ETIOLOGY AND RISK FACTORS ASSOCIATED WITH IRON DEFICIENCY ANAEMIA AMONG PREGNANT WOMEN: A CASE STUDY OF KILOSA DISTRICT, TANZANIA

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ABSTRACT

Iron deficiency anemia is still the leading cause of maternal mortality and poor pregnancy outcomes. This study aimed to determine etiology and risk factors associated with iron deficiency anaemia among pregnant women in Kilosa district, Tanzania. Longitudinal study involved 368 pregnant women aged 15 to 49 years in the second trimester followed to term. Socio-demographic and biochemical data were collected. Anaemia status was determined based on Hb cut-off values as recommended by WHO. Data were analyzed by SPSS version 16.0. Results showed that, majority (80.4%, n = 296) of respondents reported at antenatal clinics towards the end of the second trimester. Overall prevalence of anaemia was 31.9% (n = 124) implying moderate anemia. Majority (69.8%, n = 54) of the respondents who were in the third trimester were anaemic. Respondent aged below 25 years had low knowledge (50.9%, n = 87) and negative attitude (76.9%, n = 136) on eating iron rich foods. Average weight gains in the second and third trimesters were 2.79 ± 0.69 and 1.32 ± 0.33 kg respectively. Body fat gained ranged from 2.06 - 3.41%. This fat gained was considered bit high for pregnant women with normal body mass index. Body fat classification showed that (50.9%, n = 56) above 25 years were obese. Average birth weight of neonates was 2.9 ± 1.34 kg implying normal birth weights. Causes of iron deficiency anaemia included late reporting to antenatal clinics, low knowledge and negative attitudes on eating iron rich foods, monthly income below the poverty line. Poor maternal weight gains were some of the risk factors for increased low haemoglobin status. It was concluded that, there is a need for strengthening nutrition education at all level especially on anaemia control. The study, recommends, that all pregnant women must be screened for anaemia at each visits, and haemoglobin results discussed and given to the pregnant woman.

DECLARATION

I, **Vumilia Patrick Ngandango,** do hereby declare to neither the Senate of Sokoine University of Agriculture that this dissertation is my own original work done within the period of registration and that it has neither been submitted nor being concurrently submitted in any other institution.

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The above declaration confirmed;

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Prof. T. C. E. Mosha Date

(Supervisor)

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DEDICATION

To my supporting father and mother who in their love, understanding and subtle ways initiated, drove and inspired me to pursue my education

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

AIDS	Acquired Immunodeficiency Syndrome
ANC	Antenatal Clinic
CDC	Centres for Disease Control
Hb	Haemoglobin
HIV	Human Immunodeficiency Virus
IDA	Iron Deficiency Anaemia
IOM	Institute of Medicine
IPT	Intermittent Preventive Treatment
ITNs	Insecticide Treated Nets
MDG'S	Millennium Development Goals
MMR	Maternal Mortality Rate
MoHSW	Ministry of Health and Social Welfare
NICE	National Institute for Health and Clinical Excellence
NSGRP-MKUKUTA)	National Strategy for Growth and Reduction of Poverty
PHSDP-MMAM	Primary Health Services Development Program
OHCEA	One Health Central and Eastern Africa
RBCs	Red Blood Cells
RCH	Reproductive and Child Health
SPSS	Statistical Package for Social Sciences
SSA	Sub Saharan Africa
UNICEF	United Nations Children Fund
USAID	United States Agency for International Development
W H O	World Health Organization

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Iron deficiency is one of the most common nutritional deficiencies, whose impact has global implications (Erhabor, 2013). It manifests clinically as anaemia in which plasma hemoglobin concentrations are usually less than 11 g/dl (Balarajan *et al.,* 2011). Anaemia resulting from iron deficiency adversely affects cognitive and motor development, cause fatigue, low productivity and during pregnancy, it may be associated with low birth weight and increase risk for maternal and prenatal mortality (Fuglestad *et al.*, 2013). The World Health Organization (WHO) (2011) recommends that, hemoglobin levels in pregnant women, should ideally be maintained at or above 11.0 g/dl, and should not be allowed to fall below 10.5 g/dl in the second trimester.

Iron requirement is increased during pregnancy, especially from the second through the third trimester when there may be several times higher needs than at other stages of the life cycle (Chowdhury *et al*., 2014). Despite increased iron requirements, pregnancy is also a period of increased risk for anemia. So far reduction and control of anaemia prevalence among women remains as a public health priority, especially in women of childbearing age worldwide (Noronha *et al.,* 2012).

Anaemia is a global public health problem, affecting all ages of the population with its highest prevalence in pregnant women especially those with low socio-economic status. It is one of the most important health problems among women from 18 to 45 years of age (Chatterjee and Fernandes, 2014). Despite anaemia having been identified as a global public health problem for several years, no rapid improvement has been observed and

prevalence of this problem is still high globally (Ghislain and Manfred, 2012). Iron deficiency is the most common cause of anaemia worldwide, accounting for about 50% of all cases (Kassebaum, 2014). Studies in Africa have shown high prevalence of iron deficiency anaemia during pregnancy, ranging from 41 to 84% in different settings (Haggaz *et al*., 2010; Abriha *et al.*, 2014).

In Tanzania, anaemia in pregnancy is among the top five leading causes of maternal morbidity and mortality. Maternal Mortality Ratio (MMR) has slowly been decreasing from 578 per 100 000 live births in 2005 to 454 per 100 000 live births (4.3 %) in 2010. However, this decrease does not warrant that we should reduce our effort in managing the situation. More efforts are needed in order to achieve the Five Years Development Plan (Reduce MMR by three quarters, between 2016 and 2021, aiming at average decline rate of up to 11.5% per year (MoHSW, 2013). WHO identifies and categorizes anaemia prevalence as a mild public health problem when it is between 5.0 - 19.9%, a moderate public health problem when prevalencve is between 20.0 - 39.9% and a severe public health problem when the prevalence is ≥ 40.0% (Rosmawati *et al.*, 2012). Few studies have assessed anaemia among pregnant women in rural Tanzania, especially in the second and third trimesters when anaemia most likely increases the risk for poor pregnancy outcomes (Kidanto *et al*., 2010).

1.2 Problem Statement and Study Justification

Anaemia is a global public health problem affecting people in all age groups, but the burden of the problem is higher in pregnant women (WHO, 2011).

Low maternal hemoglobin concentration is more likely to result in preterm delivery, low birth weight, low APGAR scores and reduced resistance to infections of both mother and

baby. Moreover, it decreases work capacity including food productivity and hence food insecurity (Msuya *et al.,* 2011).

Iron deficiency has been documented during pregnancy, particularly among lower socio-economic groups consuming predominantly cereal-based diets (poor in iron and folate). In addition, prolonged cooking and re-heating of leaf food preparations aggravate the iron losses from the foods. Malabsorption processes, common among tropical, low socio-economic class families, impair women folate absorption (Hughes, 2013).

There is a growing evidence suggesting that, majority of pregnancy women from developing countries are increasingly making unhealthy food choices due to lack of knowledge and wrong perception towards healthy foods. Knowledge and attitudes surrounding nutritional practices during pregnancy can impact the maternal nutritional status and outcomes (Viljakainen, 2016).

The WHO and the United Nations Children's Fund (UNICEF) have stated that there is immediate need to reduce the prevalence of anaemia during pregnancy and highlighted the importance of identifying its numerous determinants, in order to reach the global nutrition targets of 50% reduction of anaemia in women of reproductive age by 2025 (WHO, 2014).

In Tanzania, the importance of iron deficiency anaemia during pregnancy as a public health problem has been increasingly recognized by health authorities and policy makers. The Ministry of Health and Social Welfare (MoHSW) has been implementing a public health package to combat anaemia in pregnancy through public and private healthcare facilities. The public health package includes supplementation with iron and folic acid,

promotion of antenatal care, prevention and control of malaria infection with intermittent preventive treatment (IPT), use of insecticide treated mosquito nets (ITNs), treatment and control of helminthes infestation, despite of all these interventions given, still maternal anaemia continues to be a common cause of morbidity and mortality) during pregnancy (MoHSW, 2013).

In Morogoro region, all women attending antenatal clinic are put on supplementation, but still the prevalence of anemia during pregnancy is 44.9% (mild anaemia = 34.8%, moderate anaemia =10.0% and severe anaemia 1%), and is more prevalent among low socio -economic families (NBS and ICF Macro, 2010-2011). According to WHO (2011), a severe public health problem exists if the prevalence of anaemia is above 40% in any group, in which Tanzania qualifies (de Benoist *et al*., 2011). This study was designed to determine the etiology and risk factors associated with iron deficiency anaemia among pregnant women attending antenatal clinics in Kilosa district. Results obtained from this study would be useful in planning appropriate intervention programs to address the problem of anaemia in pregnancy thus reducing the burden of nutritional anemia among the residents in Kilosa district.

1.3 Objectives of the Study

1.3.1 Overall objective

To determine etiology and risk factors associated with iron deficiency anaemia among pregnant women in Kilosa District, Tanzania.

1.3.2 Specific objectives

(i) To assess knowledge, attitudes and dietary practices of pregnant women in Kilosa district.

(ii) To assess the hemoglobin status of pregnant women in Kilosa district during the second and third trimesters of gestation.

(iii) To determine the body weight and fat gain in the second and third trimesters of gestation.

(iv) To determine socio-economic factors associated with anaemia in women in the district.

1.4 Research Questions

The study aimed to answer the following research questions pregnant:

(i) Do pregnant women have knowledge, good attitude and appropriate dietary practices?

(ii) What is the average weight gain for pregnant women during the second and third trimesters in Kilosa district?

(iii) What is the hemoglobin status of pregnant women during the second and third trimesters in Kilosa district?

(iv) What are the socio-economic factors associated with iron deficiency anaemia among pregnant in Kilosa district?

CHAPTER TWO

2.0 LITERATURE REVIEW

Anaemia has been defined by the World Health Organization (WHO, 2011) as "a condition in which the number of red blood cells (RBCs) or their oxygen-carrying capacity is inadequate to meet physiologic demands in the body, in which the haemoglobin level. Many studies show that, anemia in pregnancy is globally common, but Africa and Asia bears the greatest burden (WHO, 2011: Chowdhury *et al*., 2014). In Africa and South East Asia, prevalence is estimated at 57.1 and 48.2% respectively (Koura, 2011) while in Tanzania 35 - 47% of pregnant women were anaemic (NBS, 2011). Another study conducted in Northern Tanzania on prevalence of anaemia among pregnant women, showed that, prevalence of anemia in pregnancy was 47.4%, despite the national policy of routine iron supplementation and intermittent preventive treatment (IPT) for malaria (Msuya *et al.,* 2011).

2.1 Functional Consequences of Iron Deficiency during Pregnancy

2.1.1 Cognitive development

Many studies have shown that, iron deficiency anaemia has been associated with delay in psychomotor development and impaired cognitive performance of neonatal, infant and preschool children (Fuglestand *et al.,* 2013). Moreover, an estimated 10 - 20% of preschool children in developed countries, and an estimated 30 -80% of children in developing countries, are anaemic at one year of age, which is inherited from their mothers during pregnancy. These children will have delayed psychomotor development, and when they reach school age they will have impaired school performance (WHO, 2012).

2.1.2 Resistance to infections

The role that iron deficiency plays in decreasing immune response has been reported in many studies (Dallman, 1987). Leukocytes (neutrophils, in particular) appear to have a reduced capacity to ingest and neutralize microorganisms while mitogen-stimulated lymphocytes exhibit a decreased ability to replicate (Neckers and Cossman, 1983). Additionally, depressed T-cell responses have been widely documented, with the depression proportional to the severity of iron deficiency. Iron is a fundamental element for normal development of immune system, it is essential for proper cell differentiation and cell growth. It is an important component of peroxide-generating enzymes and nitrousoxide-generating enzymes that are critical for proper enzymatic functioning of immune cells (Viteri *et al*., 2011). Iron is an integral component of enzyme myeloperoxidase (MPO) which produces reactive oxygen intermediates responsible for intracellular killing of pathogens. Various abnormalities of cellular defenses observed in iron deficiency includes: Reduced neutrophil function with decreased myeloperoxidase (MPO) activity, impaired bactericidal activity, depression of T-lymphocyte numbers with thymic, atrophy. Defective T-lymphocyte-induced proliferative response and impaired natural killer cell activity (Gazz and Nemeth, 2009).

2.1.3 Preterm delivery and growth

One theory suggests that anemia (leading to hypoxia) and iron deficiency (which increases serum nor-epinephrine concentrations) induces maternal and fetal stress, which leads to stimulation of the production of corticotrophin-releasing hormone (CRH) (Emanuel *et al*., 1994). Elevated CRH is a major risk factor for preterm labour, pregnancy-induced hypertension, eclampsia, premature rupture of the membranes and maternal infection, and increased fetal cortisol production, inhibiting longitudinal growth of the fetus (Falkenberg *et al.,* 1999).

2.2 Eatiology of Anemia

Nutritional anemia (iron deficiency anemia) is the commonest cause of anaemia during pregnancy (Hughes, 2013). The most common causes are low socio-economic status, poor women diets of cereal-based food which contain less minerals. Cereal-based diets also contain phytates which inhibit bio-availability of nutrients such as iron, magnesium, manganese, cobalt and zinc which are important for various body functions including immune response to infections. Poor absorption of iron is aggravated by diet rich in phytates and phenolic compounds (Chowdhury *et al*., 2014). In resource-poor areas, this is frequently exacerbated by infectious diseases. Malaria, HIV/AIDS, hookworm infestation, schistosomiasis and tuberculosis all affect iron status in pregnant women. Predisposing factors are grand multiparty, young age, low socio-economic status and illiteracy (Gyorkos *et al.*, 2011).

