs adherence.

The overall prevalence of IFAs adherence among the studied respondents was 60.6% with 146 mothers having reported taking at least 5 iron-folic acid tablets per week throughout pregnancy. Out of the IFAs non-compliant cohort, slightly more than one third (35.3%) consumed 3-4 iron-folic acid tablets per week on average throughout pregnancy. The highest adherence was observed among the single mothers (79.7%), followed by younger mothers of 18 years and below (76.9%). There was a similar IFAs compliance trend among Muslims and Christians, 60% and 60.6% respectively. About 8 in every 10 mothers who never experienced any iron-folic acid related side effects (75.9%) were IFAs compliant. Less than half (41.7%) of the respondents with a primary education level took iron-folic acid as recommended. Mothers who resided within 30 minutes distance from their ANC facilities had a slightly higher adherence (61.2%) as compared to their counterparts residing more than 30 minutes away from their facilities of ANC (57.1%), as shown in table 4.4.

Table 4.4: Prevalence of IFAs adherence during pregnancy among mothers of 0-6 months post-delivery at Kakamega county hospital in the year 2020.

Variables	IFAs adherence Average number of iron-folic acid tablets taken by respondents per week					
	0-2	**%**	**3-4**	**%**	**5-7**	**%**
Mother's age						
≤18	0	0	6	23.1	20	76.9
19-29	6	3.7	56	34.1	102	62.2
≥30	4	7.8	23	45.1	24	47.1
Education level						
Primary	1	2.2	27	56.3	20	41.7
Secondary	4	4.0	29	29.3	66	66.7
College	5	5.3	29	30.9	60	63.8
Marital status						
Married	8	4.7	73	42.4	91	52.9
Single	2	2.9	12	17.4	55	79.7
Distance to ANC						
>30 mins	3	8.6	12	34.3	20	57.1
≤30 mins	7	3.4	73	35.4	126	61.2
Side effects						
No	4	3.7	32	29.6	82	75.9
Yes	6	5.0	53	43.8	64	52.9
Occupation						
Formal	3	6.3	14	29.2	31	64.6
Non-formal	2	2.9	30	42.9	38	54.3
Housewife	3	4.3	27	39.1	39	56.5
Student	2	3.7	14	25.9	38	70.4
Religion						
Christian	10	4.3	81	35.1	140	60.6
Muslim	0	0	4	40.0	6	60.0
Total	**10**	**4.149**	**85**	**35.3**	**146**	**60.6**

Overall IFAs prevalence **(60.6%)**

A total of 95 respondents were not IFAs compliant. Out of this cohort, most of the mothers (41.3%) attributed the non-compliance to iron-folic acid related side effects. Similarly, other common reasons for non-adherence stated by the respondents were; forgetfulness (37.3%), bad smell of the iron-folic acid tablets (10.3%) and pharmacophobia (6.3%) as shown in table 4.5.

Table 4.5: Reasons for non-compliance as stated by mothers of 0-6 months post-delivery at Kakamega county hospital in the year 2020.

Non-adherence reason	Responses	%	95% CI
Side effects	52	41.3	32.68, 50.40
Forgetfulness	47	37.3	29.00, 46.41
Bad smell	13	10.3	5.83, 17.32
Pharmacophobia	8	6.3	2.98, 12.53
Make the fetus grow bigger	4	3.2	1.02, 8.42
Unaware of IFAs importance	1	0.8	0.04, 4.99
Ran out of supplements	1	0.8	0.04, 4.99
Total	**126**	**100**	

A total of 123 mothers experienced IFAs related side effects. Out of this, almost half of them (48%) were non-compliant. The most prevalent side effects were vomiting (41.3%), nausea (26.9%) and dizziness (18.6%). Slightly over half (52.2%) of the mothers who experienced vomiting while on IFAs were non-compliant. Similarly, about half (48.4%) of those who felt dizzy due to iron-folic acid consumption and the majority of the mothers who experienced IFAs related diarhoea could not comply with IFAs, (Figure 4.3).

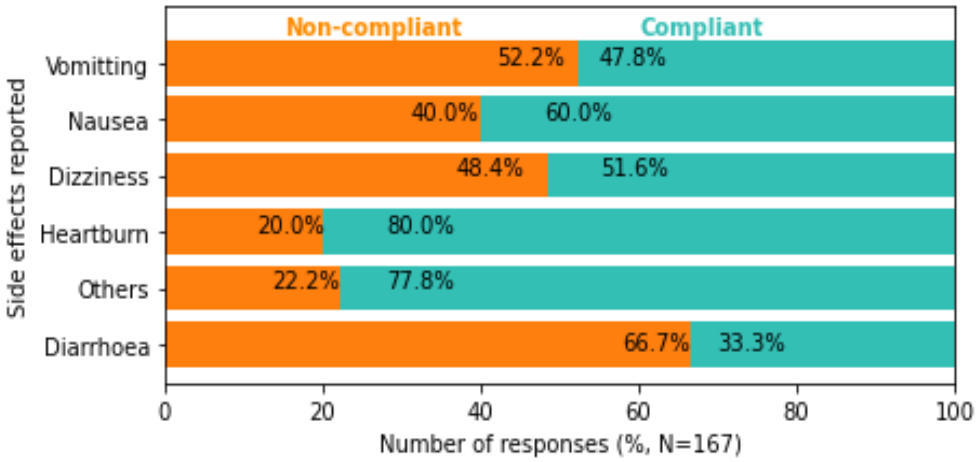

Figure 4.3: Variations in IFAs compliance according to the side effects experienced among respondents, Kakamega county hospital, Kenya, 2020.

4.6 Socio-demographic determinants of IFAs adherence.

Pearson's Chi-square test was used to investigate any significant correlations between the socio-demographic related factors and IFAs adherence. The study revealed significant correlations between IFAs adherence and maternal age (x^2=6.992, df=2, p<0.030), education level of the mother (x^2=9.142, df=2, p<0.010), marital status (x^2=14.815, df=1, p<0.001) and gravidity (x^2=21.741, df=1, p<0.001). Also, IFAs adherence was found to significantly correlate with mother's knowledge of anaemia (x^2=7.263, df=1, p<0.007), number of ANC visits (x^2=4.897, df=1, p<0.027) and iron-folic acid related side effects (x^2=7.687, df=1, p<0.006) as shown in table 4.6.

Table 4.6: Chi-square test correlation between IFAs adherence and socio-demographic related characteristics of the study participants at Kakamega county hospital, Kenya, 2020.

Socio-demographic related variables		IFAs non-compliant N=95	IFAs compliant N=146			
		n (%)	n (%)	X^2	df	P-value
Mother's age (Years)	≤18	6 (23.1)	20 (77.0)			
	19-29	62 (37.8)	102 (62.2)	6.992	2	**0.030**
	≥30	27 (52.9)	24 (47.1)			
Education level	Primary	28 (58.3)	20 (41.7)			
	Secondary	33 (33.3)	66 (66.7)	9.142	2	**0.010**
	College	34 (36.2)	60 (63.8)			
Marital status	Married	81 (47.1)	91 (52.9)	14.815	1	**<0.001**
	Single	14 (20.3)	55 (79.7)			
Gravidity	Multigravida	63 (54.8)	52 (45.2)	21.741	1	**<0.001**
	Primigravida	32 (25.4)	94 (74.6)			
Birth complication	No	81 (38.2)	131 (61.8)	1.083	1	0.298
	Yes	14 (48.3)	15 (51.7)			
Anaemia knowledge	Low	21 (60.0)	14 (40.0)	7.263	1	**0.007**
	High	74 (35.9)	132 (64.1)			
ANC visits	≥3	84 (37.5)	140 (62.5)	4.897	1	**0.027**
	≤2	11 (64.7)	6 (35.3)			
Distance to ANC	>30 minutes	15 (42.9)	20 (57.1)	0.203	1	0.653
	≤30 minutes	80 (38.8)	126 (61.2)			
Iron-folic acid side effects	No	36 (30.5)	82 (69.5)	7.687	1	**0.006**
	Yes	59 (48.0)	64 (52.0)			

Chi-square ($\mathbf{X^2}$), degrees of freedom (df), Significant (P<0.05)

Further investigation of IFAs adherence trends through univariable logistic regression was conducted. Specifically, it was noted that mothers who were at least 30 years of age were less likely to be IFAs compliant as compared to their younger counterparts of 18 years and below, (OR=0.267, 95% CI: 0.086, 0.741; p=0.015). Mothers with a primary level of education had their odds of being IFAs compliant

reduced by 60% as compared to mothers who had acquired a college level of education, (OR=0.405, 95% CI: 0.196, 0.819; p=0.013). Similarly, the study established reduced odds of IFAs adherence among the respondents who had attended ANC for at most two times as well as those who had reported experiencing iron-folic acid related side effects, (OR=0.327, 95%CI: 0.109, 0.893; p=0.034) and (OR=0.476, 95% CI: 0.279, 0.804; p=0.006), respectively. Unlike mothers in marriage, single mothers were 3.5 times more likely to be IFAs compliant (OR=3.497,95% CI: 1.852, 6.971; p<0.001). The primigravida mothers were almost four-fold more likely to be IFAs compliant as compared to multigravida mothers (OR=3.559, 95%CI: 2.081, 6.187; p<0.001). Equally, the respondents who seemed to have higher anaemia knowledge were noted to have elevated odds of adhering to IFAs, (OR=2.676, 95% CI: 1.296, 5.680; p=0.009), (Table 4.7).

