KNOWLEDGE, ACCEPTANCE AND BARRIERS TO OPTIMAL USE OF IRON SUPPLEMENTS AMONGST PREGNANT WOMEN ATTENDING MUTARE CITY CLINIC IN MANICALAND, ZIMBABWE

BY

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PREFACE

The work described in this thesis was carried out from August 2015 to November 2020, under the supervision of Dr Kirthee Pillay and Dr Nicola Wiles.

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As the candidate's supervisors, we agree to the submission of this thesis:

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DECLARATION

I, Plaxcedia Mahundi declare that:

1. The research reported in this thesis, except where otherwise stated, is my original research.

2. This thesis or any part of it has not been submitted for any degree or examination at any other university.

3. This thesis does not contain any other persons' data, pictures, graphs or other information, unless specifically acknowledged as being sourced from those persons.

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ABSTRACT

Iron deficiency anaemia (IDA) is a global public health challenge, most prevalent in developing countries, including Zimbabwe. It mostly affects young children and women of childbearing age, particularly pregnant women. In the developing world, unbalanced diets which lack haem-iron from animal sources due to high costs, predisposes many pregnant women to IDA. Most women usually enter pregnancy with already depleted iron stores, consequently resulting in high maternal mortality and morbidity, premature deliveries and low birth weight infants. Pregnant women with IDA have a high risk of complications at delivery and are also prone to infections. Therefore, to increase haemoglobin levels and prevent IDA, the World Health Organization (WHO) recommends a daily supplement of 60 mg of iron for all pregnant women for at least six months during pregnancy, until six weeks post-partum. This is meant to complement iron from the diet, because dietary sources of iron alone are inadequate to meet the iron requirements during pregnancy. However, there are many barriers to the acceptance and use of iron supplements among pregnant women. This is also exacerbated by poor knowledge on the importance of iron supplements during pregnancy. Mutare City, in Zimbabwe was chosen as the study site because there is a lack of published data on the use of iron supplements by pregnant women in this area. The aim of this study was to assess the knowledge and acceptance levels of iron supplements among pregnant women, attending Mutare City Clinic, Manicaland, Zimbabwe. The study also aimed to identify possible barriers to optimal use of iron supplements among the pregnant women. In addition, the study aimed to develop and test a nutrition education tool with the aim of creating awareness regarding the importance and use of iron supplements among pregnant women, thus improving acceptance and use of the supplements.

The objectives of the study were as follows: (i) To assess knowledge on the importance of iron supplements during pregnancy amongst pregnant women attending Mutare City Clinic, Manicaland, Zimbabwe. (ii) To assess the acceptance levels of iron supplementation given during pregnancy amongst pregnant women attending Mutare City Clinic, as perceived by nurses and pregnant women attending Mutare City Clinic for ante-natal care (ANC). (iii) To identify the barriers to optimal iron supplementation by pregnant women attending Mutare City Clinic. (iv) To ascertain from pregnant women attending Mutare City Clinic, the form of the nutrition education tool to be developed, the importance of the tool, information and language to be used in the tool. (v) To develop a nutrition education tool for pregnant women attending

Mutare City Clinic with the purpose of creating awareness of iron supplements. (vi) To test the developed nutrition education tool to determine its user-friendliness and acceptability among pregnant women attending the Mutare City Clinic.

A survey was conducted to assess knowledge and acceptance on the importance and use of iron supplements by pregnant women. A total of 103 pregnant women, aged 16-36 years participated in the study and were selected on the basis of being either in their second or third trimesters of pregnancy, and attending Mutare City Clinic for ante-natal care (ANC). It was found that the pregnant women had inadequate nutrition knowledge to motivate them to consistently take iron supplements. Most pregnant women appreciated the importance of iron supplements, but lacked detailed knowledge to substantiate their need for taking them. The study therefore recommends early ANC booking and commencement of iron supplementation, as well as adequate nutrition education for pregnant women.

To identify barriers preventing optimal use of iron supplements by pregnant women, eight focus group discussions (FGD) were conducted, with 64 women, aged 17-39 years. Major barriers preventing the optimal use of iron supplements included erratic supplies at healthcare centres, cultural and religious influences and side-effects associated with supplements and poverty. Ignorance due to inadequate nutrition education and poor communication between nurses and pregnant women, were other notable barriers. The erratic availability of iron supplements at the healthcare centre resulted in many women not taking supplements because they could not afford to buy them from private pharmacies. However, in the few instances when supplies were available at healthcare centres, some women collected iron supplements but did not use them, while some managed to use the supplements consistently. Therefore, continuous reinforcement of positive supplementation practices is recommended to motivate for compliance among pregnant women. Adequate nutrition education and counselling is necessary for promoting awareness regarding the importance of iron supplements, dietary diversity and management of side-effects. Improvements in the procurement and delivery system at a national level will help to ensure timeous provision of iron supplements to healthcare centres.