2.3 Maternal Diet

Iron nutritional status depends on long-term iron balance and is favored by eating adequate amounts of iron in the diet (native or fortified) or through iron supplementation(Sharma *et al.*, 2010). Bioavailability of iron depends on several factors namely iron-replete; absorb iron less easily than the ones who are iron-deficient. In addition, absorption depends on the specific form that iron is in Heme iron, this is the first class (high bio-availability diet) iron source, is the most readily absorbed form of iron, and it's found in red meat, poultry, and fish. On average, people absorb between 15 to 35% of the heme iron they consume (Hurrell *et al.,* 2006). Non heme (low bio-availability) iron is found in plant foods, as well as in eggs, and milk. Compared with heme iron, it's less easily absorbed by the body. Moreover, sources of non heme iron often contain phytates, which binds the iron and carry it through the digestive tract unabsorbed. But this doesn't mean it's unimportant. What's needed is a way to improve

the body's absorption of non - heme iron, and you can do this by adding one or more of these iron absorption enhancers to the meals, examples of enhancers are vitamin C rich foods, beef, poultry, some kind of fish and pork (Teucher *et al.*, 2004; Engle- stone *et al.*, 2005).

Iron absorption during pregnancy is determined by the amount of iron in the diet, its bio-availability (meal composition), and the changes in iron absorption that occur during pregnancy. There are marked changes in the fraction of iron absorbed during pregnancy. In the first trimester there is a marked, somewhat paradoxical, decrease in the absorption of iron, which is closely related to the reduction in iron requirements during this period as compared with the non-pregnant state. In the second trimester iron absorption is increased by about 50 percent, and in the last trimester it may increase by up to about four times (Galan, 2008).

On the basis of type of the food, iron bio-availability can be characterized as Low bio-availability diet, refers *to* ***s***imple diet of beans, whole wheat and sorghum with negligible amounts of meat, fish and ascorbic acid. Intermediate bio-availability diet, refers to a diet comprised of mainly cereals, roots and tubers, but includes some animal foods like meat, fish and ascorbic acid which increase the iron absorption. *High bio-availability diet* this is a varied diet rich in meat, poultry, fish and foods with a generous amount of ascorbic acid, such as those found in industrialized communities (Wang *et al.*, 2011: Certin *et al*., 2014).

2.3.1 Nutrients needs during pregnancy

During pregnancy, the needs for most nutrients are increased to meet the high demand of both the growing fetus and the mother. What a woman eats when she is pregnant can have

profound and lasting effect on the child's health (Adair, 2014). These nutrients include energy, carbohydrate, and protein, lipids/fats, minerals (Iron, Calcium) and Vitamins (Folate, B-complex, vitamin C, vitamin A, and D).

2.3.1.1 Total energy

Recommended Dietary Intake (RDI) in non-pregnant women is 2200 kcal/day but during pregnancy especially during second and third trimesters, extra 300 kcal/day are needed to sustain the mother and the growing fetus. This extra energy can be met by adding two small snack in a day. Eating more frequently also has benefits of helping with some of the uncomfortable side effects (heart burn and nausea). The focus should be on increasing the consumption of nutrient dense foods and minimizing empty calories. Additional energy needs not only should differ by trimester but also should be tailored based on the mother's preconception BMI (Butte *et al.,* 2004). To monitor whether the mother is getting appropriate energy intake, just monitor her weight gain in each visit (Asbee *et al.,* 2009; Thornton *et al.,* 2009).

2.3.1.2 Carbohydrates requirements

Rapid growth of the fetus requires that ample amount of energy in the form of glucose be available to the fetus all the time. Extra carbohydrates are required to spare protein from being used to produce energy. There is no RDA for carbohydrates during pregnancy, it is suggested that 50% of kcal should come from carbohydrates (CDCP, 2004).

2.3.1.3 Protein requirement

Depending on the source, protein varies in nutritional value, digestibility, and efficiency of use and ratio of indispensable amino acids. Proteins from animal sources such as meat,

poultry, sea foods, eggs and milk and milk products tend to be of higher quality because they provide all essential amino acids. Proteins from plant-based sources may be limited in at least one essential amino acid and so are used less efficiently. Majority of pregnant women from developing countries consume predominantly plant-based proteins, particularly from a less varied diet, so may have a higher dietary requirement for protein in order to provide sufficient indispensable amino acid. Low protein diets are associated with adverse outcomes of pregnancy. Pregnant women should be advised to eat at least two servings of lean meat, poultry, fish, eggs, nuts and seeds or legumes per day. Regular consumption of those above foods, and wholegrain cereals, as part of a balanced and varied diet will ensure adequate protein intake (Kramer and Kauma, 2003, Ishikawa *et al.*, 2007).

2.3.1.4 Lipids and fat

Pregnant women must take diets rich in fat to meet the energy needs of the growing fetus. Dietary fat is predominantly in the form of triglycerides, which consists of three fatty acids and one glycerol unit. Fatty acids can be classified into saturated, monounsaturated and polyunsaturated fatty acids. The polyunsaturated fatty acids can be classified as omega-3 and omega-6 fatty acids (Lauritzen *et al*., 2011). During early pregnancy, the fetus uses fatty acids supplied by the mother. In late pregnancy, the fetus makes its own fatty acids, contributing to body fat found in newborns (Mennitti *et al*., 2014). Long-chain polyunsaturated fatty acids (LCPUFAs) are necessary for normal brain growth and development in infants, especially in the last trimester, when nerve tissue growth is maximal. Pregnant women should aim to reach the recommended fat intake level of 20 – 35% of energy intake (Brenna *et al*., 2009).

2.3.1.5 Iron

Iron is the trace element with a vital role during pregnancy. Potentially, pregnant women require iron to support their enlarged blood volume essential for the synthesis of hemo-dilution (Datz *et al.,* 2013). This has to be maintained during the whole period of pregnancy and lactation for health of the mother and the child post-delivery. The DRI for iron during pregnancy is 30mg per day. It is particularly important to meet this recommendation during the second and third trimesters. Studies show that, inadequate iron during the prenatal period and the first six months of life can result into lifelong neurologic effects that cannot be reversed even if iron is supplemented at adequate levels in early childhood (Beard, 2008). To prevent iron deficiency anaemia, pregnant women should eat two servings of lean meat, poultry, fish, eggs, nuts, seeds and legumes per day, monitor iron status throughout pregnancy and women should receive advice on dietary sources of iron and factors affecting iron (Allen, 2007: Alwan and Hamamy, 2015).

2.3.1.6 B -Vitamins

The RDI for most B - vitamins is higher during pregnancy compared to the non-pregnancy state. The need increases proportionally with increased in energy need. Vitamin B-complex is widely available in a range of food sources. The B- vitamins (Folate and vitamin B_{12}) are given special attention because of their unique roles during fetal development and their adverse effects on pregnancy outcome when they are deficient. Some of the role includes enzymatic functions in various biochemical pathways necessary for energy production, synthesis of new cells and general need for growth. (Ortega *et al.,* 2004)

2.3.1.6.1 Folate/Folic Acid

Folate in its synthetic form folic acid, a B vitamin involved in the metabolism of nucleic and amino acids and hence the synthesis of DNA, RNA and proteins. Folic acid has a role in recycling homocysteine to methionine and in reducing the risk of neural tube defects, including spina bifida. Food rich in folic acid are dark green leafy vegetables, spinach, and cabbage. Two to three servings are needed per day. Fruit sources are orange, strawberry, lemon, mangoes, tomatoes and grapefruits. From cereals, all whole grains are good sources of folic acids. Legumes rich in folic acid include red, white kidney and black beans. Normal RDI for folic acid is 180 µg per day but during pregnancy extra 220 µg per day are required (Molloy *et al*., 2008).

2.3.1.6.2 Vitamin B12 requirement

Vitamin B_{12} activates folate enzymes necessary for cell division and protein biosynthesis. It is essential for production of healthy red blood cells, keeping nerve cells healthy, energy production and cognitive function. It is also essential for heart health as it assists in the breakdown of homocysteine, to methionine an amino acid associated with cardiovascular diseases. Foods rich in Vitamin B_{12} include: meat, fish, and poultry, eggs, milk and milk products. Risk groups for vitamin B_{12} deficiency include women from low socio-economic status who cannot afford to purchase meat and meat products and strict vegetarians. RDI for Vitamin B_{12} during pregnancy is 2.2 µg per day, while for non-pregnant additional 0.2 µg per day is required (Molloy *et al*., 2008)

2.3.1.7 Vitamin C

The main function of Vitamin C includes antioxidant activity, especially in the acidic environment of the stomach. In this way, vitamin C may be important in blocking production of compounds such as nitrosamines, most of which are known to be

carcinogens. Collagen synthesis, a connective tissue which is an important structural component of blood vessels, tendons, ligaments and bones represses the accumulation of arterial plaque (very common condition during pregnancy), cleans the arteries, and enables a healthy flow of blood to the heart Vitamin C, enhances absorption of iron and promote immune function of the body (Hallberg and Rossander ., 1987). Foods rich in vitamin C includes; Oranges, Strawberries, Lemons, Mangoes, Tomatoes, Grapefruits, Melons, Potatoes, and Peppers (Bhatt, 2010).

2.3.1.8 Vitamin A

Vitamin A is a fat soluble vitamin. It has many diverse functions, critical during fetal development. Vitamin A is involved in immune integrity, cellular differentiation and growth, reproduction, vision cycle and protein biosynthesis. Both Vitamin A (Retinol) and Beta-Carotene cross the placenta. Beta-carotene is found in orange fruits and sweet potatoes while the pre-formed form of Vitamin A is found in animal products such as fish meat and milk. Despite the importance, the RDI for Vitamin A does not increase during pregnancy. RDI for non-pregnant women 800 μg RE per day and it remains the same for pregnant women (Strobel *et al.*, 2007).

2.3.1.9 Vitamin D

Vitamin D is very important during fetal life as it plays vital role in building up and maintaining strong bones and teeth. It also facilitates calcium absorption and utilization in the GIT. Calcium retention by the kidneys helps to demobilize Calcium from the bones into the blood. Pregnant women at high risk of vitamin D deficiency include those who dislike dairy products. Low socio-economic status and low education levels have also been identified as risk factors (Holick and Wagner, 2008). Vitamin D deficiency in pregnancy is associated with decreased foetal growth via the effect on maternal calcium

homeostasis while in infant, vitamin D deficiency results in inadequate mineralization of the skeleton (Brunvand *et al*. 1996).

2.4 Knowledge, Attitudes and Feeding Practices during Pregnancy

There is growing evidence suggesting that majority of pregnant women from developing countries are increasingly making unhealthy food choices due to lack of knowledge and wrong perception towards healthy foods (Beck *et al.,* 2014). Knowledge refers to a set of understandings and capacity of a person to perceive, e.g. increased understanding of the benefits of intake of iron rich foods and balanced diet during pregnancy and the resulting good outcome. Attitudes are emotional, motivational, perceptive and cognitive beliefs that positively or negatively influence the behavior or practice of an individual. An individual's feeding or eating behavior is influenced by her emotions, motivations, perceptions and beliefs. The terms attitude, beliefs and perceptions are interchangeable. These dietary perceptions or beliefs are most often forced by the elders, mother-in-law, or husbands and other family members (Wundari and Whelan, 2011). Practice is defined as the observable actions of an individual that could affect her nutrition, such as eating, feeding, washing hands, cooking and selecting foods (Dwumfour, 2013).

Several studies have been conducted highlighting negative attitudes towards dietary eating practices among communities over the world. Most of them found that, pregnant women had negative attitudes mainly on taking first class iron rich foods. A study done by Arzoaquoi *et al.* (2015), reported that, some pregnant women had bad perceptions on eating meat, certain vegetables and fish to avoid having a drooling or a 'spirited' child. Another study conducted in Southern Tanzania revealed that, 69% of the women had negative perception on eating fish, eggs and meats during pregnancy (Kalinjuma *et al.,* 2013, Mayuni and Oishi, 2015).

Table 1: Traditions, customs and beliefs related to pregnancy and childbirth in rural Tanzania

Beliefs / Perception	Explanation
If a pregnant woman eats eggs during pregnancy	She will give birth to a child without hair
If the pregnant women eat avocado	The embryo will have stomach ache and amniotic fluid will become turbid
If a pregnant woman eats fish	The fetus will be slippery during delivery and cause prolonged labor
If a pregnant woman eats offals	The baby will have hernia of the umbilical cord and the fetus will be malformed

Source: (Mayuni and Oishu, 2015)

2.5 Common Problems That Interfere With Feeding During Gestation

The way women experience pregnancy differs from woman to woman, and even for the same women, the experience may be different from pregnancy to pregnancy. Factors contributing to the way a woman feels include, her physical reactions to pregnancy, health conditions that she has or developed, her physical environment including food availability, housing, health care, financial capability, stress, her job and children. All these have impact on the eating practice (Keller and Layer., 2008). Mild nausea and vomiting are the most common early signs of pregnancy known as "nausea and vomiting of pregnancy. Studies report that, up to 80% of pregnant women experience nausea and vomiting of pregnancy (Einarson *et al*., 2013). The most severe version of nausea and vomiting is known as hyperemesis gravidarum, the condition characterized by persistent vomiting, dehydration, ketosis, electrolyte imbalances and weight loss of up to 5%. This is dangerous to both the mother and the fetus due to the impairment on dietary intake especially of iron rich foods that may cause iron deficiency anaemia (Ismail and Kenny, 2007).