Table 4.7: Univariable logistic regression model demonstrating socio-demographic related risk factors for IFAs adherence, Kakamega county hospital, Kenya, 2020.

Variables	Estimate	Std. Error	Z value	OR (95% CI)	P value
Mother's age (Years)					
≤18	Ref				
19-29	-0.706	0.493	-1.434	0.494 (0.173, 1.23)	0.152
≥30	-1.322	0.544	-2.432	**0.267 (0.086, 0.741)**	**0.015**
Education level					
College	Ref				
Secondary	0.125	0.303	0.414	1.133 (0.626, 2.055)	0.679
Primary	-0.905	0.363	-2.491	**0.405 (0.196, 0.819)**	**0.013**
Marital status					
Married	Ref				
Single	1.252	0.t336	3.725	**3.497 (1.852, 6.971)**	**<0.001**
Gravidity					
Multigravida	Ref				
Primigravida	1.269	0.278	4.575	**3.559 (2.081, 6.187)**	**<0.001**
Birth complication					
No	Ref				
Yes	-0.412	0.398	-1.036	0.662 (0.303, 1.457)	0.300
Anaemia knowledge					
Low	Ref				
High	0.984	0.374	2.629	**2.676 (1.296, 5.680)**	**0.009**
ANC visits					
≥3	Ref				
≤2	-1.117	0.526	-2.124	**0.327 (0.109, 0.893)**	**0.034**
Distance to ANC					
>30 mins	Ref				
≤30 mins	0.167	0.370	0.450	1.181 (0.564, 2.432)	0.653
Iron-folic acid side effects					
No	Ref				
Yes	-0.742	0.269	-2.754	**0.476 (0.279, 0.804)**	**0.006**

Standard Error (Std. Error), Odds Ratio (OR), Significant (P<0.05)

To understand the independent association between IFAs adherence and the socio-demographic related factors, all the variables with crude P values of less than 0.2 (P<0.2) were fitted to a multivariable model. These included: mother's age, mother's education level, marital status, gravidity, mother's knowledge of anaemia, number of

ANC visits, and IFAs related side effects. The multivariable model confirmed the independent correlation between IFAs adherence and gravidity, mother's anaemia knowledge, number of ANC visits and iron-folic acid side effects as shown in table 4.8.

Table 4.8: Multivariable logistic regression model demonstrating socio-demographic related risk factors for IFAs adherence, Kakamega county hospital, Kenya, 2020.

Variables	Estimate	Std. Error	Z value	OR (95% CI)	P value
Mother's age (Years)					
≤18	Ref				
19-29	-0.356	0.615	-1.578	0.701 (0.21, 2.339)	0.563
≥30	-0.196	0.747	-0.263	0.822 (0.19, 3.553)	0.793
Education level					
College	Ref				
Secondary	0.295	0.359	0.822	1.344 (0.664, 2.718)	0.411
Primary	-0.481	0.428	-1.125	0.618 (0.267, 1.429)	0.260
Marital status					
Married	Ref				
Single	0.712	0.447	1.592	2.037 (0.848, 4.893)	0.111
Gravidity					
Multigravida	Ref				
Primigravida	0.995	0.389	2.559	**2.704 (1.262, 5.793)**	**0.010**
Anaemia knowledge					
Low	Ref				
High	1.168	0.444	2.629	**3.215 (1.346, 7.68)**	**0.009**
ANC visits					
≥3	Ref				
≤2	-1.300	0.618	-2.102	**0.273 (0.081, 0.916)**	**0.036**
Iron-folic acid side effects					
No	Ref				
Yes	-0.811	0.302	-2.687	**0.444 (0.246, 0.803)**	**0.007**

Standard Error (Std. Error), Odds Ratio (OR), Significant (P<0.05)

4.7 Health system-related determinants of IFAs adherence based on quantitative analysis.

To understand the health system's influence on IFAs adherence, some health system-related factors were subjected to Pearson's Chi-square test. The health system-related

factors included: IFAs related education, having had a pregnancy counselling session with a healthcare provider before conception, ANC turnaround time, iron-folic acid stock out and attitude of the mothers towards ANC healthcare provider. There were significant correlations between IFAs adherence with IFAs education (x^2=7.187, df=1, p=0.007), having had a pregnancy counselling session before conception (x^2=6.901, df=1, p=0.009) and attitude of the mother towards ANC healthcare provider (x^2=5.278, df=1, p=0.022) as shown in table 4.9.

Table 4.9: Chi-square test correlation between IFAs adherence and health system related factors at Kakamega county hospital, Kenya, in the year 2020.

Health system related variables		IFAs non-compliant N=95	IFAs compliant N=146			
		n (%)	n (%)	X^2	df	P-value
IFAs education	No	20 (60.6)	13 (39.4)	7.187	1	**0.007**
	Yes	75 (36.1)	133 (63.9)			
Pregnancy counselling	No	81 (44.0)	103 (56.0)	6.901	1	**0.009**
	Yes	14 (24.6)	43 (75.4)			
Turnaround Time	Longer than expected	23 (46.0)	27 (54.0)	1.144	1	0.285
	As expected	72 (37.7)	119 (62.3)			
IFAs stock out	No	82 (38.7)	130 (61.3)	0.404	1	0.525
	Yes	13 (44.8)	16 (55.2)			
Attitude towards healthcare provider	Negative	19 (57.6)	14 (42.4)	5.278	1	**0.022**
	Positive	76 (36.5)	132 (63.5)			

Chi-square ($\mathbf{X^2}$), degrees of freedom (df), Significant (P<0.05)

All the health system-related factors studied were subjected to univariable analysis. Mothers who received education on iron-folic acid were almost three times more likely to be IFAs compliant as compared to those who did not receive education on IFAs (OR=2.728, 95% CI: 1.297, 5.921; p=0.009). Similarly, attending pregnancy counselling sessions prior to conception played a significant role on IFAs adherence. The study revealed that mothers who sought pregnancy counselling sessions were more than twice likely to be IFAs compliant as compared to their counterparts who never attended pregnancy counselling sessions before conception (OR=2.415, 95%

CI: 1.262, 4.859; p<0.01). Unlike mothers who had a negative attitude towards ANC healthcare provider, mothers who had a positive attitude towards ANC healthcare provider were up to 2.4 times more likely to be IFAs compliant (OR=2.357, 95% CI: 1.124, 5.052; p=0.024) as shown in table 4.10. According to the KIIs with CHVs, poor attitude towards ANC healthcare provider is partially contributed by the long turnaround time taken during ANC visits.

"*There are still others who prefer enrolling for ANC a bit late say three to four months due in pregnancy. They just want to buy time, especially when they think of the long queue that awaits them at the ANC. They complain that they take a lot of time at ANC…*" (KII: CHV).

Table 4.10: Univariable logistic regression model demonstrating health system related risk factors for IFAs adherence, Kakamega county hospital, Kenya, 2020.

Variables	Estimate	Std. Error	Z value	OR (95% CI)	P value
IFAs education					
No	Ref				
Yes	1.004	0.384	2.611	**2.728 (1.297, 5.921)**	**0.009**
Pregnancy counselling					
No	Ref				
Yes	0.882	0.342	2.581	**2.415 (1.262, 4.859)**	**<0.01**
Turnaround Time					
Longer than expected	Ref				
As expected,	0.342	0.321	1.067	1.408 (0.747, 2.640)	0.286
Iron-folic acid stock out					
No	Ref				
Yes	-0.253	0.400	-0.634	0.776 (0.355, 1.723)	0.526
Attitude towards ANC healthcare provider					
Negative	Ref				
Positive	0.856	0.381	2.253	**2.357 (1.124, 5.052)**	**0.024**

Standard Error (Std. Error), Odds Ratio (OR), Significant (P<0.05)

All the health system related factors that showed a p≤0.2 in the univariable logistic regression were subjected to a multivariable model. Precisely, IFAs education, having had a pregnancy counselling session and mother's attitude towards ANC

healthcare provider were adjusted for in the multivariable model. Having had a pregnancy counselling session with a healthcare provider before conception and having received education on IFAs showed independent association with IFAs adherence, (OR=2.086, 95% CI: 1.071, 4.255; p=0.036) and (OR=2.372, 95% CI: 1.109, 5.218; p=0.028) respectively, (Table 4.11).

Table 4.11: Multivariable logistic regression model demonstrating health system related risk factors for IFAs adherence, Kakamega county hospital, Kenya, 2020.