2.6 Pregnancy Outcome

Many studies suggest that, a decrease, in maternal hemoglobin below 11.0 g/d1 in the third trimester is associated with a significant rise in perinatal mortality rate due to low birth weight (Gustavo *et al.*, 2012). A significant decrease in birth weight associated with premature births and intrauterine growth retardation has been reported when maternal hemoglobin levels were below 8.0 g/dL. Anaemia increases the risk of low birth-weight in infants and maternal mortality (Huang *et al.*, 2015).

2.7 Maternal Weight Gain

Maternal weight gain during pregnancy influences the pregnancy outcome. Inadequate gestational weight gain is significantly higher in anaemic pregnant women especially those who are also underweight (Denison *et al.*, 2014). In 2009, the Institute of Medicine (IOM) published updated guidelines for weight gain during pregnancy in line with healthy eating, that is important during pregnancy as it supports optimal body weight gain associated with improved outcomes for the mother and the baby regardless of the mother's existing body mass index (BMI) (IOM and NRC, 2009). The guidline recommends that, when a woman is planning to be pregnancy, the health practitioner (Nutritionist or clinician) should discuss with the woman the most appropriate nutrition and activity plan that would support pre-conception health (NIHCE, 2010).

2.8 Body Fat Gain during Pregnancy

There are many good reasons for the prospective mother to gain body fat. The first one is that the body is preparing for breastfeeding. Breastfeeding a baby actually requires as much as 500 - 800 kcal extra per day, Additional body fat built up during pregnancy is a life insurance for the mother and the baby. Body fat is also a protection against infections

since starving mother is certainly more prone to get ill (Nelson and Matthews. 2009; Heddsonrson *et al.,* 2010).

2.9 Number of Antenatal Care (ANC) Visits and Tming of First Visit

Antenatal care can be most effective in avoiding adverse pregnancy outcomes when it is sought early in the pregnancy and continues throughout the gestation period. Ministry of Health and Social Welfare (MoHSF) has promoted a four - visit (Focused Antenatal – Care approach since 2002. Although the policy is to start attending antenatal clinic before the 16th week of gestation, Tanzania Service Provision Assessment in 2010. found that over 80% of pregnant women initiated later than 17 weeks of gestation (NBS, 2010 - 2011). One of the most important functions of antenatal clinic is to offer women and their families with appropriate information and advice for a healthy pregnancy, safe childbirth, and postnatal recovery, including care of the newborn, nutrition counseling (promotion of early, exclusive breastfeeding), and assistance with deciding on future pregnancies in order to improve pregnancy outcomes. Antenatal clinics also help screening for conditions and diseases such as anaemia, STIs (particularly syphilis), HIV infection and mental health (Mrisho *et al*., 2009). A number of studies have reported positive association between higher quality of services and higher rates of utilization of maternal health services (Plotin *et al.,* 2010; Shimpuku *et al*., 2013; Mselle *et al.*, 2013).

2.10 Adolescent Pregnancy

Iron deficiency anaemia (IDA) in adolescence is a major public health problem. Studies indicate that, incidence of anaemia in adolescents tends to increase with age and corresponds with the rapid growth spurt during adolescence. The highest prevalence is between the ages of 12 - 15 years when requirements are at peak. More than 50% of girls in this age group have been reported to be anaemic (Toteja, 2006; NBS, 2011).

Adolescents (age 10 - 19 years) are at high risk of iron deficiency due to increased in requirements for iron, poor dietary intake of iron, high rate of infection and worm infestation as well as the social norm of early marriage and adolescent pregnancy. Research has shown that the risk of low birth weight, preterm delivery and perinatal mortality increases among iron deficient anaemic adolescents. Physiologically pregnancy adolescents compete with the growing fetus for the nutrients and also they often receive inadequate antenatal care. Anaemia during labour and postpartum period make than worse off than the in older women. Severe anaemia is a major cause of maternal mortality among adolescents (Hettiarachchi, 2006).

2.11 Anaemia Prevention during Pregnancy

The WHO, (2012) guidelines recommend a daily folate intake of 800 μg in the antenatal period and 600 μg during lactation. However, 300 - 500 μg of iron present in most preparations is enough for prophylaxis. Pregnant women should eat more green vegetables (e.g. spinach and broccoli) and offals (e.g. liver and kidneys). Furthermore food consumption of foods fortified with iron and folate are recommended and such foods already in use in many families (Sharma *et al.,* 2010).

2.12 Intermittent Preventive Treatment for Malaria

As a protective measure, it is recommended that all pregnant women in Tanzania should receive at least two doses of Intermittent Preventive Treatment (IPT) with Sulphadoxine-Pyrimethamine (SP) during the second and third trimesters of pregnancy (Kalinjuma *et al.*, 2013). A report by Kayento *et al.* (2013) conducted in Tanzania Mainland and Zanzibar reveled that, more than 66 % of pregnant women in the Mainland and 85 % of women in Zanzibar took ant- malaria prophylactic drugs during gestation in the year 2016. Malaria prevention is integrated in antennal clinic services through provision of

subsidized Insecticide Treated Nets (ITNs) distributed through a voucher scheme, which is known as“ Hati Punguzo“ Pregnant women are therefore encouraged to attend antennatal clinics from the first trimester (NBS, 2011).

2.13 Water and sanitation

Poor water, hygiene and Sanitation (WASH) such as lack of toilet, clean and safe water result in microbial ingestion that may cause diarrhea. Diarrhea may lead to mal-absorption of iron rich foods which may lead to iron deficiency anemia. Poor hygienic conditions and the inability to control some intestinal parasites (Ascaris, Lumbricoides and Hook worms) have serious impacts on nutrient losses in the GIT leading to protein and micronutrient deficiencies (Ngure *et al.,* 2014).

2.14 Maternal Education

Under- nutrition is associated with education level especially of mothers. Several studies have reported that, under- nutrition decreases with increase of maternal education level. A study in Karnataka in Belgium showed that, aenemia was high in mothers with secondary and below education level (Ota *et al.,* 2015). Three important ways that ignorance and lack of education contribute to under nutrition. First people may know very little about nutrients, and they fail to eat even the cheap and available nutrients. Secondly, lack of awareness or ignorance on the important causes of diseases and their consequences. Treatment and prevention options may be most of the time accessible and cheap but cheap due to ignorance (Murakami, 2009).

CHAPTER THREE

3.0 METHODOLOGY

3.1 Description of the Study Area

Kilosa district is of one the six districts in Morogoro region, located in East central Tanzania, about 148 km from Morogoro town. It extends between latitude 5°55’ and 7°53’ South and longitudes 36°30’ and 37°30’ East. Kilosa district is bordered by Mvomero district to the East, Kilombero and Kilolo districts to the South, Kiteto and Kilindi to the North and Mpwapwa district to the West. It has a total population of 438 175 (URT, 2012). Administratively, Kilosa district is divided into nine divisions. The divisions are further subdivided into 36 wards, and 168 registered villages. The district is endowed with an abundant agricultural land while agriculture is the major economic activity for almost 84.2% of the total labour force of both substance and cash crop.

Approximately, 93% of land used for farming is under subsistence crop production, while7% is used for cash crop production. The main food crops are maize and paddy. The livestock keeping is another economic activity undertaken in the district. It includes keeping cattle, goats, sheep, pigs, poultry and dairy. This activity is mostly performed by Masai and Sukuma tribes who migrated from other regions. The main sources of water used in the households are piped water (22.7%), protected wells (26.9%) and surface water (29.4%). Kilosa district has 57 health facilities, 50 dispensaries, 6 health centers and one district hospital. The facilities are evenly distributed over the different villages in the district. However, the number of villages exceeds the number of facilities by far and most of the health facilities have infrastructure in poor condition (URT, 2013).

3.2 Study Population

The study population comprised of 368 pregnant women aged between 15 - 48 years attending antenatal clinic at Kilosa and Kimamba Reproductive and Child Health (RCH) clinics from the second trimester. Iinclusions criteria were all pregnant women attending antenatal clinic from the second and third trimesters at Kilosa hospital and Kimamba RCH clinic. Exclusion criteria: all pregnant women who had chronic illnesses such as TB, HIV/AIDS, sickle cell disease, hypertension and diabetes and those on iron supplementation were excluded from the study. Likewise, pregnant women who were in their first trimester, those who were unwilling to participate in the study and those who were are not resident in Kilosa district for at least six months were also excluded from the study.

3.3 Study Design

This study was longitudinal in design in which pregnant women were followed up from the second trimester to term.

3.4 Sampling Technique and Sample Size

Kilosa district was purposively selected because it was the pilot area for the One Health Central and Eastern Africa (OHCEA) Project which supported this study. Purposive sampling was used to select two health facilities (the district hospital and one health centre). The district hospital was selected for better presentation of the study subject because, it was the referral unit for the whole district, and therefore it attends almost all pregnant women from different areas within the district and from surrounding villages. Kimamba health centre was selected because it usually receives a large number of pregnancy women compared to the other health centres. Pregnant women were thereafter selected purposively basing on gestational age until the desired number of subjects was

attained. The pregnant women were recruited at the second and third trimesters and followed up to term. The sample size was estimated based on the prevalence of anaemia during pregnancy in Morogoro region (34.8%) (NBS, 2010 – 2011). To determine the sample size Fisher's formula was used.

$N = z^2 * p\ (1-P)/d^2$

Where:

n = minimum sample size, p = Proportion in target population estimated to have anemia (in this case 35%), d = tolerable error = 5%, Z= 1.96.(Fisher's, 1935). Therefore the sample size of the pregnant women attending the antennal clinic was:

$$N = \frac{1.96^2 * 0.35 * (1-0.35)}{(0.0025)} = 349.5 = 350$$

Thus the sample size was 350 women.

Assuming attrition rate of 5%, 18 mothers were added to the sample to take care of statistical power in case of drop outs. The total number of pregnant women selected for the study was 368.

3.5 Data Collection

3.5.1 Construction of the questionnaire

A questionnaire (Appendix I) was constructed to collect information from the selected respondents. The questionnaire was divided into four sections, section A collected information on socio-demographic characteristics of the respondents, section B gathered information on gynaecological and obstetric information, section C solicited information about dietary knowledge, attitudes, practises and socio- economic factors while section (D) gathered information on measurements such as haemoglobin status, body weight, body fat percentage and blood pressure. Either the pregnant outcomes namely neonates were body weight, body length and head circumference were measured. Section A - C

were filled at the beginning of the study while section D was filled in each follow up visit to the RCH clinics for six consecutive months.

3.5.2 Pretesting the questionnaire

The questionnaire was pre-tested among pregnant women attending at RCH clinic in SABASABA Morogoro municipality. Necessary adjustments were made on the questionnaire after pre-testing.

3.5.3 Training of enumerators

Two enumerators (one nurse and one laboratory technician) were trained on data collection prior to administration of the questionnaires. They were taught on how to take blood specimen for determining hemoglobin concentration, how to interview the respondents, proper recording of the responses, confidentiality of data and ethical issues.

3.5.4 Administration of the questionnaire

Data were collected through face to face interviews during monthly clinic visits. Interviews were conducted in the morning to noon hours from Monday to Friday.

3.5.5 Assessment of knowledge and attitudes

Knowledge about anaemia was determined using an index summated (Likert, 1932) which was made up of a series of five questions seeking whether the respondents had correct knowledge about anaemia definition, causes, symptoms and signs, prevention and complications. For each correct answer, a respondent scored one, while for each wrong answer, a respondent scored zero. Based on the five statements, the minimum and maximum possible scores were zero and five, respectively. Zero meant having no knowledge on anaemia, while five meant having enough knowledge about anaemia.

The average overall score point was computed, and the respondents were grouped into three categories, zero score represented having no knowledge, one to two having moderate knowledge and three to five represented having high/enough knowledge about anaemia.

Attitudes about the causes of anaemia were determined using a Likert summated scale (Likert, 1932) which was made up of four items translating into 20 points. To each of the items of the Likert summated scale, the respondents were required to give one of the following alternatives: one (strongly disagreed), two (disagree), three (neutral), four (agree), and five (strongly agree). For ease comparison, the responses were re-grouped into three categories: strongly disagree and disagree were grouped as disagree, agree and strongly agree were grouped as agree and neutral remained as it is. The minimum and maximum possible scores on the Likert summated scale were two and 20 points, denoting bad (negative) attitudes and good (positive) attitudes on eating iron rich foods. A score of 12 denoted a neutral attitude. Therefore, four to11 points, and 13 to 20 points meant negative or poor and positive/good attitudes, respectively.

3.5.6 Measurements and tools

3.5.6.1 Body weight

This was measured by using a digital weighing scale (SECA 878; Made in UK) placed in a correct level position. The scale was adjusted before the respondents stepped on it. Respondents were requested to remove shoes, reduce as much as possible any heavy clothing, heavy objects on them such as wrist watches, mobile phones, wallets and heavy jewelries. The scale was turned on to displayed zero, then respondents were asked to step on it with bare feet and stand still on the centre of the scale with their arms hanging loosely at their sides and look straight-ahead. The measurements were displayed on the

screen of the scale and recorded to the nearest 0.1 kg. For accuracy reading, weighing process was repeated 2-times until the readings were within 100 g of each other.

Maternal weights from the second trimester to term were grouped into trimester basis i.e. second and third trimester. Changes in weight gain were calculated by subtracting the weight of the respondent in the lowest month from the highest months. Following this process, the mean and standard deviation for each group was calculated to elicit the change in weight gain.

3.5.6.2 Body Fat

Body fat was measured by the use of Bio -electrical empedance (BIA) machine (Model TANITA BF 350- America). Respondents were asked to stand with clean bare feet. The body fat analyzer automatically measured both body weight and body fat percentage. Body weight was displayed on top portion of the screen while the body fat percentage was displayed on bottom portion of the screen. The body fat was recorded in percentage.

3.5.6.3 Haemoglobin concentrations

Haemoglobin levels were measured by using capillary blood samples obtained via finger prick with a sterile lancet. The tip of the middle finger was cleaned with alcohol swab. Using a sterile lancet, the finger was pricked and capillary blood samples were obtained. The blood sample was picked by using a micro cuvette. The micro cuvette with blood was then gently inserted in the Hemocue Photometer and gently closed. The photometer displayed the reading that was recorded to the nearest 0.01 g/dl. The Haemoglobin levels were classified according to WHO (2006) guideline where by Hb level " less than 7.0 g/dl" were classified as severe anaemia, Hb levels "7.0 to 9.9 g/dl" were classified as

moderate anaemia, Hb levels "10 to 10.9 g/dl" were classified as mild while Hb level above 11.0 g /dl" were classified as normal (Nieburg, 2012). Maternal blood samples collected at enrollment (first visit) gestational ages of 14, 20, and 30 weeks of gestation were used to determine trimester hemoglobin levels.

Blood sample for haemoglobin estimation was collected in each visit to term, and then haemoglobin status for 368 respondents was determined using Hb results taken at baseline visit (entry point) and the last month (ninth) of delivery to compare if there were changes in Hb levels as the pregnancy advanced.

3.5.6.4 Blood pressure

Systolic and diastolic blood pressures were measured from the mid-upper-arm of the left hand while the respondents was seated in a chair, arm supported in the level of heart and relaxed. For accuracy, the measurement was repeated twice and the average reading was recorded. Automatic digital blood pressure machine (Model M3, Made in Vietnam) was used to take the measurements , The results were classified as 120 to 129/80 to 84 mmHg is normal, ≥ 130 systolic and ≥ 90 diastolic mmHg is higher than normal, and values anything below or above those levels are classified as hypotension or hypertensionand (CDCP, 2004) .

3.5.6.5 Birth outcomes

The newborns were weighed by using the normal hospital weighing scales to obtain the birth weights .The lengths of the babies were measured using appropriate calibrated length boards with fixed headboard and movable footboard perpendicular to the face of

the baby. The weight and lengths were recorded to the nearest 0.1 kg and 0.1 cm respectively.

3.6 Data Analysis

The data collected were entered into the Microsoft excel spread sheet and transferred to the Statistical Package and Service Solutions (SPSS) program for Windows Version 20 (SPSS Inc, Chicago, IL, USA). Data were coded, entered and cleaned to identify outliers. Descriptive statistics were performed; means and frequencies were used to describe social demographic data and other related information about iron deficiency anaemia in pregnancy. The haemoglobin levels were analyzed descriptively to determine prevalence on the basis of Hb cut-off recommended by WHO (2006). Paired t- test was used to compare the Hb results at entry and last visit. Descrptive statistics were used to analyse the summated scale index and Likert summated scale data. Chi- square was done to find the associations between various factors associated with iron deficiency including socio-demographic data, maternal knowledge, attitudes and reproductive characteristics. Multivariable logistic regression was run to assess association of anaemia as possible risk factors (haemoglobin as a dependent variable) for low birth weight, poor maternal weight gain and low APGAR score. The predictor variables included Maternal occupation, maternal monthly income, knowledge status, education level, food consumption patterns, antennal clinic booking and birth weight. Univariate and multivariate analyses were performed to determine the influence of the various pregnancy risk factors on the pregnancy outcomes. A difference was considered to be significant at $p \leq 0.05$.

3.7 Ethical Consideration

Ethical clearance to conduct the study using human subject was obtained from the Ethical Committee of the National Institute for medical Research (NIMR). Permission to conduct

the study at Kilosa Hospital and Kimamba Health centers was obtained from Kilosa District Executive Director (DED). Before admission of the questionnaire informed verbal and written consent was obtained from the respondents. All mothers who agreed to participate in the study signed a consent form to confirm their willing to participate in the study. Pregnant women were free to drop out of the study at any stage without any fear of retribution. All data were confidentially and subject was identified by numbers instead of their real names.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Maternal Socio- economic and Demographic Characteristics

A total of 368 respondents were enrolled in the study (Table 2).

Table 2: Maternal socio-economic and demographic characteristics

Characteristic	Response	No. of respondents	Percent
Maternal Age (years)	15- 18	70	19.0
	19-35	248	67.4
	> 36	50	13.6
	Total	**368**	**100**
Marital status	Single	108	29.3
	Married	260	70.7
	Total	**368**	**100**
Education level	Informal education	111	30.2
	Primary school	169	45.9
	Secondary	56	15.2
	College level	32	8.7
	Total	**368**	**100**
Occupation of the pregnant woman	Peasant	237	64.4
	Employee	43	11.7
	Petty business	37	10.0
	Livestock keeper	7	1.9
	Dependent	44	12.0
	Total	**368**	**100**
Monthly income (TShs)	Less than 60 000	151	41.0
	100,000- 200 000	129	35.1
	More than 200 000	88	23.9
Total		**368**	**100**

Majority of the respondents (67.4%, n = 248) had age range of 19 - 25 years. Teenage mothers 15 - 19 years were (19.0%, n = 70), while older mothers above 35 years were (13.6%, n = 50). The lowest age was 15 years while the oldest age was 48 years. Maternal average age was 31 ± 4.7 years. Majority of respondents (70.7%, n = 260) were married while (29.3%, n = 108) were single.

About (6.4%, n = 169) of the mothers had attained primary school education (30.2%, n = 111) had no any formal education, few (14.8%, n = 54) had attained secondary education and very few (8.8%, n = 32) had attained college education level. Majority of the mothers (64%, n = 237) were farmers while (12.0 %, n = 44) were dependents, (12.2%, n = 43) were employed for wages, (10.1%, n = 37) were petty business women while (1.9%, n = 7) were livestock keepers. Most of the respondents (40.4%, n = 151) earned less than Tshs 60 000 per month implying that, they were living below one dollar per day. About (35.1%, n = 129) of respondents were earning about TShs 100 000 – 200 000 while very few (23.9%, n = 88) earned above TShs 200 000 per month.

In Tanzania, youth below 19 years constitute 31% of the total population (NBS, 2011). This group is very susceptible to early marriages and underage pregnancies, exposing young women to high risk of nutritional anemia. Results of this study, showed that (19.0 %, n = 70) of the respondents were aged 15 - 18 years, which was in line with the proportion (23%) reported by NBS (2011). Another study by Nyaluhucha *et al.* (2006) showed that, the lowest and highest age of studied sample were 17 and 45 respectively. Teenage pregnancy and motherhood are more common among young women living in rural areas and those living in poor families. These mothers may already have experienced suboptimal nutritional status prior to conception making them at higher risk for developing iron deficiency anemia (Toteja *et al.*, 2006). WHO (2011) recommends that, an appropriate age for pregnancy should range between 20 to 35 years. Having a child under 20 years and over 35 years of age have increased risk of poor pregnancy outcomes such as pre-term, small for gestation and low birth weight babies and high neonatal mortality.

4.2 Maternal Reproductive Characteristics According to Age Category

Results in Table 3 revealed that, more than half of the respondents (85.1 %, n = 313) were in the third trimester, while only (14.9%, n = 55), were in the second trimester. Most (55.5%, n = 101) of the respondents aged 15 - 25 years were gravid one while 46% (n = 23) of those aged above 35 years were multigravida, having more than five pregnancies. The highest number of pregnancies was seven while the lowest was one. Regarding multiparty, majority (36%, n = 18) of the respondents were in the age category above 35 years, and very few (0.5%, n = 1) were aged 15 - 25 years.

It was observed in this study that, majority of pregnant woman at advanced age (above 35 years) were multigravida and multipara. Studies report that, one tenth of total maternal population with older age is constituted of multigravidiae and in developing countries it accounts for one third of maternal deaths (Al-Farsi *et al*., 2011). Some studies have found that increasing parity was associated with an increase in the risk of iron deficiency anaemia during pregnancy (Akhter, 2013). Besides the obstetric complications, multigravida and grand multiparity are also indicators of poverty that lead to poor diet deprivation and social inequalities among woman in developing world. It also reflects poor literacy rate, unemployment and lack of family planning in a country (Yasir *et al.*, 2010). Regarding child spacing, majority of respondents aged 26 - 36 years (49.2%, n = 64) had child spacing of three years, followed by (33.3%, n = 13) who had child spacing of two years, only (16.5%, n = 18) of the respondents had child spacing exceeding four years.

This showed that, majority of respondents had child spacing of more than two years which is in line with recommendation by the WHO (2015) and other international organizations that recommend child spacing of at least 2 to 3 years between pregnancies.

Mothers with short intervals between their births do not have enough time to recover from the nutritional burden of the pregnancy preceding pregnancy. Long pregnancy intervals allow repletion of the nutritional status of mothers before the next conception (Dewey and (Cohen, 2007).

Table 3: Maternal gynecological and obstetric characteristic by age category

Characteristic	Response	Age category of respondent in years					
		15 - 25	**%**	**26 - 35**	**%**	**Above 35**	**%**
Age of pregnancy(trimester)	Second	35	19.2	19	14.0	1	4.0
	Third	147	80. 8	117	86.0	49	96.0
	Total	**182**	**100**	**136**	**100**	**50**	**100**
Number of pregnancies	Gravida one	101	55.5	20	14.7	4	8. 0
	Gravida two	52	28.6	27	19.9	2	4. 0
	Gravida three	17	9.3	39	28.7	11	22. 0
	Gravida four	5	2.7	24	17.6	10	20.0
	Multigravida	7	3.8	26	19.1	23	46.0
	Total	**182**	**100**	**136**	**100**	**50**	**100**
Number of deliveries	Para 0	97	53.3	20	14.9	4	8.0
	Para one	54	29.7	33	24.6	4	8.0
	Para two	4	8.3	29	21.3	12	24.0
	Para three	12.	25	4	2. 9	8	16.0
	Para four	26	16.8	42	30.9	4	8.0
	Multipara	1	0.5	8	5.9	18	36.0
	Total	**182**	**100**	**136**	**100**	**50**	**100**
Pregancy spacing Years)	Less than one	5	6.2	2	1.8	1	2.6
	2	20	24.7	25	22.9	13	33.3
	3	46	35.4	64	49.2	20	15.4
	>4	10	12.3	18	16.5	5	12.8

4.2.1 Timing of first visit to the ANC

Regarding first visit to the antenatal clinic (Table 4) (8.8%, n = 16) of respondents aged 15 - 25 years reported in the first trimester. Very few (4.4%, n = 6) respondents aged 26 - 35 years reported in the first trimester and (36.3%, n = 3) of respondents above 35 years reported in the first trimester. For those who enrolled in the second trimester, most (7.6%, n = 123) of respondent were aged 15 - 25 years. Regarding those who reported in the third trimester, results revealed that, majority (44.0%, n = 22) of the respondents were those above 35 years. Based on these results, majority (90.2%, n = 332) of the prospective mothers started the antenatal clinic visit later than 16 weeks of gestation age and only (9.8%, n = 36) reported at first trimester. For respondents who reported at the antenatal clinic after 16 weeks, some (29.1%, n = 107) reported during third trimester from 28 weeks.

Table 4: Time of first Visit to the ANC

Trimister	**Age category of respondent in years**					
	15-25	**%**	**26-35**	**%**	**Above 35**	**%**
1st	16	8.8	6	4.4	3	6.0
2nd	123	67.6	88	64.7	25	50.0
3rd	43	23.6	42	30.9	22	44.0
Total	**182**	**100**	**136**	**100**	**50**	**100**

Late booking observed in majority of respondent was contrary to the recommendations by WHO (2016). Antenatal Care model recommends that, first antenatal care visit should be done preferably in the first trimester and soon as the perspective mothers are enrolled in the antenatal clinic they should be screened for anaemia and other biochemical and biomedical tests (WHO, 2016).

Antenatal clinic care provides women and their families with appropriate information and advice for a healthy eating during pregnancy, safe childbirth, and postnatal recovery (Souza *et al*., 2013). Antenatal care is a key element aimed at improving maternal and newborn health (Pell *et al*., 2013). Many health problems in pregnant women can be prevented, detected and treated during early antenatal care visits. Furthermore, early antenatal clinic attendance promotes early detection and treatment of complications during pregnancy which results in proper management during delivery and puerium (Kisuule *et al.,* 2013).

Although the policy is to start attending antenatal clinic before the sixteenth week of gestation, a study conducted in (2010 – 2011). By the Ministry of Health and Social Welfare observed that, over 80% of pregnant women initiated antenatal clinic later than seventeen weeks of gestation (Plokin *et al.,* 2010; NBS, 2011). It was also observed in this study that, there was strong association between the health mothers who reported early and those who reported late at antenatal clinic .More than (69.8%, n = 54) and (54.6%, n = 6) of the pregnant women who reported during the second and third trimesters, respectively were anaemic compared to 9.1% (n = 1) of pregnant women who reported in the first trimester.

Pregnant women who sought antenatal care early were likely to and be on prescribed iron supplements for a longer duration than those who reported late. The delay in seeking antenatal care could be due to out-dated traditional rites and taboos regarding pregnancy, lack of knowledge, resources or mere uncertainty.

4.2.1.1 Reasons for reporting late to the ANC

Results in Table 5 shows gestation age at which pregnant women reporting to the antenatal clinic and reasons for reporting late. For those who reported to the antenatal clinic in the first trimester, 53.4% (n = 8) had severe vomiting, 41.7% (n = 5) had history of anaemia in previous pregnancy and 29.4% (n = 5) were not sure whether they were pregnant. For those who reported in second trimester, majority 69.8% (n = 192) thought that it was the right time for them to start the antenatal service, 58.3% (n = 9) reported that it was due to threat of abortion, 60% (n = 12) reported fear of anaemia as it was in the previous pregnancy while 47.7% (n = 21) reported that they were not sure if they were pregnant. For the respondents who reported in third trimester majority 50% (n = 22) thought that it was the right time for them to start antenatal clinic, 28% (n = 77) said that, they reported in third trimester because they were not sure if they were pregnant while 15% (n = 3) reported that it was due to past history of anemia in previous pregnancy. There were no respondents who reported at the antenatal clinic in the third trimester due to experiencing any illness in the present pregnancy. Quarter of respondents who reported in the first trimester had history of medical complications (either at present or previous pregnancies).