Variables	Estimate	Std. Error	Z value	OR (95% CI)	P value
IFAs education					
No	Ref				
Yes	0.864	0.392	2.203	**2.372 (1.109, 5.218)**	**0.028**
Pregnancy counselling					
No	Ref				
Yes	0.735	0.350	2.102	**2.086 (1.071, 4.255)**	**0.036**
Attitude towards ANC healthcare provider					
Negative	Ref				
Positive	0.641	0.400	1.637	1.900 (0.884, 4.150)	0.102

Standard Error (Std. Error), Odds Ratio (OR), Significant (P<0.05)

4.8 Health system-related determinants of IFAs adherence based on KIIs.

According to the analysed KIIs, the following themes were linked to IFAs adherence trends among the study participants.

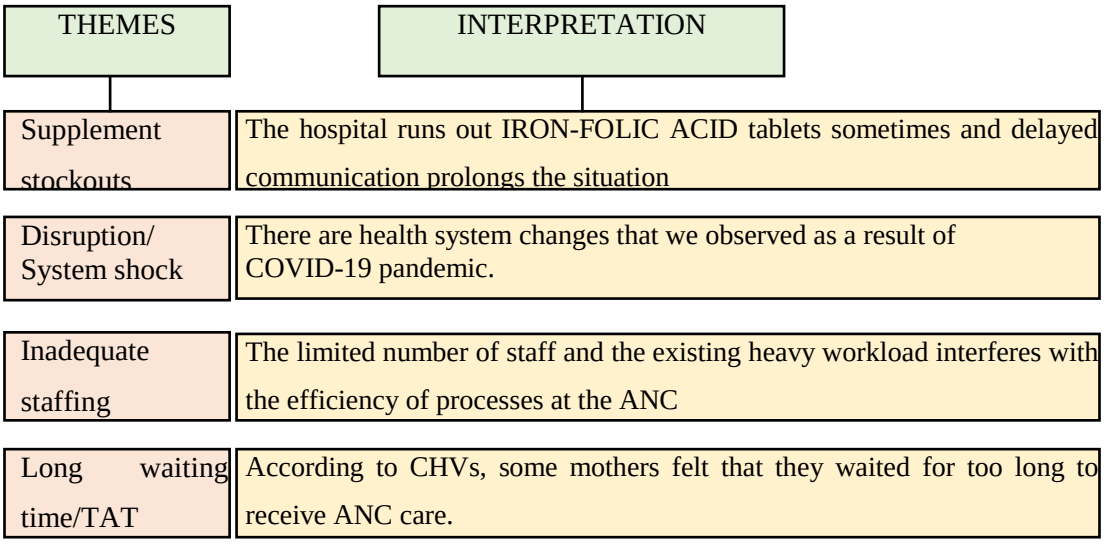

Figure 4.4: Health system related determinants of IFAs adherence based on KIIs among healthcare workers at Kakamega county hospital, Kenya, 2020.

4.8.1 Supplement stockouts

KIIs with healthcare workers revealed that the facility runs out of the supplements at times although not very often. Despite the existence of clear channels on how to source for the iron-folic acid tablets, it would take a lot of time for the officer in charge to be notified of the iron-folic acid stock-outs. The respondent felt that the situation was exacerbated by delayed communications among the staff and this, to some extent, would result to missed opportunities for taking iron-folic acid as noted below.

"*…As I said, we need to have a nutritionist in every room but that's almost impossible for now. So sometimes when I'm compiling monthly reports, I notice that the mothers have not been issued with the supplements for some time. When you make follow-ups, you will be told that iron-folic acid had run out of stock. But the problem is that they did not communicate because I could have looked for the supplements somewhere else even if it means borrowing from another facility…"* (KII: healthcare provider).

4.8.2 Health system disruption/system shock

We also learned that the ANC healthcare providers experienced challenges in providing IFAs education and general MCH talks to ANC seeking mothers. They attributed this to health system disruptions caused by the COVID-19 pandemic whereby the ANC services were shifted to another department to create more space for COVID 19 patients as indicated in transcripts below.

"*Before we came here, we got some space at the eye clinic. But it was even smaller than this. We tried giving health talks there and you would find yourself talking to a group of eye patients, ANC mothers and under-five mothers. It was such a bad confusion and we had to move from there to this orthopaedic department. The space here doesn't still allow for such talks though. That is as it is for now…"* (KII: healthcare provider).

"Did you notice that even the sitting space is not enough? We have no space for more benches. Some mothers are standing as you can see. In fact, this has impacted negatively on our ANC visiting trends. It seems mothers are no longer motivated to come for ANC as they feel that the place is congested to an extend that they miss a place to sit…" (KII: healthcare provider).

4.8.3 Inadequate staffing

As indicated in the following verbatim, healthcare workers at the ANC section experience a heavy workload very often. This is partly due to the limited number of staff as well as the rigorous writing involved in their line of duty.

"I'm the only one here and the two ladies you see over there are interns, the other lady is a casual on the hospital's payroll. And there is a lot of writing involved by the way. We do not have enough computers and the few that we have keep on hanging [dragging]…" (KII: healthcare provider).

4.8.4 Long waiting time/TAT

The study noted that some ANC sessions end up taking a lot of time than what the mothers expect. Some CHVs reported some instances where mothers felt that they waited for too long before receiving care. As noted in the verbatims below, long waiting times may tend to discourage mothers from seeking ANC especially when there are other competing tasks.

"They did not used to get service on time. Someone would leave for ANC early in the morning and still they will not have been attended to by 1pm." (KII: CHV).

"There is always a queue at the facility …where will she get the time to wait, and she is needed at a funeral somewhere?" (KII: CHV).

4.9 Socio-cultural determinants of IFAs adherence

The socio-cultural determinants of IFAs adherence were explored through KIIs with the CHVs. Some of the themes that were noted in the interviews are tabulated below.

THEMES	INTERPRETATION
Religious beliefs	Some churches are against use of medicines especially blood enhancing products.
Lay beliefs	Some women believe that birth out comes will always be good regardless.
Past experience	This includes previous IRON-FOLIC ACID use experiences.
Age and health Seeking behavior	Elderly mothers seem to have a different health seeking behavior as compared to younger counterparts.
Myths/ Misconceptions	These consist of the myths and misconceptions that pertains to IRON-FOLIC ACID use.
Competing tasks	Women have many roles in the society which they equally have to attend to besides ANC visits.
Use of traditional medicines	Some women use traditional medicines during pregnancy for various reasons.

Figure 4.5: Socio-cultural determinants of IFAs adherence based on KIIs among CHVs attached to Kakamega county hospital, Kenya, 2020.

4.9.1 Strong religious beliefs

We noted that strong religious beliefs contributed to iron-folic acid non-adherence. More than half of the 11 CHVs mentioned the existence of churches in Kakamega that discourage their believers against seeking care from the hospital as well as taking any form of medicine.

"*There are some churches…. The members just believe in prayers and repentance. Another church here has made the members believe that once someone prays and spits on you then you will be fine. They are not very many though*." (KII: CHV). In some cases, pregnant women are forced to take these supplements in secrete for fear of being noticed by their husbands who are staunch members of such religious beliefs.

"Some of them told me that they have to hide when taking the supplements so that their husbands who are staunch followers may not realize that they are using them." (KII: CHV)

4.9.2 Lay beliefs

There is also a notion among some women that their birth outcomes would always be good regardless of whether they take iron-folic acid supplements or not. According to some CHVs, these women believed that the birth outcomes in their areas have always been good for so long that any woman in the area was likely to give birth to healthy babies without any complication.

"There is a belief here that women in this community have always been giving birth to healthy babies and have experienced good birth outcomes for a very long time. And therefore, these women can still experience good birth outcomes regardless of whether they take supplements or not. Even some pregnant women tell me that…" (KII: CHV)

4.9.3 Past experience

Some women also opt not to use the iron-folic acid supplements because they never used them in their previous pregnancies, as captured in the verbatim below.

"Just recently I met another woman whom I captured late, she was 7 months pregnant, and I referred her to the clinic. She was given iron-folic acid and all other ANC examinations conducted. However, I was surprised when I visited her at home only to tell me that she has not been using the iron-folic acid tablets and that she has never even used them in previous pregnancies." (KII: CHV).

4.9.4 Age and Health Seeking Behavior

There also seemed to be a problem with IFAs adherence among elderly mothers, especially if they became pregnant unexpectedly. Firstly, they felt shy carrying the pregnancy and secondly; they did not want the younger healthcare provider to attend to them. They felt uncomfortable being examined by younger healthcare providers, regardless of gender. To them, these younger professionals are like their children who shouldn't examine them during ANC visits.

"There is another problem, especially with elderly mothers. They feel shy when they become pregnant, and they do not like being attended to by young healthcare providers whom they view as their children." (KII: CHV).

"*And there are cases where mothers who have been on family planning end up being pregnant unexpectedly, maybe due to one reason or another and she already has grown-up children. This makes her feel shy carrying pregnancy when she already has grown-up children."* (KII: CHV)

4.9.5 Myths and Misconceptions

Out of the 126 mothers who were IFAs non-compliant, 3.2% of them said that they feared that the supplements could make the foetus grow bigger, making it difficult for delivery. This was also reported by the CHVs who noted that some women insisted that IFAs would make the foetus grow bigger or be born with deformities. Something that made them not to comply with IFAs.

"*…there are a few women who still believe that iron-folic acid supplements make the unborn baby grow bigger consequently causing problems during delivery to an extend of making caesarian deliveries inevitable. Others believe that the supplements given during ANC make the unborn baby have congenital deformities. They simply talk about the opposite of the actual scenario."* (KII: CHV)

4.9.6 Competing tasks

Some women may not be able to take iron-folic acid supplements as required just because they ran out of the supplements and could not get time to go and collect them at the facility on the appointment date. There are some community functions that are highly prioritized in this area such that a mother would better attend them rather than honoring their ANC appointments. A good example of such community functions that came up during the interviews were funerals. A CHV mentioned that mothers end up foregoing ANC at the expense of funeral services if the two events coincide.

"*So many of the mothers decide to attend a funeral and then check at the facility the following day. You notice that she will have missed taking iron-folic acid on that particular day. If I had the supplements, such a mother would pass by my home and take iron-folic acid on her way to the funeral function."* (KII: CHV).

4.9.7 Use of traditional medicines in pregnancy

About 10.4% (25) of the participants admitted to having used traditional medicines during pregnancy. This practice was also noted by a few of the CHVs, however, they did not think that the practice interfered with IFAs adherence at all. They said that the mothers took the traditional medicines for various reasons and not as a substitute for the iron-folic acid.

"You know it reaches a time when you are pregnant and find yourself in a lot of labor-like pains and you aren't even closer to your delivery date. We call this 'indwasi' and such a mother needs to take these traditional medicines to purify blood and alleviate pain. This happens often. However, we normally tell them to take their traditional medicine while at the same time continue taking the supplements. I tell

them to take iron-folic acid in the morning and maybe take the traditional medicine at around midday." (KII: CHV)

CHAPTER FIVE

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter discusses the findings illustrated in chapter four. The subsections are based on the objectives that the study sought to achieve. Besides expounding on the findings reported, the chapter also provides possible explanations for various trends observed and puts the findings in context by comparing with other similar studies. The researcher culminates this chapter by highlighting the limitations of the study, conclusions, and recommendations.

5.2 Discussion

5.2.1 Prevalence of IFAs adherence

The first objective of this study was to determine the prevalence of self-reported IFAs adherence during pregnancy among mothers seeking MCH 0-6 months post-delivery at Kakamega county hospital. We noted a moderate adherence to IFAs (60.6%) during pregnancy among mothers seeking MCH at Kakamega hospital. The finding is consistent with similar studies conducted in a sub-city of Ethiopia (60.9%) as well as a metropolitan area of Ghana (58.8%), (Gebreamlak et al., 2017; Wemakor et al., 2020). The IFAs prevalence was however higher as compared to 32.7% reported in Kiambu county of Kenya (Kamau et al., 2018) and 20.3% among rural communities of North Western Tanzania (Lyoba et al., 2020) but lower than 71% reported in India (Manasa et al., 2019) and 68.6% in Niger (Khadija et al., 2018). The moderately higher IFAs prevalence recorded in the current study could be attributed to the fact that the study was conducted in a hospital located within a town. This implies that the hospital is very accessible and the mothers seeking MCH within the hospital have more access to information as they are likely to be residing closer to town. Nevertheless, the moderate IFAs adherence at Kakamega county hospital suggests that pregnant mothers seeking MCH in this facility and their unborn babies are still exposed to some risks of gestational maternal anaemia. This is because,

pregnant mothers are expected to comply with daily iron-folic acid uptake throughout the gestation period as in accordance with the WHO guidelines.

5.2.2 Socio-demographic related determinants of IFAs adherence.

In the second objective, the study set out to identify the socio-demographic related determinants of IFAs adherence. A set of possible socio-demographic related factors were studied, and these included: mother's age, education level, marital status, gravidity, birth complications history, mother's knowledge of anaemia, number of ANC visits attained, distance to ANC facility and IFAs related side effects.

Participants who experienced iron-folic acid related side effects were less likely to be IFAs compliant. Equally, most of the respondents who admitted not having adhered to IFAs during their gestation period mentioned side effects (41.3%), forgetfulness (37.3%) and the bad smell of the supplements (10.3%) as the main challenges. Similar reasons for non-adherence have also been reported among pregnant women in India (Lavanya et al., 2020) and Ghana (Wemakor et al., 2020). In Ethiopia, Nasir et al observed that more than half of the mothers who were IFAs non-compliant either attributed the poor trend to iron-folic acid related side effects or forgetfulness (Nasir et al., 2020). Most mothers do not seem to know how to manage iron-folic acid related side-effects, and this makes them give up on the supplements quite easily. Out of the 123 mothers who reported to have experienced some side effects due to iron-folic acid consumption, almost 90% of them either stopped taking the supplements or let the side effects subside on their own. There is a need for health care providers to include education on the management of iron-folic acid related side effects as part of ANC counselling. Practices such as taking iron-folic acid alongside meals or just before going to bed as well as eating plenty of vegetables and fruits have been linked to reduced iron-folic acid side effects (Kamau et al., 2018). Forgetfulness among iron-folic acid users could be reduced by encouraging mothers to embrace modern technology reminders or take the supplements at specific times, such as after meals, every morning, and just before going to bed. The women could also ask a reliable member of the family or friend to remind them to take the supplements.

Gravidity is a great determinant of IFAs adherence. Primigravida mothers were almost three times more likely to be IFAs compliant as compared to multigravida respondents. This is in line with other studies conducted in Kenya and India (Kamau et al., 2018; Lavanya et al., 2020). However, this finding is not consistent with Alemayu et al and Niguse et al who observed higher odds of IFAs compliance among multigravida mothers in Ethiopia, (Alemayehu et al., 2019; Niguse & Murugan, 2018). The low IFAs compliance among the multigravida mothers could be attributed to their experience with delivery and iron-folic acid usage. Some studies have shown that women who experience unpleasant side effects with iron-folic acid or have a history of good birth outcomes may not appreciate the need to adhere to iron-folic acid in their consecutive pregnancies (Getachew et al., 2018). Therefore, sensitizing multigravida mothers on the importance of adhering to IFAs during subsequent pregnancies regardless of the previous past experiences is key.

Mothers who attained fewer ANC visits were exposed to iron-folic acid non-adherence. Precisely, the respondents who attained a maximum of two ANC visits had up to 70% reduced chances of being IFAs compliant. A large population-based study conducted among pregnant women in SSA noted higher odds of IFAs compliance among women with at least 4 ANC visits (Ba et al., 2019). In Ethiopia, Molla et al. observed that women with at least 4 ANC visits were almost 7 times more likely to be IFAs compliant while Tarekegn et al. reported higher IFAs compliance among women who had attained at least 3 ANC visits, (Molla et al., 2019; Tarekegn et al., 2019). Generally, ANC visits correlate positively with IFAs adherence. A higher number of ANC visits indicates more frequency of contact between the mother and the healthcare provider. This provides a good opportunity for the healthcare provider to encourage the mothers to use the supplements as required. The mothers also get their supplements replenished through such visits to ensure that they do not run out of iron-folic acid. Besides, they could share any challenges encountered while taking the supplements with the healthcare provider and be advised accordingly. The WHO recommends at least eight ANC visits in pregnancy and therefore encouraging pregnant women to complete the recommended number of visits is likely to have a positive influence on IFAs compliance.

Women who have a higher knowledge of anaemia were more than three times likely to be iron-folic acid adherent as compared to their counterparts of low anaemia knowledge. Similar findings have also been reported in other studies elsewhere, (Molla et al., 2019; Sendeku et al., 2020; Wemakor et al., 2020). It is possible that having higher knowledge of anaemia enables a mother to understand the aetiology of anaemia, its prevention measures as well as the deleterious effects that the condition could cause to the mother and her unborn baby. This makes the mothers appreciate the importance of taking iron-folic acid as recommended.

5.2.3 Health system related factors influencing IFAs adherence.

In the third objective, the study sought to identify some of the health system related factors that influence IFAs adherence. A set of possible health system related factors were studied, and these included: ANC education on IFAs, pregnancy counselling before conception, turnaround time at the ANC, iron-folic acid stock outs and attitude towards ANC healthcare provider.

Pregnancy counselling before conception and ANC education on the importance of IFAs adherence are good ways of ensuring compliance with the supplements. The study revealed that women who received education on the importance of iron-folic acid during ANC were 2.4 times more likely to be IFAs compliant as compared to their counterparts who had no education with regards to IFAs. Just like IFAs education, mothers who attended pregnancy counselling sessions before conception had higher odds of IFAs compliance. This is consistent with other reports where IFAs education during ANC or pregnancy counselling improved the uptake of the supplements (Gebreamlak et al., 2017; Kamau et al., 2018). Being educated on the importance of iron-folic acid helps mothers to appreciate the need to take the supplements consequently leading to compliance. Unfortunately, KIIs with ANC health care workers revealed that the staff were almost unable to provide this crucial education to ANC mothers as at the time of the study due to health system disruptions caused by the COVID-19 pandemic (Adeigbe, 2020) that led to a shift in location of ANC services. Moreover, the understaffing at the ANC department and the rigorous documentation involved within this section barely leaves enough opportunity for individual health talk between a mother and the health care provider.