Table 5: Gestational age at which pregnant women reported to the ANC and reasons

Gestational age	**Reason for reporting ANC**									
	not sure	%	Anaemia	%	Right time	%	Threat of abortion	%	Severe vomiting	%
≤ 16	1	2.3	5	20	6	2.2	5	41.7	8	53.4
17-28	21	47.7	12	60	192	69.8	9	58.3	7	46.6
29-40	22	50	3	158	77	28.	0	0	0	0
Total	**44**	**100**	**20**	**100**	**275**	**100**	**14**	**100**	**15**	**00**

This results meant that, they reported early since they had problems that forced them to check up early. The reasons given by pregnant women for not reporting to antennal clinic on time indicated poor knowledge on the time to report to the antennal clinic. They did

not have concrete reasons for why they should report earlier for antennal service. A similar study done in Mozambique and southern Tanzania reported that, women at an early stage of pregnancy delayed antennal clinic initiation purposely in order to protect the unborn from witchcraft and sorcery attacks of jealous neighbors and kin (Kisuule *et al*., 2013; Wado *et al.,* 2013). However, a study conducted by Mrisho *et al*. (2008) in Tanzania found different reasons for late antenatal clinic initiation. These included avoiding coming to clinic many times, lack of money, unsure of being pregnant, being away, shyness and embarrassment of being pregnant.

It is very important to attend the antenatal clinic early in order to identify the underlying conditions which may need early intervention such as control of anaemia, and prevention of malaria complications. Good care during pregnancy is important for the health of the mother and the growth of the unborn baby. Pregnancy is a crucial time to promote healthy eating behaviors and parenting skills (Nieburg, 2012).

4.3 Food Consumption

Results in Table 6, indicate the food consumption patterns of the respondents. The foods were divided into five food groups namely: (i) Cereal, roots, tubes and green banana (ii) Legume, nuts, meat and meat products, (iii) fruits (iv) vegetables (v) Sugar, honey, and fat (Kushi *et al.,* 2006: Johnson *et al.,* 2012).

In this case, 82.6% (n = 304) of the respondents consumed cereals (Maize meal and Rice), 4 - 7 times per week while roots and tubes (sweet, Irish potatoes and cassava and green banana) were consumed by (36.9%, n = 136) of the respondents 4 - 7 time per week. Plant protein rich food namely legumes, pulse, nuts and seeds (beans, peas, cowpeas and nuts) were consumed by (37.5%, n = 138) of the respondents 2 - 3 times per week while animal

protein foods source (beef, poultry, eggs, milk and fish) were consumed by 14.7%, (n = 54) of the respondents 4 - 7 times per week. Fruits and fruits juices (Mango, Orange, Pawpaw, Watermelon, ripe banana, and Rosella juice, was consumed by 53.5%, (n = 197) of the respondents 4 - 7 times per week. The mostly consumed fruit during this period was Mangoes as it was mangoes season, hence mangoes were readily available than other fruits. Vegetables group (Sweat potato leaves, Pumpkin leaves, Spinach, Carrots, Tomatoes) were consumed by 56.5% (n = 208) of the respondents 4 - 7 times per week where by sweet potato leaves were more frequently consumed compared to the other vegetables. Fat/oil (coconuts, sunflower oil) sugar and honey foods were highly consumed by (82.3% (n = 303) of the respondents 4 - 7 times per week.

Results from the study showed that, majority of the respondents were consuming mainly one type of food from some food groups, for example in case of carbohydrate foods source they consumed mostly stiff porridge made from refined maize flour and rice. Reasons given for taking one type of food daily were: the food was readily availability and inexpensive. Plant protein rich foods such as beans were frequently consumed by 37.5% (n = 138) compared to animal protein foods source which were rarely consumed. Only few (14.7%, n = 54) respondents were able to consume beef 4 - 7 times per week. The reasons given for taking beef less frequently were meat and meat products were expensive and many families could not afford. Other respondents reported that, they don't prefer meat when they are pregnant while others did not consume meat as they were restricted by their elders. Consumption of vegetables and fruits food group was also less frequently by majority of respondents, reasons given were that vegetables and fruits was available mainly in rain season but during dry season was not available thus many households failed to consume required amount of vegetables and fruits in each meal in a day due to high cost.

Similar finding were reported by Choundhury *et al.* (2011) who reported that, the causes of iron deficiency anaemia during pregnancy were multifactorial and varied greatly by geographical locations, seasons, and food consumption. The most common causes of iron deficiency were socio-economic status, daily intake of poor cereal based foods which contain less Vitamins and minerals but also contain phytates and other anti-nutritional factors which inhibit bioavailability of micro-nutrients such as iron. The Tanzanian Household Budget Survey (2011/2012) revealed that, 28.2% of Tanzanians have incomes below the poverty line of one us dollar per day which make them unable to consume at least one type of food from the five food groups necessary for long-term physical wellbeing (FAO, 2013).

When cereal based staple foods dominate the diet and lack food groups such as vegetables, fruits and animal sources there is a high risk for developing iron deficiency anaemia (URT, 2012). Similar finding were reported in Kilosa district by Khamaldin (2016**)**, whereby fruits, cooking oils, fats, roots and tubers were consumed only in small amounts in the observed household foods consumption patterns during the rainy season.

Other findings on food consumption among adolescent girls had shown that, more than 90% of girls failed to consume the recommended amount of fruits, vegetable and dairy products but they consumed of solid fat and added sugars (Moore *et al.,* 2012). This indicates that, while some households were able to include these foods in their diets a good number could not manage, hence they concluded that there were a low consumption of vegetables and fruits particularly during the harvest season (Martin *et al.*, 2014).

Food consumed during pregnancy need to be balanced by containing variety of foods within each of the major five food groups, so that it can provide all essential nutrients for

the mother as well as for fetal growth. The major five food groups includes (i) Cereal, roots, tubes and green banana (ii) Legume, nuts, meat and meat products, (iii) Fruits (iv) Vegetables (v) Sugar, honey, and fat (Kushi *et al.*, 2006: Johnson *et al.*, 2012). The quantities and proportions of these foods need to be such that they fulfill daily requirements for all essential nutrients which include energy, protein, minerals and vitamins for the mother as well as for fetal growth (Adair, 2014).

Table 6: **Maternal Meal Patterns**

Food group		**Frequency of food consumption per week**					
Type		**1 day**	**%**	**2 - 3 days**	**%**	**4 -7 days**	%
Cereals	Maize ugali	20	5.4	46	12.5	304	82.6
	Rice	14	3.8	54	13.7	290	80
Tubers ,and green banana	Cassava	56	15.2	70	19.0	20	5.4
	Sweet potatoes	46	12.5	31	8.4	104	28.3
	Irish potatoes	103	27.9	136	36.9	31	8.4
	Yams	78	21.2	69	18.7	51	13.8
	Green banana	120	32.6	56	15.2	72	19.6
Legumes, Pulse, Seed and Nuts	Beans	50	13.5	138	37.5	85	23.0
	Peas	20	5.4	18	4.8	12	3.3
	Cowpeas	111	30.2	26	7.1	48	13.0
	Lentil	150	40.8	39	10.6	68	18.5
Meat, Poultry, Fish	Beef	81	22.0	56	15.2	54	14.7
	Eggs	47	12.8	19	5.2	12	3.3
	Chickens	50	13.6	45	12.2	25	6.8
	Fish	50	13.6	21	5.7	8	2.2
	Milk	48	14.0	52	14.1	50	13.6
Fruits	Orange	130	35.3	38	10.3	30	8.2
	Mango	51	14	82	27.5	197	53.5
	Water melon	70	19.0	42	11.4	4	1.1
	Ripe banana	106	28.8	50	13.7	24	6.5
	Rosella juice	51	14	30	8.2	21	5.7
	Pawpaw	64	17.4	16	4.3	12	3.2
Vegetables	Sweat potatoes leaves	108	29.3	56	15.2	208	56.5
	Pumpkins leaves	100	27.2	86	23.3	77	20.9
	Spinach	104	28.3	44	11.9	43	11.7
	Tomatoes	12	3.3	80	22	154	42.3
	Karote	153	42	12	3.3	8	3.3
Fat/oil, Sugar and Honey	Fat / oil	15	18.4	12	13.2	305	82.9
	Sugar	38	10.4	211	58	69	18.9

4.4 Maternal Knowledge, Attitude and Dietary Practice Regarding Iron Deficiency Anaemia

4.4.1 Knowledge on anaemia

Table 7 summarizes maternal responses about knowledge on anaemia. Results showed that, closer to half of the prospective mothers (50.9%, n = 91) aged 15 - 25 years, had low knowledge on anemia (definition, causes, symptoms/signs, ways to prevent anaemia and complications of anaemia in pregnancy) while 48.4% (n = 44) of respondents in the same age group had high knowledge. For women aged 26 - 35 years 45.1 % (n = 41) they had high knowledge while 36.3% (n = 31) had low knowledge. For respondents with age above 35 years only 6.6 %, (n = 6) had low knowledge, while quarter (12.9%, n = 22) had high knowledge. This implies that respondents with young age (15 - 25 years) had low knowledge score compared to those in the older age above 26 years. Knowledge of the respondents was strongly associated with increase in age at (P = 0. 004). This may be due to the fact that, old women may have heard about anaemia several times in the course of their pregnancies leading to increase in their knowledge about anaemia.

Table 7: Overall knowledge of the respondents on iron deficiency anaemia

Age of Respondent (years)	Overall knowledge of the respondents						
	Low	%	Medium	%	High	%	P value
15-25	91	50.9	51	50.0	44	48.4	0.004
26-35	62	36.3	31	30.4	41	45.1	
Above 35	6	6.6	20	19.6	22	12.6	

Based on results it also appeared that, nutrition education was only provided in health facilities that was why the older mothers (those with more than one pregnancy) had high knowledge on anaemia because they received such information during their antennal visit in their previous pregnancies. These findings were similar to those reported by Kefiyalew

et al. (2014) and Viljakainen (2016) who reported, anaemia was common among young women living in rural areas and majority were coming from poor families which had limited access to information on anaemia. Poor maternal nutrition information on anaemia is a risk factor for adolescents (15 to 21 years) and younger mothers. Over 42% of girls aged 15 to 25 years are anaemic (WHO, 2014).

4.4.2 Association of knowledge on anaemia with selected socio-demographic characteristics

Results in Table 8 showed that, majority (49.1%, n = 86) of the respondents with informal education had little knowledge on anaemia compared to the respondents who attained primary level, (42.1%, n = 75) secondary level (4.6%, n = 8) and (3.4%, n = 6) college level. Education levels had significance association with knowledge on anaemia (P = 0.01), this means that the higher the education level the high is the knowledge on accessing nutrition information on anaemia.

Table 8: Association of knowledge on anaemia with selected socio-demographic characteristics

Characteristic	Response	Overall knowledge of respondent						
		Low	%	Medium	%	High	%	P value
Education level	Informal	86	49.1	21	20.6	6	6.6	0.01
	Primary	75	42.9	53	51.9	41	45.1	
	Secondary	8	4.6	20	19.6	26	28.6	
	College	6	3.4	8	7.8	18	19.8	
	Total	**175**	**100**	**102**	**100**	**91**	**100**	
Marital status	Single	66	37.7	20	19.6	24	26.4	0.01
	Married	109	62.3	82	80.5	67	73.6	
	Total	**175**	**100**	**102**	**100**	**91**	**100**	
Occupation	Peasant	126	72.0	69	67.6	42	46.2	0.02
	Petty business	12	6.9	13	12.7	12	13.2	
	Dependent	25	14.3	0	0	5	5.5	
	Livestock keepers	2	1.1	8	7.8	11	12.1	
	Employee	10	5.7	12	11.7	21	23.1	0.04
	Total	**175**	**100**	**102**	**100**	**91**	**100**	

Maternal knowledge on anemia is important because it makes women to make choice and consume iron rich foods during pregnancy and after childbirth thus improving the iron status of both the mother and the child. A study done in Southern Israel and Saudi Arabia reported that, presence of anaemia in infants and level of maternal knowledge were inversely related, with low knowledge of anaemia leading to a 12 - fold increase in prevalence of anaemia in infants compared to women with higher levels of knowledge (Bilenko *et al.*, 2007, Kabir *et al.*, 2010).

Regarding occupation, results showed that, knowledge was low particularly among those who were peasants (72%, n = 126) and those who were dependent (14.3%, n = 25) compared to those who were petty business women (12%, n = 6.9) and livestock keeper's (1.1%, n = 2). Occupation had a significant association with knowledge on anaemia at (P = 0.02). This was because, petty business women and livestock keepers were economically well off compared to the peasants so it was easy for them to access various information on nutrition. Similar results were reported by Morsy and Alhady (2014), who reported that, education level, occupation, marital status, monthly income and nutrition information during pregnancy were identified as important predictors of knowledge for women regarding nutrition during pregnancy.

4.4.3 Maternal attitude regarding iron deficiency anaemia

Table 9 results revealed that, almost (37.0%, n = 136) of the respondents in age group 15 to 25 years had wrong perception on eating iron rich animal foods compared to their older peers aged 26 to 35 years (29.1%, n = 107). In this regard, respondents were asked to choose the causes of anaemia during pregnancy (eating diet with less iron rich foods or witch craft). The response given by the majority of the respondents was witch craft,

implying wrong attitude/perception. Wrong perception on the causes of anaemia may lead to wrong intervention measures to control the deficiency. The results also showed that, closer to half (25.5%, n = 69) of respondents aged 15 to 25 years had negative attitude on eating fish. Regarding milk consumption, quarter (13.9%, n = 38) of respondent aged 15 to 25 years had negative attitude compared to the peer groups with good attitude . (10.3%, n = 38) were aged 26 to 35 years while 8.1% (n = 30) aged 15 - 25 years and very few (4.9%, n = 18) were aged above 35 years.

Table 9: Attitude of pregnancy women regarding causes of anemia

Attitude	**Age group (years) of responded**					
	15-25	**%**	**26-35**	**%**	**> 35**	**%**
Attitude on causes						
Poor diet,	46	12.5	31	8.4	17	4.6
Witch craft	136	37.0	107	29.1	31	8.4
Attitudes on eating iron rich foods						
Fish	69	25.2	49	17.9	20	7.3
offal	22	8.0	16	5.8	9	3.4
Milk	38	13.9	35	12.7	16	5.8

Food restricted by elders during pregnancy included fish, offal, milk, and eggs. Fish was restricted during pregnancy because the new born would be slippery during delivery. Offal's on the other hand were avoided because the mother will have complicated labour due to prolapse of the cord. Likewise milk was avoided because; if the mother takes milk during pregnancy she will bear a big baby that will interfere with the normal process of labor resulting in complication.

Similar findings by Wulandari and Whelan (2011), revealed that that, there was a wide range of what 'should and should not be eaten' lists for pregnancy which are Indigenous-informed. In Ghana, food avoidance by pregnant women ranged from avoiding meat and certain vegetables to avoid a drooling or a 'spirited' child (Arzoaquoi, 2015). Study conducted in Southern Tanzania revealed that, 69% of pregnant women had negative perception on fish and farm meats during pregnancy create significant iron deficiency vulnerabilities for the mother and the fetus (Kalinjuma *et al.*, 2013).

Despite the fact that all age groups reported to have negative attitude on eating animals iron rich food sources, it was observed than younger mothers (15 to 25 years) were the leading in having negative attitude in all food assessed. This could be due to the fact that, young women were less informed about effects of iron deficiency and complications associated with iron deficiency anaemia. Since they were young it was possible for the grandmothers, husbands and in laws to inject them with wrong perception regarding first class iron rich foods sources.

4.4.4 Maternal practices on iron deficiencies anaemia prevention

Table 10 data shows consumption practices of iron dense foods from animal sources, fruits, and vegetables available in their area. Inclusion of at least one type of iron rich food groups e.g. meat and meat product group (beef or fish or, eggs), vegetables groups (sweet potatoes leaves and cassava leaves), fruits group (water melon, mangoes, oranges) in each meal was regarded as 'good eating practices' while consuming these foods in one meal in a day or by skipping some days was considers as 'bad practice. Example of bad practice meal reported that included: breakfast (black tea with left - over of rice without vegetables. Lunch (stiff maize porridge with potatoes and pumpkin leaves only), Dinner (Rice and Pumpkins leaves). Good practices meal included: Breakfast (Milk tea, rice with

beans, mango and vegetable), lunch (stiff maize porridge, beans, potatoes leaves, and mango) dinner (rice, meat, pumpkin leaves and mango) and two snacks of fresh fruit juice or fruit or milk.

Vegetable consumption practices showed that, majority (86.2%, n = 318) of respondents had bad eating practices while only 13.8% (n = 50) of the respondents had good eating practices. Fruits consumption practices showed that, quarter 54.6% (n = 201) of the respondents had bad eating practices while (45.4%, n = 167) had good eating practices. Also consumption of meat and meat products, indicated that majority (79.1%, n = 291) of the respondent eating had bad practices while only 20.9% (n = 77) had good practices. URT (2013) reported that, diets in most parts of Tanzanian are based on cereals (maize, rice sorghum) root (cassava) and pulse (beans lentils). Eating practice of micronutrient dense foods such as animal products, fruits, and vegetables is not common and subsequently, micronutrient deficiencies are widespread.

Table 10: Consumption practices of iron rich foods

Iron rich foods	**Practice**			
	Good practices	**%**	**Bad practices**	**%**
Vegetables				
Sweet potatoes	260	70.7	108	29.3
Pumpkin	68	18.5	300	81.5
Spinach	87	23.6	281	76.4
Overall	**50**	**13.8**	**318**	**86.2**
Fruits				
Orange	38	10.3	330	89.7
Rosela	56	15.2	313	84.8
Water melon	54	14.6	240	65.2
Mangoes	268	72.8	100	27.2
Overall	**167**	**45.4**	**201**	**54.6**
Meat and meat product				
Fish	64	17.6	304	82.6
Milk	98	26.6	270	73.4
Beef	139	37.8	229	62.2
Overall	**77**	**20.9**	**291**	**79.1**

Increasing dietary intake of balanced diet can be challenging because iron (micronutrients) dense foods are often expensive and not readily accessible. Iron deficiency is the most pervasive nutritional problem in the world today but progress to eliminate it has been limited, due in part, by the fact that, iron-rich foods – like liver, red meats, eggs, fish, whole-grain bread, and legumes are not widely available or affordable to many families (Stevens, 2015).

4.5 Assessment of Haemoglobin Status

4.5.1 Haemoglobin of the pregnant women at recruitment and last visit according to gestation age (GA)

Table 11 shows the distribution of haemoglobin status of pregnant women during the first visit to the reproductive health clinic. Results showed that, 31.9% (n= 124) of the respondents had moderate anaemia, 26.0% (n=101) had mild anaemia while 1.8% (n=7) had severe anaemia. Mild and moderate anemia was predominant with average Hb of 9.9 g/dl ± 1.7 g/dl and ranging from 6.5 to 13 g/dl. A study by Khamaldin (2016) showed that, maternal anaemia prevalence rate in Kilosa district was 30.5%. Also Mosha and Philemon (2010), reported that, 32.1% of the studied pregnant women in Morogoro had haemoglobin levels below the cut of point.

Table 11: Distribution of haemoglobin levels among pregnant women during first visit to Antenatal clinic

Characteristics Anaemia classification	**No of Respondents**	**%**	**Mean Hb g/dl**
Severe anaemia	7	1.8	9.8+1.71
Moderate anaemia	124	31.9	
Mild anaemia	103	26.0	
Normal	134	40.3	
Total	**368**	**100**	

Table 12 shows the Hb concentration of pregnant women at recruitment and last visit. For respondents recruited at the 16 weeks, results showed that, the mean Hb level at 40 weeks (GA) had increased to 11.64 ± 1.466 g/dl compared with the mean Hb level of 8.460 ± 0.9263 g/dl taken during first visit (16 weeks GA). The increase was statistically significant at (P= 0.013). Regarding respondents with 20 weeks, results showed that, Hb level increased to 11.28 ± 1.732 g/dl at 40 (GA) compared with 9.173 ± 1.8423 g/dl at 20 weeks. Regarding respondents recruited at 24 weeks, results showed that, mean Hb level increased to (11.53 ± 1.922) at 40 weeks compared to the mean Hb level of 10.403 ±1.5985 g/dl at 24 weeks. The results showed that, most of respondents who reported to the reproductive health clinic during the second trimester had low Hb in first visit but at 40 weeks (term) their Hb level results had increased. The increase in hemoglobin level could be due to early reporting to the reproductive health clinic which made them to receive important service offered at clinic including malaria and helmentis prophylaxis, screening for Hb level and nutrition counseling.

For the respondents who reported in the third trimester (28 weeks), results showed that there was a very small (0.119) g/dl increase in the Hb concentration at first visit, (10.234 ± 1.6612 g/dl) compared with mean Hb concentration at last visit (40 weeks) (10.99 ± 1.85 g/dl). This small change in Hb concentration was similar to that enrolled at 32 weeks with mean Hb concentration of 10.193 ± 1.86 g/dl at first visit and 10.38 ± 1.975 g/dl at the 40 week (P = 0.069). These results implied that late reporting at antennal clinic caused late detection of infections, Haemoglobin screening and missing of opportunity to correct the iron deficiency through nutrition counseling and iron supplementation. In this study, majority (85.1 %, n = 313) of the respondents were in third trimester, while only (14.9%, n = 55) of respondents were in second trimester. Out of these, more than (69.8%, n = 54) and (54.6%, n = 6) of the mothers who reported

during the second and third trimester trimesters, respectively were anaemic compared to 9.1% (n = 1) of the pregnant women who reported in the first trimester.

Table 12: Haemoglobin concentration of the pregnant women at recruitment and last visit according to gestation age (GA)

GA (weeks)	Hb (g/dl) at first visit	Hb (g/dl) at last visit	P- value
16	8.460±0.9263	11.64±1.466	0.013
20	9.173±1.8423	11.28±1.732	0.003
24	10.403± 1.5985	11.53±1.922	0.001
28	10.234±1.6612	10.99±1.849	0.00
32	10.193±1.8605	10.38±1.975	0.029

Similar findings for a study conducted in Kenya revealed that ,majority of pregnant women in their third trimester 37.3% and second trimester (39.3%) were anaemic and only 10% of the women in their first trimester had anaemia (Carolyne, 2011). Thus anaemia was therefore more prevalent in the second and third trimesters of pregnancy compared to the first trimester. Another report by Justina (2015) in Mbulu, Tanzania, reported that pregnant women in developing countries are at high risk of anaemia due to low intake of iron rich foods, poverty, grand-multiparty, too early pregnancies, too many and too frequent pregnancies spacing of less than one year, low socioeconomic status, illiteracy, and late reporting at antenatal care clinic.

In WHO (2011) reports, anaemia in pregnancy peacked in the second and third trimesters. High prevalence of anaemia in the second and third trimester could be attributed to late initiation of antenatal care. Since iron deficiency anaemia is the most frequent maternal complication of pregnancy, antenatal care should therefore be important in early detection and management of iron deficiency anaemia.

4.5.1 Association of selected maternal reproductive characteristics and anaemia

Results in Table 13 summarises the association of gestation age and time for reporting at the antenatal clinic. Regarding the number of pregnancies anaemia prevalence was found to be higher in gravid one mothers and multigravida. Prevalence of anaemia among gravid one mothers was 44.2% (n = 61) (moderate anaemia) which (45.5% (n = 5) had severe anaemia. Regarding anaemia prevalence among multigravida mothers 24.6% (n = 34) were moderately anaemic while 29.4 % (n = 4) were severely anaemic. Majority of gravid two and three respondents, had mild anaemia (23.4 %, n = 18) and (20.8 % ,n = 18) respectively. The number of pregnancies was strongly ($P < 0.02$) associated with prevalence of anaemia. In this study, anaemia was observed to rise from in primi gravid to multigravida and also as maternal age advanced. These results were in agreement with studies by Araújo *et al*. (2013), Gebremedhin *et al.* (2014) and Morsy (2014) which found that teenagr and older mother have significantly increased risks of developing anaemia.

It is generally believed that anaemia in pregnancy increase with rising gravidity and maternal age. Besides the general body weakness with advanced maternal age, older women are expected to be multigravida. Multigravida may induce anaemia by reducing maternal iron reserves at every pregnancy and by causing blood loss at each delivery. This may be aggravated by poor diet especially of iron rich foods which is very common in pregnant mothers living in rural area. Regarding the primigrada mothers, majority were young aged (15 - 19) years, still depending on their parents or married to the younger husband with low or no income making it difficult for the pregnant woman to get the right meal rich in iron Primigravida mothers are also less informed about important nutrition issues such as good eating practices during pregnancy and early reporting at the antenatal health clinics.

Regarding time for reporting at the ANC, there was strong association between the mothers who reported early and those who reported late. Almost 69.8% (n = 54) and 54.6% (n = 6) of the mothers who reported during the second and third trimesters, respectively, were anaemic compared to 9.1% (n = 1) of pregnant women who reported in the first trimester. Majority of prospective mother in this study made their first visit to the ANC from mid third (32 week) trimester. Findings by Sahoo *et al.* (2014) indicated that, overall women reported late to the antenatal clinic (gestation age 23 weeks). Anaemia was more common, and more rigorous among mothers who reported late for the antenatal services.

Table 13: Association of selected maternal reproductive characteristics with anaemia

Maternal characteristics		Hb in g/dl								
		Severe anemia		Moderate anaemia		Mild anamia		Normal		P value
No of pregnancy	Gravida one	5	45.5	66	47.8	19	24.7	44	31	
	Gravida two	1	9.1	13	9.4	18	23.4	39	27.5	0.02
	Gravida three	1	9.1	15	10.9	16	20.8	28	19.8	
	Multigravida	4	29.4	44	31.9	24	31.2	31	3.7	
	Total	**11**	**100**	**138**	**100**	**77**	**100**	**142**	**100**	
1st visit at ANC	First trimester	1	9.1	7	5.1	7	7.8	11	7.8	0.02
	Second	4	11.3	87	63.0	54	69.8	94	66.7	
	Third	6	54.6	44	31.9	17	22.1	36	25.5	
	Total	**11**	**100**	**138**	**100**	**77**	**100**	**142**	**100**	

4.5.2 Association of haemoglobin status and maternal knowledge, attitude and practices of consuming iron rich food sources

Results in Table 14 showed that, anaemia was more (58%, n = 80) prevalent among respondents who had low score in knowledge on taking iron rich food sources compared to those with medium score in knowledge (26.1%, n = 28) and high scores. (15.9%, n = 22).