The MoH should put measures in place to ensure uninterrupted continued provision of essential health care services such as MCH even in times of pandemics like COVID-19.

Although a significant correlation between mother's attitude towards healthcare provider and IFAs adherence was not confirmed in the multivariable model, univariable analysis and KIIs revealed otherwise. Initial findings of the univariable model showed that mothers who had a positive attitude towards ANC healthcare provider were two-fold more likely to be IFAs compliant as compared to their fellow counterparts of negative attitude towards ANC healthcare provider, (OR=2.357, 95% CI: 1.124, 5.052). Out of the 125 mothers who admitted to having sought ANC services with at least 4 months of gestation age, 36% of them feared that they would end up making many ANC visits. Most of the CHVs attributed the negative attitude towards ANC to fear of making many ANC visits, long queues at the ANC and even long distances to the ANC facility. Such observations have also been noted elsewhere (Jinga et al., 2019). Generally, having a negative attitude towards ANC healthcare provider impacts negatively on the number of ANC visits (Okedo-alex et al., 2019). Women who attain fewer ANC visits have higher chances of running out of the supplements. Besides, they may not have access to sufficient iron-folic acid related education consequently affecting their iron-folic acid uptake.

5.2.4 Socio-cultural factors influencing IFAs adherence.

The fourth objective of the study was to identify the socio-cultural determinants of IFAs adherence during pregnancy among mothers seeking MCH 0-6 months post-delivery at Kakamega county hospital. The KIIs with CHVs showed some connectivity between religion and IFAs adherence. Most of the CHVs reported about the existence of some churches within the study area that neither allowed their members to seek medical care from hospitals nor let them take any kind of medicine. Cases of some staunch religious believers rejecting medication especially blood products have existed for a long time (Koenig, 2004). This has direct negative consequences on IFAs adherence. The fact that the believers reject any medicine, especially blood products, implies that IFAs is less likely to be accepted among them

as well. Besides, not being able to visit hospitals while sick means that their chances of getting access to health information are very small.

The present study also noted that some women opted not to use IFAs because they have had good birth outcomes in their previous pregnancies without having taken the supplements. Others believed that the supplements made the foetus grow bigger making delivery difficult or resulted in babies with deformities. Such misconceptions have also been reported in Ethiopia, Ghana and Tanzania (Lavanya et al., 2020; Lyoba et al., 2020; Wemakor et al., 2020). This can be attributed to insufficient knowledge of IFAs. Women who do not have sufficient knowledge of the importance of IFAs may not appreciate how useful it is to take the supplements as recommended. There is need to provide further education to childbearing mothers about the importance of iron-folic acid especially during ANC visits.

Mothers who become pregnant at an older age tend to feel shy about the pregnancy. It seems a bit unusual for elderly mothers to get pregnant in this community. As mentioned by some of the CHVs, the situation gets worse if the pregnancy was unplanned. Not surprisingly, the chances of such mothers seeking ANC services are very low as most of them become stressed (Hijazi et al., 2018; Muhwava et al., 2016). Moreover, such mothers feel uncomfortable being attended to by younger health care providers. Consequently, as one would expect, their motivation to seek ANC goes down. This results in IFAs non-compliance as they may not have continuous access to IFAs or IFAs related education. The MoH should empower CHVs with necessary skills and knowledge on how to handle or even help such mothers access care.

5.3 Limitations of the study

The study investigators acknowledge the following limitations:

1. The data accruing from this study was only collected at one point in time and just like other cross-sectional studies there are challenges in making the causal effect inferences. We measured both the risk factors and the outcome

at the same time and therefore difficult to tell whether the exposure proceeded the outcome indeed.

2. The study relied on self-reported IFAs adherence, which may not be the gold standard approach of determining IFAs compliance. Self-reported adherence studies are non-invasive, less expensive, easy to administer and pose minimal patient burden (Stirratt et al., 2015). The best alternative would have been a longitudinal study to measure IFAs compliance in the entire gestation period through pill count method. However, the pill count method requires more resources, and it would have been almost unachievable considering the fact that the study was conducted during the COVID-19 pandemic with restricted movements within the country. Equally, self-reported adherence is prone to recall bias. Usually, studies assessing IFAs adherence have recall periods ranging from as short as seven days to as long as five years as used in KDHS (KDHS, 2014). Although shorter recall periods of 7 days of iron-folic acid use during pregnancy are frequently used in other studies, the method is not without disadvantages either. Firstly, measuring iron-folic acid use in a single week during pregnancy makes it difficult to infer whether the mother will be compliant throughout the gestation, especially with the current change of IFAs adherence guidelines by WHO from 90-day use of iron-folic acid to daily use throughout pregnancy (WHO, 2016). Secondly, as reported by Stirratt et al., such short recall periods experience a ceiling effect which results in overestimation of the adherence (Stirratt et al., 2015). Chang et al. report that in salience, some pregnancy healthcare indicators could be accurately remembered up to 20 months post-delivery (Chang et al., 2018). Other studies show that long recall periods of more than 1 year are prone to recall bias unless the event is very salient (Kanyangarara et al., 2019). Therefore, a trade-off between information and bias is almost inevitable when determining the length of the recall period in self-reported compliance studies (Kjellsson et al., 2014). Nonetheless, researchers need to consider the salience of the event when determining the length of the recall period. Pregnancy itself is a salient event in a woman's life and evidence shows mothers are likely to recall most of the healthcare indicators within our stipulated cut-off or 0-6 months post-delivery (Chang et al., 2018).

5.4 Conclusions

1) There is moderate adherence to IFAs during pregnancy among mothers seeking MCH at Kakamega county hospital. The greatest impediments of IFAs compliance are iron-folic acid related side effects, forgetfulness and the bad smell of the iron-folic acid tablets.
2) There is higher compliance to iron-folic acid during pregnancy among mothers who are; primigravida, have higher knowledge of anaemia and those who attained a higher number of ANC visits.
3) Counselling women in preparation for conception as well as routine education on the importance of iron-folic acid during ANC visits have a positive influence on iron-folic acid uptake.
4) The existence of some socio-cultural factors within the study area hinder iron-folic acid uptake during pregnancy. Specifically, strong religious beliefs, misconceptions, and perceptions of old age pregnancies negatively affect IFAs *adherence.*

5.5 Recommendations

Based on the findings reported in this study, we recommend that:

1) The MCH department of Kakamega county hospital should intensify counselling on the importance of iron-folic acid intake and ensure that every pregnant woman benefits from this. Also, the anticipated side effects of iron-folic acid supplements should be explained to all pregnant mothers seeking ANC. The healthcare providers should advise them on home-based remedies that could help alleviate the side effects such as taking the supplements with food, taking them while going to bed and eating plenty of vegetables and fruits. Alternatively, the mothers could be encouraged to seek assistance from a healthcare provider any time the side effects persist.
2) Public awareness should be created on the importance of IFAs as well as ANC attendance. This could be done through mass media campaigns, public forums, but even better if maternal education could be incorporated in the Kenyan high school curriculum so as both men and women are empowered

on this subject as early as possible. Little incentives such as issuing a card or certificate to mothers who complete more than four ANC visits could boost ANC adherence to some extent.

3) The MoH and the department of health at Kakamega county should adopt effective ways of communicating to women on the importance of iron-folic acid, especially community-based channels. Such channels should help stop some of the popular misconceptions of iron-folic acid such as giving birth to over-weight babies making delivery difficult or resulting to disabled babies.
4) There is a need for further research in this area. The study needs to be replicated in non-urban health facilities in Kakamega county to get a clear picture of the status of IFAs adherence in these facilities. It is possible that iron-folic acid uptake in non-urban health facilities may be different from the one reported here due to differences in sociodemographic characteristics of the mothers seeking MCH and even hospital accessibility. Such studies should also investigate on the dietary habits of these women during pregnancy to provide more information on other possible causes anaemia.

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APPENDICES

Appendix I: Informed consent form (MCH seeking mothers)

Title: Determinants of adherence to iron-folic acid supplementation during pregnancy among postnatal mothers seeking maternal and child healthcare at Kakamega county referral hospital.

I'm Felix Bahati, a Master of Public Health student at Jomo Kenyatta University of Agriculture and Technology. I am conducting a study to find out the determinants of adherence to iron-folic acid supplementation during pregnancy among postnatal mothers seeking maternal and child healthcare at Kakamega county referral hospital**.** Let me inform you about this study briefly. This study aims at understanding the determinants that influence iron and folic supplementation during pregnancy among mothers seeking Postnatal Care in this hospital. The investigator wishes to learn how those determinants influence iron and folic acid supplementation adherence during pregnancy.