Regarding association of eating iron rich foods and occurrence of iron deficiency anaemia, it was revealed that, pregnant women who ate less of iron rich foods were severely (63.6%, n = 7) and moderately anaemic (59.4%, n = 82) compared to those who ate iron rich foods (50.6%, n = 39) (P = 0.04), Regarding perception of pregnant women on causes of anemia. Results revealed that, anaemia was more (72.5%, n = 100) in pregnancy women reported that it was due to witch craft (P = 0.04).

Educational level, monthly income and nutrition information during pregnancy are important predictors of knowledge and attitudes of women on prevention of iron deficiencies anaemia during pregnancy. A study conducted in Malaysia demonstrated that, pregnant women with better nutrition knowledge levels had good nutritional attitude towards eating iron rich foods and therefore had high hemoglobin and good pregnancy outcome (WFP, 2014).

Table 14: Association of haemoglobin status of pregnant women with knowledge, attitude and practices

Characteristics	Response	Hemoglobin level								
		Severe anemia		Moderate anaemia		Mild anaemia		Normal		P value
		No	%	No	%	No	%	No	%	
Respondent overall knowledge	Below average	6	54.6	80	58.0	31	40.8	59	40.8	0.001
	Medium	3	27.3	36	36.0	28	36.4	35	24.6	
	Above the average	2	18.2	22	6.0	18	23.4	49	34.5	
	Total	**11**	**100**	**138**	**100**	**77**	**100**	**142**	**100**	
Overall eating practice on Iron rich food	Bad practice	7	63.6	82	59.4	38	49.4	62	43.7	0.004
	Good practices	4	36.4	56	40.6	39	50.6	80	56.3	
	Total	**11**	**100**	**138**	**100**	**77**	**100**	**142**	**100**	
Attitude on causes of anemia	Good perception	5	45.5	38	27.5	24	31.2	27	19	
	Bad perceptions	6	54.5	100	72.5	53	68.8	115	81	0.002
	Total	**11**	**100**	**138**	**100**	**77**	**100**	**142**	**100**	

4.6 Maternal Weight Gain and Body Fat Distribution during Second to Third Trimesters of Gestation

4.6.1 Classification of nutritional status of pregnant women according to body fat distribution

Table 15 summaries the classification of nutritional status of pregnant women based on body fat percentage. Results showed that, on average body fat gained in the two trimesters ranged from 2.06 to 3.41% while, the minimum and maximum body fat gained was 0.5 % and 2.5% respectively per month. A total of 5.47% body fat was gained by the respondents from the second to third trimester. The maximum amount of 2.5% gained per month was considered to be slightly high for the pregnant women with a normal body mass index (BMI). For acceptable range of body fat gain, IOM (2009), recommends for underweight pregnant to gain 2.26% in the first trimester (Heddsonrson *et al.*, 2010).

According to IOM (2009), classification of nutrition status by fat percentage, results revealed that, quarter (76.5%, n = 9) of respondents aged 15 - 20 years (teenage mothers) had normal fat distribution as compared to those who were thin (73.5%, n = 25), overweight (41.9%, n = 44) and obese (27.3%, n = 30). Regarding age group 21 to 25 years, majority (50.9 %, n = 56) of the respondents were obese, 44.8% (n = 47) were overweight, few (21.8%, n = 26) were normal and very few (14.7%, n = 5) were in thin category. For the older age group (above 26 years), closer to half (21.8%, n = 24) of respondent were obese, 13.3%, (n = 14) were overweight and very few (11.8%, n = 4) were thin.

These results showed that, majority of respondent above 21 years were classified as overweight and obesity. Maternal obesity is emerging as a public health problem in most developing countries. Many developing countries including Tanzania now experiences a

double burden of malnutrition with increased maternal overweight and obesity (Haddad *et al.*, 2014; Lear, 2014). More than 40% of the reproductive aged women being overweight or obese (Black *et al.*, 2013). Obese mothers were found to have increased risks of wound infection, gestational diabetes mellitus, pregnancy induced hypertension, pre-eclampsia, antepartum , and postpartum haemorrhage interfere with minerals and vitamin rich food intake by pregnancy (Jeremiah, 2011). Iron deficiency and obesity are molecularly linked and mutually affect each other. Obesity may promote iron deficiency by inhibition of dietary iron uptake from the duodenum (Datz, 2013). A study by Sanad *et al.* (2011), reported that, iron uptake from the duodenum is limited in obese compared to normal weight individuals.

Table 15: Maternal body fat classification according to age

Characteristics		**Nutrition classification**								
Characteristic	**Respondents Age group**	**Normal**		**Thin**		**Overweight**		**Obesity**		**P value**
		No	%	No	%	No	%	No	%	
Teenage	15-20	91	76.5	25	73.5	44	41.9	30	27.3	0.00
Active	21-25	26	21.8	`5	14.7	47	44.8	56	50.9	
Older age	Above 35	6	1.7	4	11.8	14	13.3	24	21.8	
Total		**119**	**100**	**34**	**100**	**105**	**100**	**110**	**100**	

4.6.2 Maternal weight gain

Results in Table 16 revealed that, average monthly weight gain was 1.5 kg for the (fourth, fifth, sixth (lowest) months and (fifth, sixth ,seventh (highest) months and 1.29 kg for (sixth ,seven and eighth (lowest) and seventh, eighth ninth (highest) months. therefore total average weight gain during the second trimester was therefore 2.79 kg. On the third trimester, average weight gain was 1.32 kg for (seventh, eighth and ninth months). The total average weight gain in the two trimesters of gestation was 4.11kg. This average weight gain was slightly lower than the values reported in other studies in Morogoro, Nyaruhucha *et al.* (2006) reported an average maternal weight gain of 4.59 kg during the second and third trimesters in Morogoro. Another study on "Factors influencing pregnancy outcomes in Morogoro Municipality" revealed that, total average maternal weight gain during the third trimester was 7.76 kg (Mosha and Philemon, (2010). In this study, only 56 out of 281 pregnant women (19.9%) gained a total weight of 12 kg or more from the second to third trimesters

These results showed that, closer to half (80.1%, n = 281) of pregnant women were below recommended normal body weights gain. Low weight gain observed in this study could be associated with low haemoglobin status which was observed in most of the respondents. Many studies suggest that a fall in maternal hemoglobin below 11.0 g/d1 in the third trimester is associated with a significant decrease in maternal weight gain and rise in prenatal mortality rate due to low birth weight (de Jersey *et al.,* 2012). A woman's body mass index (BMI) at the start of pregnancy is important to determine how much weight she should gain during pregnancy. The best way to begin a pregnancy is to have BMI in the normal weight category. Women, who are overweight before their pregnancy, should not gain more than 7 to about 11 kg during their pregnancy. Women, who are

underweight before their pregnancy, should gain about 12 to 18 kg. If a woman has a normal body weight, should aim to gain weight of about 11 to 16 kg (IOM, 2009).

4.6.3 Maternal blood pressure

Results in Table 16 showed that, majority (94.8%, n = 349) of the pregnant women had blood pressure within normal range (80 -- 134 / 60 -- 89) mmHg (systolic/diastolic). Only 3.3 % (n = 12) of the women had elevated blood pressure above normal (≥ 135/90 mmHg), and 1.9% (n = 7) had low blood pressure (≤ 80/60 mmHg). Majority of the pregnant women were therefore out of risks of hypertension. Blood pressure is among the important maternal health and nutrition indicators. High and low blood pressure results to poor pregnant outcomes for both mothers and babies due to poor perfusion of oxygen to the placenta. National Heart Foundation of Australia and the Cardiac Society of Australia (NHFA) (2011) guidelines have classified a blood pressure of less than 120/80 mmHg as optimal. Blood pressure of 120 to 129/80 to 84 mmHg is normal, ≥ 130 systolic and ≥ 90 diastolic mmHg is higher than normal, and values anything below or above those levels are classified as hypotension or hypertension, iron deficiency during pregnancy can adversely impact the blood pressure resulting in cardio- vascular complications leading to poor growth and development of the offspring in later life (Lewis *et al*., 2012).

4.6.4 Birth outcomes

Table 16 summaries birth outcomes whereby more than (95.33%, n = 347) of the new born were delivered at Kilosa hospital and Kimamba health center. About (4.03%, n = 14) of the pregnant women were test to follow up (mothers who didn't delivered at earmarked health facilities). About 0.86% (n = 3) of the pregnancy mother had still birth's. Average birth weight of the neonates was 2.9 kg. A study by Nyaruhucha *et al*. (2006), reported

slightly higher average birth weight (2.97 kg) for children who were born in Morogoro urban. Another study by Mosha and Philemon (2010), reported an average birth weight of 3.05 kg in Morogoro rural district.

Classification of nutritional status for the neonates based on measurements taken revealed that, 24.4% (n = 89) had normal weight for age. More than 14.5% (n = 54) of the neonates were moderately stunted while 7.7% (n = 28) were severely stunted. Results also showed that 24.2% (n = 85) of the neonates were moderately wasted, 2.2% (n = 8) were severely wasting while 14.8% (n = 54) were overweight. Moreover, 44.3% (n = 94) of the neonates were moderately underweight while 9.4% (n = 20) were severely underweight. Stunting suggested that, the children had intra-uterine growth retardation as a result of maternal poor diets or recurrent infections .Wasting represents recent failure to receive adequate nutrition, low birth weight indicates multifaceted public health problem that includes long-term maternal malnutrition, ill health, hard work and poor health care in pregnancy. Childhood obesity is associated with a higher probability of maternal obesity (Maternal and Child Under nutrition Study Group (2008). Survey conducted by Tanzania Statistics Bureau (2016) showed that, prevalence of stunting and underweight in Morogoro region were 33.4% and 11.5% respectively, these were slightly lower than the National average of 34 and 14%, respectively.

Table 16: Distribution of Maternal Characteristics, Maternal Weight Percentage, Blood Pressure and Birth Outcomes

Variable	Mean±SD	Range Minimum	Range Maximum
Parity	2.9 ± 1.5	1	7
Maternal age (years)	26 ±7.6	15	48
Total body weight gain 2nd trimester (kg)	2.75 ± 1.294	1	2.3
Total body weight gain third trimester(kg)	1.32 ± 0.398		
Total weight gain (2 - 3 trimisters) (kg)	4.11 ± 2.776		
Total fat gain percentage	5.47 ± 2.4		
Total fat second trimester (percentage)	2.02 ± 0.98	0.5	2.7
Total fat third trimester (percentage	3.41 ± 1.87	1.0	2.5
Blood pressure (average)			
Systolic (mmHg)	113 **± 12**	118	179
Diastolic (mmHg)	70 ± 10	65	90
Blood pressure average in second trimester			
Systolic (mmHg)	108 **± 15**	90	179
Diastolic (mmHg)	69 ± 11	60	115
Blood pressure average in third trimester			
Systolic (mmHg)	114 **± 12**	80	179
Diastolic	70 ± 9.6	60	115
Birth outcomes			
Average birth weight (kg)	2.9 ± 1.34	1.9	4.5
Birth length (m)	45.6 ± 2.7	43	55

4.6.5 Association of maternal weight gain, haemoglobin status, age of respondent and knowledge

Regarding haemoglobin status, the results showed that mothers with weight gain below the standards, majority had moderate anemia (40.4%, n = 90) and mild anemia at (36.3%, n = 81) compared to mothers with standard weight gain. Proportion of moderate and mild anaemia was 28% (n = 41) and 21.4% (n = 31) respectively. Maternal weight gain has shown strong association with hemoglobin status (P = 0.032). Regarding age of respondents, majority (53.8%, n = 120) of mothers aged 15 - 20 years gain weight below standard. Regarding respondents overall knowledge results showed that 41.7% (n = 93) of

the respondents with anaemia had weight gain below average, while 30.9% (n = 69) and 27.4% (n = 61) of the respondents had average and above average weight gains respectively (P = 0.005).

Table 17: Association of maternal weight gain and hemoglobin status, age of respondent and overall knowledge pregnancy women

Characteristics	Change in maternal weight gain				P value
	Response	Below standard weight gain	Standards weight gain		
		No	**%**	**No**	**%**	
Hemoglobin status (g/dl)	Severe anaemia	7	3.1	4	2.8	0.032
	Moderate	90	40.4	41	28.2	
	Mild anaemia	81	36.3	31	21.4	
	Normal	45	20.2	69	47	
	Total	**223**	**100**	**145**	**100**	
Age of respondent (years)	15-20	120	53.8	62	43.4	0.02
	21-35	69	30.9	62	42.4	
	Above 35	34	15.3	21	14.2	
	Total	**223**	**100**	**145**	**100**	
Respondent overall knowledge on iron deficiency anaemia	Below average	93	41.7	64	44.1	0.06
	Average	69	30.9	36	6.2	
	Above average	61	27.4	64	48.9	
	Total	**223**	**100**	**145**	**100**	

Women who gained a lot of weight in pregnancy have a higher risk of having very big baby with a birth weight of over 4000 to 4500 g (macrosomia). These big babies are more likely to need a cesarean section. Extra maternal weight after giving birth is difficult to loose. On the other hand, if a woman does not gain enough weight and is undernourished during pregnancy, it can harm her growing baby. Such babies are then often born too early (preterm birth) or often with too little weight due to inter-uterine growth retardation (IOM, 2009).

4.7 Socio-economic Factors Associated with Anaemia in Pregnant Women

Table 18 summaries the socio-economic factors associated with Hb status in Kilosa district. The hemoglobin status of the pregnant women was associated with their occupation, education and income level. Regarding level of education, results showed that 45.3% (n = 72) of the respondents, who had no formal education were moderately anaemic while 25.8% (n = 41) of those who attained primary education were moderately anaemic while 15.1% (n = 24) of the respondents with secondary education and 13.8% (n = 22) of those with college education had moderate anemia. A study by Nzwizu *et al.* (2011), reported that anaemia significantly as higher among women with no formal education compared to those with formal education level has direct effects on the understanding of nutrition and food aspects as well as improvement of the socio-economic conditions. Maternal education level therefore influences the food choices and feeding patterns of family members.

Regarding monthly income earned by the respondents, those with income less that TShs 60 000/= per month had significantly higher proportion (P = 0.000) of moderate anaemic subjects (71.7%, n = 114) compared to those who earned TShs 100 000 - 200 000/= (25.2%, n = 40) moderate anaemia and above TShs 200 000/ = (3.1%, n = 5). These results implied that more than half of the respondents had incomes that were below one dollar T Sh 60 000/= per month. Findings by Bloch *et al.* (2008) and Mosha and Philemon, (2010) reported that, low incomes adversely affected food and nutrition security, thus increasing the risk for poor pregnancy outcomes. Regarding occupational status, respondents who were peasants were more moderately anaemic (82.4%, n = 131) compared to those who were livestock keepers (12.6%, n = 20) and employed for wage (5%, n = 8).

Table 18: Socio-economic factors associated with hemoglobin status in pregnant women

Characteristics	Hemoglobin level g /dl								
	Severe anemia		Moderate anaemia		Mild anamia		Normal		P value
Education level	No	%	No	%	No	%	No	%	
Informal educational	26	38,2	72	45.3	22	34.4	13	16.9	
Primary level	16	23.5	41	25.8	17	26.6	18	23.3	0.001
Secondary	14	20.6	24	15.1	15	4.0	30	39.0	
College	8	11.7	22	13.8	10	15.6	26	33.8	
Total	**68**		**159**				**64**		
Income level(T Shs)									
Less than 60 000	47	69.1	114	71.7	42	65.6	9	11.7	
100 000- 200 000	16	23.5	40	25.2	16	25.0	28	36.4	0.000
More than 200 000	5	7.4	5	3.1	6	9.4	40	51.9	
Total	**68**		**159**		**64**		**77**		
Occupation									
Peasant	44	64.7	131	82.4	49	76.6	7	9.1	
Employed for wage	9	10.3	8	5.0	0	0.0	42	54.5	
Livestock keeper	15	25.0	20	12.6	15	23.4	28	36.4	0.001
Total	**68**		**159**		**64**		**77**		

4.8 Association of Risk Factors of Iron Deficiency Anaemia in Pregnancy

Table 19 shows the association between the haemoglobin (dependent variable) and some of the risk factors. Maternal occupation, maternal monthly income, knowledge status, education level, food consumptions patterns, meat consumptions practices, fruits intake practices, antenatal care first visit to RCH , total maternal weight gain during the second and third trimesters and birth weight, had strong ($p \leq 0.05$) association with haemoglobin status. Other variables such as maternal total body fat, birth length (stunting) and wasting did not show strong association ($P > 0.05$) with haemoglobin status.

Table 19: Regression analysis when the dependent variable is Hemoglobin status

Independent	Coefficient	Standard error	Significance
Maternal occupation	-0.027	0.023	0.024
Maternal monthly income	-0.031	0.288	0.032
Maternal knowledge status	-0.560	0.110	0.000
Maternal education level	-1.803	0.451	0.002
Time for booking	-0.377	0.187	0.044
Food consumptions patterns	-0.462	0.221	0.003
Meat eating practices	0.044	0.019	0.002
Fruits eating practices	-0.450	0,224	0.044
Maternal total weight gain	-0.0234	0.0248	0.034
Maternal total body fat	0.339	0.173	0.005
Neonates nutrition status			
Underweight	-0.471	0.235	0.004
Stunting	0.410	0.414	0.670
Wasting	-0.51	0.280	0.951

Generally it was learnt that, risks of developing anaemia among studied group were significantly increased with increasing parity and age, also with late reporting of pregnant women to the antenatal clinic, low education level, poor weight gain, low knowledge and bad attitude on eating iron rich foods. Pregnant women in developing countries are at risk of anaemia due to poverty, grand multiparity, too early pregnancies, too many and too frequent pregnancies spacing of < 1 year, low socioeconomic status, illiteracy, and late booking of pregnant women at antenatal care units (Jufar *et al.*, 2014).

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

This study revealed that, anemia in pregnancy is still a significant problem where by more than half of the women attending antenatal care at Kilosa was found to be anemic 31.9% (n = 124) had moderate aneamia 26.0% (n =101) had mild anaemia while 1.8% (n = 7) had severe anaemia. Late reporting to the antenatal clinic, low level of knowledge, negative attitude and bad practices on eating iron rich foods were some of the factors that contributed in the increase of low level of hemoglobin among pregnant women in the study area. Causes of iron deficiency anaemia were late reporting to antenatal clinics of majority of pregnant women, low knowledge and negative attitudes of pregnant women on eating iron rich foods. Furthermore, low level of education and monthly income below the poverty line was found to be major drawbacks for effective control of anaemia among the pregnant women. Also it was found, increased parity, young age and poor maternal weight gain were some of the risk factors for increased low hemoglobin among pregnancy in Kilosa district therefore low hemoglobin status was associated with poor maternal weight gain and increased risk of low birth weight babies. It was also found that pregnant women aged 21 - 35 years from low socioeconomic status consumed highly refined diets and had low Hemoglobin and were generally obesed.

Iron deficiency anaemia during pregnancy needs to be addressed through vigorous health education in private and public health institutions, in order to prevent risk factors of anaemia and mitigate the adverse effect of anaemia in pregnancy. Educating women on early initiation of antenatal clinic attendance would also reduce the problem of iron deficiency anemia during gestation.

5.2 Recommendations

(i) Anaemia in pregnant mothers needs to be tackled seriously by nutritionist and health care workers, from national (ministry) and village (dispensary) level because of possible health implications to the mothers and babies, adequate counseling and health education to women concerning the importance of taking iron rich food and supplementation throughout the pregnancy. In addition education should include antenatal care that focuses on intake of iron rich foods. As iron deficiency anaemia is a diet related micronutrient deficiency, so it is important to clarifying and encourages a wide variety of locally or seasonally available foods. On a national scale, consideration should be made on fortification of foods with iron to curb iron deficiency anemia.

(ii) Other intervention measures and programs to educate the mothers on the need to initiate antenatal care early should be instituted.

(iii) Screening for anaemia must be recommended for all women at booking and at 28 weeks. At 36 weeks gestation .Hemoglobin results should be discussed and given to the client, ensuring that she is able to make a fully informed decision. Furthermore, all women should be counseled at the first reproductive health visit and in the subsequent visits regarding diet in pregnancy including details of iron rich food sources and factors that may inhibit or promote iron absorption and why maintaining adequate iron stores in pregnancy is important.

5.3 Study Limitations

Delay of pregnant women to register at antennal clinic for the first visit, this made some women to be tracked for only 2 to 3 months during the study. Majority of the pregnant women were followed for 2 to 3 months only. Most pregnant women reported for their antenatal clinic at the beginning or middle of the third trimester 28 GA. In light of the foregoing, some of the findings reported in this study could have been better if the data would have been collected from the first trimester to term.

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APPENDICES

Appendix 1: Questionnaires on eatiology and risk factors associated with iron deficiency anaemia among pregnant women in kilosa district

Rapport

ID no : ---------- (iii) Village : ……..……...(iii) District……

(iv) Health facility ……... (vi) Phone number……

Section A: Socio – Demographic Data

(1). Age (yrs) ---------- (2) Marital status : (i) Single (ii) Married (iii)Divorced (iv) Widow (v) Cohabitated

(3) . Educational level : (i) Informal education (ii) Primary schoo l (ii) Secondary school

(4) (iv) College level. (5) Head of the House hold ……

Section B: Gynecological and Obstetric Data

6.Gravida ---------- (7) Parity ------- ((8) Gestation Age ……

(9) Number of abortion ---------- (10) what was the causes ……..

If only one pregnancy skip to # 12.question

11. If more than one pregnancies how long was the interval between your previous and current pregnancy?.....years

12. At what gestational age did you started the antenatal clinic ?.....months

13. Why did you start at that stage? (Tick where applicable)

(i) Not sure of pregnancy (ii) Previous experience of anaemia during pregnancy (iii) Miscarriage (iv) it is the right to start (v) very severe vomiting

13. Have you had any problems with this pregnancy? (i) Yes (ii) No. 14. If yes what was /were the problem(s) (i) Bleeding (ii) dizziness (iii) Fever (iv) severe vomiting (v) oedema

15. Have you ever had Anemia in this pregnancy? (i) Yes (ii) No

18. Have you taken any deworming drugs during your pregnancy? (i) Yes (ii) No

19. Were you given any anti- malaria drugs during this pregnancy during ANC visits? (i) Yes (ii) No

20 Do you sleep in a treated bed net?(i) Yes (ii) No

Appendix 2: To assess knowledge, attitudes, practices of pregnant women on iron deficient anemia in pregnancy

Choose the correct answer

21. What is anaemia? (i) Is a decrease number of white blood cell count in the body (ii) is the inability of the heart to pump blood to the peripheral part of the body. (iii) Is a decrease in concentration of red blood cells or haemoglobin level in the blood? ( )

22. How can one get anaemia? answer (i) I agree (ii)disagree (iii) undecided (iv) Strongly disagree.

(i) Poor dietary intake, parasitic infections, chronic infection e.g. TB and HIV, (ii) witchcraft.

23. How can one know that she is suffering from anaemia?

(i) Reduced body weight (ii) the skin appear pallor and paleness of he conjunctiva, palm, tongue, general body malaise, heart palpitation and fatigue (iii) coughing up blood.

Are their any attitude that prohibit you from taking iron rich foods Yes/ No

If yes in the list below answer (i) I agree (ii)disagree (iii) undecided (iv) Strongly disagree. Fish, (ii) milk (ii) egg (iv) offals

24. How can one protect herself from getting anaemia?

(i) Eating high carbohydrate diet (ii) eating meat, eggs, green vegetables and fruits (iii) eating high fat diet

25. Mention complications of anaemia for both mother and foetus (tick all correct answers)

(i) Low birth weight, (ii) still birth (iii) preterm delivery (iv) Unhealthy baby (iv) death may occur.

26. Do you usually include meat and meat products in your diet (i) No (ii) Yes

27 If no why (i) very expensive I cant afford (ii) I don't like (iii) No advantage

28 Why do majority of pregnancy mother/ Communities does not include fruits and vegetables in each meal:

Expensive, (ii) seasonal (iii) no advantage

29. Where do you get water for domestic use? (tick all correct answers) (i) Pumped into residence (ii) Public tape (iii) River/stream (ii) Shallow well

30. What type of toilet do you have at home (i) Pit latrine (ii) flash toilet (iii) other specifies.....?.

31. Did you receive iron tablets during your ANC visit ? (i)Yes (ii) No 32. How long did you take them? ---------- months

33. What are the best foods in your area that are taken during pregnancy that supply

(i)Iron ……..,……..,…….

(ii) Vitamin A ……..,……,……..

Dietary History

33. What are the best foods in your area that are taken during pregnancy that supply

(i) Iron ……..,……..,…….

(ii) Vitamin A ……..,……,…….

34 What are the limitation for obtaining foods that are suitable for pregnant women?.....

35. Do you usually drink (i) coffee (ii) Tea (iii) cocoa?(tick where applicable)

36. How many cups do you drink in average per day (i) (i) coffee …….(ii) Tea …….(iii) cocoa…….?

37. Do you crave for food? (i) Yes. (ii) No. 37 Why do you crave (give reasons)

……

Food Frequency Questionnaire

Section D

Food consumptions				
	[2] 2-3 times/ week	[3] 4-6 times / week	[4] Irregular	[5] Not at all
Fruits : (i) Orange (ii) Strawberries (iii) Rosela Juice (iv). Grapefruit (v) . Tangerine (vi) .Others …….				
Vegetables (i) Carrot (ii) Spinach (III) Amarants (Iv) Sweet potatoes leaf (v) Others				
Fish (i) Fish (ii) Sadine				
Meat (i) Beef (ii) Chicken (iii) Pork (iv) Others …..				
Dairy product (i) Milk (i) Yought Others ……				

Appendix 3: To determine weight fain and body fat in second and third trimister

2.1.body weight (total weight gain Kg)

Baby's birth weight……Kg

2.2 Body fat distribution (in percentages)

Trimister	Months					
Second & Third	4	5	6	7	8	9
Body fat mass in percentage						

Appendix 4: To dermine haemoglobin status

Trimister	Months					
Second & Third	4	5	6	7	8	9
Haemoglobin level in g/dl						

Biomarker: Determination of Blood pressure (mmHg)

Trimister	Months					
Second & Third	4	5	6	7	8	9
BP in mmHg						

Appendix 5: To Determine Socio- Economic and Cultural Characterics

Associated With Anaemia in Pregnant Women

4.1 Are there any cultural practices that prohibit the intake of certain foods during pregnancy?

(i) Yes (ii) No

4.2 If yes circle the food restricted in the following list (i) Fish, (ii) offal (iii) Milk (iv) Meat

4.3. give reasons/ norms on why you are not allowed to eat the food you have circled above

What is your occupation ----------

4.6 How many acres of farm do you have ? _____ acres

4.7 How much sachets of carbohydrate giving foods do you harvest per year (i) Rice ----------Kg,(ii) Maize -------(iii) Sweet Potatoes ……..torn (v) Cassava

4.8 How much sachets of protein giving foods do you harvest per year (i) Beans -------- Kg,(ii) pease -------(iii) others s ……..4.9 What is your average monthly family income per month? (circle ne)

less than Tsh 60,000/= (2) 100,000- 200,000/= (3) >200,000/=

THANK YOU