Participation in this study is purely voluntary. If you agree to participate in this study, you will sign at the end of this form and I will proceed to ask you some questions. Specifically, I will ask you questions regarding your previous pregnancy of the child that you have just brought to the clinic today. However, if you feel that you do not want to participate, you are free to do so and you will not be compromised in any way. You will continue getting services at this facility as usual without any discrimination. The interview will take approximately 30 minutes only.

There are no risks involved in this study. The study is purely for academic purposes. There are no direct benefits to you as a participant either. However, the findings of this study will be used to provide future insights on iron and folic acid supplementation programs so as to scale on the utilization of the program. The answers that you will provide to the questions in this study will be kept confidential. Your name will not appear anywhere either on our data storage devices or the final write-up.

You are free to ask any questions to clarify any issues that may not be clear to you at any time. If you wish to know anything related to the study later, feel free to reach out to the researcher on 0728512911. If you wish to contact any other person apart from the researcher regarding any concern about the study, then you can speak to;

1. Dr. Japheth Mativo, department of Environmental Health and Disease Control, Jomo Kenyatta University of Agriculture and Technology. **Phone number: 0720048474**.

2. Dr. Salome Wanyoike, department of Environmental Health and Disease Control, Jomo Kenyatta University of Agriculture and Technology. **Phone number: 0716178777.**

Consent: I agree to participate in this research.

Participant

Name……. Signature ……. Date……

Witness

Name……. ……. Signature ……. Date……

Appendix II: Assent form (Younger mothers of 15-17 years seeking MCH)

Title: Determinants of adherence to iron-folic acid supplementation during pregnancy among postnatal mothers seeking maternal and child healthcare at Kakamega county referral hospital.

I'm Felix Bahati, a Master of Public Health student at Jomo Kenyatta University of Agriculture and Technology. I am conducting a study to find out the determinants of adherence to iron-folic acid supplementation during pregnancy among postnatal mothers seeking maternal and child healthcare at Kakamega county referral hospital**.** Let me inform you about this study briefly. This study aims at understanding the determinants that influence iron and folic supplementation during pregnancy among mothers seeking Postnatal Care in this hospital. The investigator wishes to learn how those determinants influence iron and folic acid supplementation adherence during pregnancy.

Participation in this study is purely voluntary. If you agree to participate in this study, you will sign at the end of this form and I will proceed to ask you some questions. Specifically, I will ask you questions regarding your previous pregnancy of the child that you have just brought to the clinic today. However, if you feel that you do not want to participate, you are free to do so and you will not be compromised in any way. You will continue getting services at this facility as usual without any discrimination. The interview will take approximately 30 minutes only.

There are no risks involved in this study. The study is purely for academic purposes. There are no direct benefits to you as a participant either. However, the findings of this study will be used to provide future insights on iron and folic acid supplementation programs so as to scale on the utilization of the program. The answers that you will provide to the questions in this study will be kept confidential. Your name will not appear anywhere either on our data storage devices or the final write-up.

You are free to ask any questions to clarify any issues that may not be clear to you at any time. If you wish to know anything related to the study later, feel free to reach

out to the researcher on 0728512911. If you wish to contact any other person apart from the researcher regarding any concern about the study, then you can speak to;

1. Dr. Japheth Mativo, department of Environmental Health and Disease Control, Jomo Kenyatta University of Agriculture and Technology. **Phone number: 0720048474**.

2. Dr. Salome Wanyoike, department of Environmental Health and Disease Control, Jomo Kenyatta University of Agriculture and Technology. **Phone number: 0716178777.**

Consent: I agree to participate in this research.

(Signature of the participant/guardian/husband if 15 to 17 years)

Participant

Name……. Signature ……. Date……

Parent/guardian

Name……. ……. Signature ……. Date……

Appendix III: Informed consent form (Health care providers and CHVs)

Title: Determinants of adherence to iron-folic acid supplementation during pregnancy among postnatal mothers seeking maternal and child healthcare at Kakamega county referral hospital.

I'm Felix Bahati, a Master of Public Health student at Jomo Kenyatta University of Agriculture and Technology. I am conducting a study to find out the determinants of adherence to iron-folic acid supplementation during pregnancy among postnatal mothers seeking maternal and child healthcare at Kakamega county referral hospital**.** Let me inform you about this study briefly. This study aims at understanding the determinants that influence iron and folic supplementation during pregnancy among mothers seeking Postnatal Care in this hospital. The investigator wishes to learn how those determinants influence iron and folic acid supplementation adherence during pregnancy.

Participation in this study is purely voluntary. If you agree to participate in this study, you will sign at the end of this form and I will proceed to ask you some questions. Specifically, I will ask you questions regarding how pregnant women that you come in contact with in your line of duty have been using iron and folic acid. However, if you feel that you do not want to participate, you are free to do so and you will not be compromised in any way. The interview will take approximately 30 minutes only.

There are no risks involved in this study. The study is purely for academic purposes. There are no direct benefits to you as a participant either. However, the findings of this study will be used to provide future insights on iron and folic acid supplementation programs so as to scale on the utilization of the program. The answers that you will provide to the questions in this study will be kept confidential. Your name will not appear anywhere either on our data storage devices or the final write-up.

You are free to ask any questions to clarify any issues that may not be clear to you at any time. If you wish to know anything related to the study later, feel free to reach

out to the researcher on 0728512911. If you wish to contact any other person apart from the researcher regarding any concern about the study, then you can speak to;

1. Dr. Japheth Mativo, department of Environmental Health and Disease Control, Jomo Kenyatta University of Agriculture and Technology. **Phone number: 0720048474**.

2. Dr. Salome Wanyoike, department of Environmental Health and Disease Control, Jomo Kenyatta University of Agriculture and Technology. **Phone number: 0716178777.**

Consent: I agree to participate in this research.

(Signature of the participant/guardian/husband if 15 to 17 years)

Participant

Name……. Signature ……. Date……

Witness

Name……. ……. Signature ……. Date……

Appendix IV: Informed consent form (Guardian or parent for mothers under 18 years)

Title: Determinants of adherence to iron-folic acid supplementation during pregnancy among postnatal mothers seeking maternal and child healthcare at Kakamega county referral hospital.

I, _____, [being a parent/guardian of _____ (name of child)], have had the study explained to me. I have understood all that has been read/explained and had my questions answered satisfactorily.

Please tic☐ **I agree to allow my child to take part in this observational research**

I understand that I can change my mind at any stage, and it will not affect the benefits due to me/my child.

Parent/guardian's signature: _____ **Date** _____

Parent/guardian's name: _____
Date_____

(Please print name)

---***Where parent/guardian cannot read, ensure a witness****** observes consent process and signs below:***

I* attest that the information concerning this research was accurately explained to and apparently understood by the participant/parent/guardian and that informed consent was freely given by the parent/guardian.

Witness' signature:_____ **Date**_____

Witness' name:_____ **Date**_____

(Please print name)

*A witness is a person who is independent from the study or a member of staff who was not involved in gaining the consent.

Thumbprint of the parent as named above if they cannot write:

Appendix V: COVID-19 Risk Information Sheet

Study title:

Determinants of adherence to iron-folic acid supplementation during pregnancy among postnatal mothers seeking maternal and child healthcare at Kakamega county referral hospital.

Due to the COVID-19 pandemic we would like to make you aware of the risks associated with spread of the disease and what we are doing to reduce these risks. In our population, many people who get COVID-19 may not show any symptoms. However, they can still unknowingly spread the disease and lead to mild, moderate or severe disease and sometimes death, especially in high risk individuals. Some of the ways in which the disease is spread is unclear but is thought to be by touching infected surfaces or droplets from an infected person (coughing/sneezing etc.) onto your eyes, nose or mouth. We are unsure how the pandemic will change over time and want to put measures in place to avoid the spread of the disease whilst you participate in this study. Below are some of the things we have put in place to reduce these risks.

What will happen when you arrive at the place where we will be having our discussions?

1. Anyone entering the room where we will be holding our interviews will be required to wear a mask and sanitize their hands before entering the room.

2. Our interviewer administering the questionnaire to you will be screened daily for symptoms of COVID-19 before they come into the workstation.

What measures are the study team taking when in direct contact with you?

3. We assure you that we are careful about whom we ask to come to interview you and the interviewer will be screened every day for COVID-19 symptoms.
4. As far as possible, we will ensure strict physical distancing practices when we meet for the interviews.
5. Any member of our team coming in contact with you will be required to wear a mask.
6. We confirm that all our team members follow infection control practices that include hand washing or sanitizing, wearing gloves where necessary, wearing masks and other protective equipment. We also encourage you to always wash your hands after touching surfaces and entering and exiting areas.
7. For the safety of all group members, we also request that you let us know if you have had contact with someone who may have COVID-19, or if you experience symptoms that could be COVID-19.

What measures can I take or have been put in place by the research team regarding keeping safe when using private or public transport?

8. We encourage you to wear a mask as per government directives when using public transport.

What happens if I am unwell or have a temperature?

9. Should we suspect that you have signs of COVID-19, you will be referred to the County COVID-19 team and a swab will be collected as per Government of Kenya guidelines.
10. Whilst waiting for results we will try to keep in touch with you on the phone (where possible) and if positive you will receive care as per the Ministry of Health guidelines.

We know that COVID-19 will be in our community for many months. We appreciate your continued participation in our study. Please contact us using the phone numbers below if there is anything you are concerned about.

1. Dr. Japheth Mativo, department of Environmental Health and Disease Control, Jomo Kenyatta University of Agriculture and Technology. **Phone number: 0720048474**.

2. Dr. Salome Wanyoike, department of Environmental Health and Disease Control, Jomo Kenyatta University of Agriculture and Technology. **Phone number: 0716178777.**

Appendix VI: Semi-structured questionnaire

Name of interviewer_____ Date of interview_____

Name of respondent _____Place of residence of respondent_____

SECTION A: SOCIO-DEMOGRAPHIC CHARACTERISTICS

A1. What is your age in years? _____

A2. What is the age of your child? (in months). **If more than 6 months end the survey.**

A3. What is your occupation?

1. Formal
2. Non-formal

A4. What is your level of education?

1. No education
2. Primary level
3. Secondary level
4. College/university

A5. What is your marital status?

1. Married
2. Single
3. Divorced
4. Separated

A6. What is your religion?

1. Christian
2. Muslim
3. None
4. Other

SECTION B: OBSTETRIC CHARACTERISTICS

B1. Have you ever had a pregnancy counselling session (with a healthcare provider) to prepare yourself for pregnancy?

1. Yes
2. No

B2. How many pregnancies have you had in total? _____

B3. Have you ever had a miscarriage?

1. Yes
2. No

B4. If yes, how many?

B5. Have you ever had a birth complication?

3. Yes
4. No

SECTION C: KNOWLEDGE OF ANAEMIA, CAUSES AND CONSEQUENCES

C1. Do you know of an illness where the affected person is said to have little or no blood (Anaemia)?

1. Yes
2. No

C2. If yes, where or from whom did you learn about this disease?

1. Community health worker
2. Health professional
3. Friend
4. Relative
5. Media
6. Other

C3. If other, specify _____

C4. Is it possible to have anaemia while pregnant?

1. Yes
2. No

C5. Ensuring proper child spacing interval can help prevent the development of Iron deficiency anaemia. True or False?

1. True
2. False
3. Don’t know

C6. What is the best child spacing interval that can help prevent anaemia?

1. <2 years
2. ≥ 2 years

C7. Do you know what causes anaemia?

1. Yes
2. No

If no go to C10

C8. What are some of the causes of anaemia? (can choose many)

1. Blood loss
2. Malnutrition i.e. lack of iron in diet
3. Malabsorption
4. Some parasites (Malaria, schistosomiasis etc.)
5. Increased iron needs by the body i.e. during pregnancy
6. Poor child spacing (<2 years)
7. Others

C9. If other, specify _____

C10. What are some of the iron rich foods that can help prevent anaemia when consumed in right proportions during pregnancy? (can choose many)

1. Dark green leafy vegetables such as spinach
2. Legumes
3. Red meat
4. Chicken
5. Turkey
6. Sea food
7. Liver and other organ meats
8. Sweet potatoes
9. Pumpkin seeds
10. Don't know

C11. What are some of the beverages that decrease iron absorption when taken during meals? (can choose many)

1. Coffee

2. Tea
3. Don’t know

C12. What are the symptoms of a? (can choose many)

1. Breathing difficulties
2. Fainting
3. Tiredness/fatigue
4. Palpitations
5. Sleeping difficulties
6. Headache
7. Difficult concentration
8. Pallor
9. Don’t know
10. Other

C13. Do you know the consequences of anaemia in pregnancy?

1. Yes
2. No

If no go to C15

C14. What are the consequences of anaemia during pregnancy? (can choose many)

1. Increased risk of perinatal infection
2. Pre-eclampsia
3. Post-partum cognitive impairment
4. Congenital malformations
5. Intrauterine growth retardation
6. Preterm birth
7. Low birth weight
8. Maternal mortality
9. Don’t know

C15. What are some of the ways through which anaemia can be prevented during pregnancy? (can choose many)

1. Taking iron supplements
2. Consumption of iron rich foods
3. Eating vitamin C rich foods during or right after meals
4. Treat/prevent other causes of a
5. Don't know

SECTION D: FREQUENCY OF ANC VISITS

D1. Did you ever attend ANC during pregnancy?

1. Yes
2. No

If yes go to D6

D2. What was the main reason that made you not to attend ANC?

1. I did not know that I was pregnant
2. I did not know that it was necessary
3. I did not have time to attend
4. I did not have money to pay for the service
5. I did not have money for transport
6. I usually do not attend ANC even for past pregnancies
7. I was not given permission to attend
8. other

D3. If other, specify _____

D4. How far (in minutes) is your place of residence from the nearest facility where you would have sought ANC? _____

D5. What means of transport would you have been required to use in case you were to attend ANC?

1. Walking
2. Matatu ride

3. Motor cycle
4. Bicycle ride

D5. How much if any would it have cost you to get to the nearest ANC facility (KSH)? _____

D6. In which facility did you attend ANC?

1. At this facility
2. Somewhere else

D7. How many months pregnant were you when you first attended ANC for this child? _____

D8. Gestation age during first ANC visit in weeks (Automatically calculated by REDCap)

D9. (If gestation age during first ANC is more than two months), what prevented you from visiting ANC earlier? (Can choose multiple)

1. Didn't know I was pregnant
2. I didn't know early visits were necessary.
3. I was busy.
4. I did not have permission to visit ANC then
5. Other

D10. If other, specify _____

D11. How many times did you attend ANC during pregnancy of this child?

1. Once
2. Twice
3. Thrice
4. Four times
5. More than four times
6. Don't know

D12. Is there any time that you were to attend ANC but could not make it?

1. Yes
2. No

D13. If yes, why couldn't you make it?

1. I was feeling unwell
2. I did not know that it was necessary
3. I did not have time to attend (busy)
4. I did not have money to pay for the service
5. I did not have money for transport
6. I usually do not attend ANC even for past pregnancies
7. I did not get permission to attend
8. other

D14. If other, specify _____

D15. How far is your place of residence from the facility where you sought ANC in minutes? _____

D16. What means of transport did you use to get to the ANC facility?

1. Walking
2. Matatu ride
3. Motor cycle
4. Bicycle ride

D17. How much if any does it cost you to get to the facility (KSH)? _____

D18. What can you say about the waiting time at the ANC?

1. The waiting time was longer than I expected
2. The waiting time was shorter than I expected.
3. The waiting time was just as I expected

4. Don’t know

SECTION E: IFAs ADHERENCE

E1. Did you ever take iron-folic acid supplements during your previous pregnancy period? (Showing the various tablets/syrup of iron-folic acid)

1. Yes
2. No

E2. Where did you used to acquire the iron-folic acid supplements?

1. I bought them over the counter
2. I was given freely at the health facility
3. I was given freely by the CHV
4. Other (Specify)…

E3. For how long would the iron-folic acid supplements last before going for replenishment?

1. Less than 1 month
2. 2-3 months
3. 4 months or more

E4. Did you take the iron-folic acid supplements faithfully as recommended by the health care provider?

1. Yes
2. No

If yes, go to E7

E5. If no why?

1. Forgetfulness
2. Side effects
3. Wasn't told how helpful they were.
4. Someone stopped me from using them (Specify).
5. The tablets had bad smell
6. Ran out of the supplements quite often
7. Other (Specify) _____

E6. If you experienced side effects, which ones were they? (Can choose multiple)

1. Dark coloured stool
2. Constipation
3. Diarrhoea
4. Nausea
5. Vomiting
6. Heart burn
7. Headache
8. Other

E7. On average, how many iron-folic acid tablets did you used to take every week throughout pregnancy?

1. Never took them
2. Less than two
3. Three to four
4. More than four

E8. Did you ever experience any side effects due to IFAs?

1. Yes
2. No

E9. If yes, what was the side effect (s)?

1. Dark coloured stool
2. Constipation
3. Diarrhoea
4. Nausea
5. Vomiting
6. Heart burn
7. Headache
8. Other

E10. If other, specify _____

E11. What did you do to overcome the side effect?

1. Sought help from the hospital
2. Just let them subside on their own

3. Stopped taking the supplements for some time
4. Other
5. If other, specify _____

SECTION F: SOCIO-CULTURAL FACTORS

F1. Are you required to seek for permission from anyone before visiting health facility for ANC?

1. Yes
2. No

F2. If yes, whom do you seek permission from?

1. Husband
2. Mother in-law
3. Father-in-law
4. Parents
5. Other

F3. According to your culture, were you required to refrain from some foods while you were pregnant?

1. Yes
2. No

F4. If yes, name the foods that you avoided _____

F5. If yes, what was the reason as to why you were required to avoid those foods?

1. The food would harm the foetus
2. The food would make the foetus bigger making delivery difficult
3. Don't know

F6. According to your culture, were you prohibited from using iron-folic acid supplements while pregnant due to one reason or another?

1. Yes
2. No

F8. If yes, what were the reasons (Can choose many)?

1. iron-folic acid supplements would harm the foetus
2. iron-folic acid supplements would make the foetus bigger making delivery difficult
3. Used traditional medicine instead.
4. iron-folic acid supplements were thought to be contraceptives
5. Don't know

F9. Did you ever use any traditional medicines/herbs while you were pregnant?

1. Yes
2. No

F10. If yes, what were they meant to help/treat?

1. Fever
2. Flu
3. Headache
4. Improve wellbeing of the foetus
5. Make delivery easy
6. Boost blood levels
7. Don't know
8. Other

F11. If other, specify_____

SECTION G: HEALTH SYSTEM-RELATED FACTORS

G1. Is there a time you went for ANC and you were not given iron-folic acid supplements?

1. Yes
2. No

G2. If yes, how many times did this happen to you?

1. Once
2. Twice
3. More than twice
4. Never given iron-folic acid throughout entire ANC visits

G3. If yes, what was the reason why you were not given the supplements?

1. The hospital had run out of supplements.
2. I did not have money to buy them at the hospital's pharmacy
3. There was a long queue and so I left
4. I forgot to collect them
5. I felt that I did not need them
6. Other

G4. Did the health care provider explain to you why taking iron-folic acid tablets was necessary?

1. Yes
2. No.

G5. Why do you think it is important to take iron-folic acid supplements faithfully as recommended by the healthcare provider? Can choose multiple answers)

1. To prevent maternal a
2. To prevent birth complications
3. To prevent bad birth outcomes (preterm birth, malformations, low birth weight)
4. Don't know

SECTION H: MOTHERS' ATTITUDE TOWARDS ANC SERVICES.

H1. The health care provider responded to all my concerns satisfactorily.

1. Strongly disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly agree

H2. The health care provider was polite while offering service to me.

1. Strongly disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly agree

H3. The health care provider took enough time responding to my concerns.

1. Strongly disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly agree

H4. The health care provider listened to me attentively to understand my problem.

1. Strongly disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly agree

H5. ANC follow up is good to monitor mother's and foetus' health

1. Strongly disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly agree

Appendix VII: Key Informant Interview guide (Healthcare providers)

Name of respondent _____ Date _____

Job title _____ Gender_____

1. Does the health facility have a policy of supplementing pregnant women with Iron/folate tablets? If yes, what is the policy?
2. Do you think it is important to supplement pregnant women with iron/folate tablets regardless of Hb levels?
3. Are the tablets prescribed as medication or as supplements to diet for all women regardless of Hb levels in this facility?
4. What information is given to pregnant women in relation to iron-folic acid supplements?
5. What is the source of supply for the iron/folate tablets and have there been any changes?
6. Who determines the amount of supplements allocated to this hospital?
7. Which channel of reporting is followed when launching a procurement for the supplements?
8. What are the stipulated time intervals on which procurement can be made?
9. How is the supply flow of the Iron/folate tablets? (Are there any challenges?)
10. Which type of iron/folate tablets are issued to pregnant women seeking care in this facility?
11. How is adherence and acceptability of the tablets like? What do you think are the issues affecting adherence and acceptability? (probe on colour, size, taste, side effects, socio-cultural beliefs)
12. What has been the trend in terms of supplementation and adherence of pregnant women to the tablets?
13. Basing on the workload experienced by health healthcare providers in this facility, do you think these healthcare providers get enough time to counsel mothers on the benefits of iron-folic acid?
14. In your opinion, what do you think can be done to enhance supplementation of pregnant women with iron/folate tablets?

Appendix VIII: Key Informant Interview guide (Community Health workers)

Name of respondent _____ Date _____

Phone number _____

1. Roughly what percentage of pregnant women from your area make use of ANC services?
2. What are the possible reasons for those who do not use ANC services?
3. Do you think mothers have enough access to iron-folic acid supplements?
4. If no, why?
5. Do you ever keep a stock of these supplements such that you are able to counsel and give them to pregnant mothers who come to you with a need?
6. Where else do you think mothers get these supplements? (Probe any other as well as proportions for the various sources)
7. Do mothers have any problem with acquiring these supplements from you as compared to acquiring them from the facility?
8. Do you think mothers take these supplements faithfully as recommended? Roughly what percentage?
9. If no what are the reasons?
10. Are there any socio-cultural beliefs that restrict iron-folic acid consumption during pregnancy in your community?
    1.Yes
    2. No
11. If Yes, what are some of the socio-cultural beliefs
12. What is your role in trying to promote the uptake of iron-folic acid supplements utilization among women in your area?
13. In your opinion, what do you think can be done to enhance supplementation of pregnant women with iron/folate tablets?

Appendix IX: Work plan

Task	Oct 2019	Nov	Dec	Jan	Feb	March	April	May	June	July
Proposal Development and Writing.										
Submission of Proposal for ethical review and approval.										
Data Collection.										
Data Analysis and Report Writing.										
Presentation and defense of final thesis.										
Submission of final thesis.										

Appendix X: Budget

Item	Description	Unit	Each (ksh)	Cost (ksh)
Thesis development	Printing and binding	6 copies	300	1,800
Stationery	Pens, pencils and notebooks	2 Pieces	100	200
Tablets	Android tablet for RedCap	1 pieces	10,000	10,000
Transport	To Kakamega hospital	To and fro for 90 days	100	9,000
Airtime	Phone calls	For 90 days	50	4,500
Meals	Lunch and refreshments	1 person for 90 days	150	13,500
Manuscript publication	Journal publication fee	1 manuscript	71,000	71,000
Contingency	Incidental expenses.		5,000	4,000
TOTAL				**114,000/=**

Appendix XI: Ethical approval

VERDICT – APPROVED

Daystar University Ethics Review Board

Our Ref: **DU-ERB/09/04/2020/000415**

Date: 9th April 2020

To: Felix Bahati

Dear Felix,

www.daystar.ac.ke

RE: DETERMINANTS OF ADHERENCE TO IRON-FOLIC ACID SUPPLIMENTATION DURING PREGNANCY AMONG POSTNATAL MOTHERS SEEKING MATERNAL AND CHILD HEALTHCARE AT KAKAMEGA COUNTY REFERRAL HOSPITAL

Reference is made to your ERB application reference no. 120320-01 dated 12th March 2020 in which you requested for ethical approval of your proposal by Daystar University Ethics Review Board.

We are pleased to inform you that ethical review has been done and the verdict is that the study has been approved. Your application approval number is **DU-ERB- 000415.** The approval period for the research is between 9th **April** ***2020 to 8th April 2021*** after which the ethical approval lapses. Should you wish to continue with the research after the lapse you will be required to apply for an extension from DU-ERB at half the review charges.

This approval is subject to compliance with the following requirements;

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

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

Mrs. Purity Kiambi,
Secretary, Daystar University Ethics Review Board

Encl. Review Report

"...until the day dawn and the daystar arise in your hearts"
2 Peter 1.19 KJV

Appendix XII: NACOSTI research permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **123932**

Date of Issue: **20/April/2020**

RESEARCH LICENSE

This is to Certify that Mr., Felix Baluti of Jomo Kenyatta University of Agriculture and Technology, has been licensed to conduct research in Kakamega on the topic: Determinants of adherence to Iron-folic acid supplementation during pregnancy among postnatal mothers seeking Maternal and Child Healthcare at Kakamega county referral hospital. for the period ending : 20/April/2021.

License No: **NACOSTI/P/20/4817**

123932

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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

Appendix XIII: Institutional Approval

COUNTY GOVERNMENT OF KAKAMEGA

COUNTY GENERAL HOSPITAL
P.O. Box 1[illegible]
KAKAMEGA

[illegible] AUGUST, 2020

MINISTRY OF HEALTH SERVICES

FELIX BAHATI
OU-ERB-000415

RE: RESEARCH PROPOSAL APPROVAL – 100/02/2020

This is to inform you that the Ethics and Research Committee has reviewed and approved your work titled "**DETERMINANTS OF ADHERENCE TO IRON-FOLIC ACID SUPPLEMENTATION DURING PREGNANCY AMONG POSTNATAL MOTHERS SEEKING MATERNAL AND CHILD HEALTH CARE AT KAKAMEGA HOSPITAL**

The approval is valid for six months from the above date and any continuation thereafter will necessitate a request for renewal.

Note that this approval is only for the work that you have submitted to us. The committee must be notified of any changes or amendments and serious or unexpected outcomes related to the study. You will be expected to submit a final report at the end of the study and may be requested to do a presentation of the same to the hospital.

This information will form part of the database that will be consulted in future when processing related research studies so as to minimize chances of study duplication.

Thank you for your interest in research in our institution.

DR. AUSTIN S. AJEVI
CHAIRMAN
ETHICS AND RESEARCH COMMITTEE
CGH - KAKAMEGA

CC

The Medical Superintendent
CGH - KAKAMEGA