Sixty-seven pregnant women in their second and third trimesters were purposively sampled to participate in eight FGDs on the development of a nutrition education tool. Pregnant women gave their views on the nutrition education tool they most preferred and the most appropriate language and information to include. The pregnant women indicated that a pamphlet was the

most preferred form of nutrition education tool, with English as the preferred main language of communication, along with some Shona phrases for clarification. Three extra FGDs were conducted with 28 pregnant women to test the developed nutrition education tool for acceptability and user-friendliness by pregnant women. It was found that good use of images which are culturally sensitive, appropriate use of colours, and labelling foods in both English and Shona enhanced the identification of foods, thus improving acceptability of the developed pamphlet. Earlier results obtained from both nurses and pregnant women revealed that most pregnant women did not receive adequate nutrition education on the importance and use of iron supplements during pregnancy, leading to poor compliance. Late ANC bookings at healthcare centres affected the initiation of iron supplementation. Thus, the development of a nutrition education tool for use by pregnant women could enhance knowledge on the importance of iron supplementation, since most women had inadequate nutrition knowledge. Intensive nutrition education programmes, routine iron supplementation and use of the developed nutrition education pamphlet are recommended to reduce the prevalence of IDA among pregnant women in Zimbabwe.

This study has shown that issuing iron supplements without an accompanying nutrition education tool may not effectively alleviate maternal IDA. Poor compliance with iron supplementation regimens remains a challenge because of several barriers, which also include inadequate baseline knowledge among pregnant women. Therefore, the development of a nutrition education tool is a positive move towards improving compliance, especially if the tool is offered to pregnant women timeously. The study has indicated that the tool may likely enhance understanding by consolidating nutrition education conducted at healthcare centres and iron supplements given to pregnant women. However, erratic supplies of supplements remains a challenge, as well as delayed ANC bookings by many pregnant women. Thus, this study has shown that offering a nutrition education pamphlet along with iron supplements, has the potential to create awareness and motivate towards compliance with iron supplements. This has the potential to reduce the prevalence of maternal IDA amongst pregnant women in Zimbabwe and sub-Saharan Africa.

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DEDICATION

This thesis is dedicated to my parents, Patterson and Loice Musendo.

To my father (1941-1995), thank you for having confidence in the girl child.

To my mother, thank you for travailing for my education. I am glad to be sharing this experience with you.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

ABBREVIATIONS

AGG:	Australian Government Geoscience
ANC:	Ante-Natal Care
ATP:	Adenosine Tri-Phosphate
BCC:	Behaviour Change Communication
CDC:	Centers for Disease Control and Prevention
CEFA:	Chemistry Explained, Foundations and Applications
DALYs:	Disability Adjusted Life Years
DDM:	Dietary Diversification and Modification
DFID:	Department for International Development
FAO:	Food and Agriculture Organization of the United Nations
FBC:	Full Blood-cell Count
Fe:	Iron
FGD:	Focus Group Discussion
FNC:	Food and Nutrition Council
Hb:	Haemoglobin
HIV:	Human Immuno-deficiency Virus
ID:	Iron Deficiency
IDA:	Iron Deficiency Anaemia
IFA:	Iron and Folic Acid
INACG:	International Nutritional Anaemia Consultative Group
IPHN:	Institute of Public Health Nutrition
IPT:	Intermittent Preventive Treatment
LBW:	Low Birth Weight
MDH:	Minnesota Department of Health
MFD:	My Food Diary
MOHCC:	Ministry of Health and Child Care

NIH:	National Institute of Health
NRHM:	National Rural Health Missions
RDAs:	Recommended Dietary Allowance
RSC:	Royal Society of Chemistry
SIC:	Sister in Charge
SRCD:	Society for Research and Child Development
SSA:	Sub-Saharan Africa
SDG:	Sustainable Development Goal
UNICEF:	United Nations Children's Fund
US:	United States
USAID:	United States Agency International Development
WHO:	World Health Organization
ZNAP:	Zimbabwe National Anaemia Profile

CHAPTER 1

INTRODUCTION, THE PROBLEM AND ITS SETTING

1.1 Introduction and background to the study

Iron deficiency anaemia (IDA) is a global public health nutritional deficiency that particularly affects developing countries [World Health Organization (WHO) 2015; Noronha, Khasawneh, Sheshan, Ramasubramaniam & Raman 2012; WHO 2012]. Although strategies to alleviate IDA have been in place for the past 30 years, it is one of the most intractable public health concerns. There is more evidence of IDA in developing countries compared to developed countries, due to unaffordable iron (Fe) food sources [Food and Agriculture Organization of the United Nations (FAO), the International Fund for Agricultural Development (IFAD) & World Food Program (WFP) 2012]. Out of the 870 million people who suffered from chronic undernutrition between 2010 and 2012, the majority (852 million), lived in developing countries (FAO *et al* 2012). Therefore, almost a billion people are believed to be lacking micronutrients that include vitamins as well as minerals, resulting in many nutritional disorders [Department for International Development (DFID) 2012; Noronha *et al* 2012; United Nations (UN) 2011; WHO 2010].

An inadequate intake of iron (Fe) results in IDA (Rashash & Abbas 2015; WHO 2015; Kawai, Spiegelman, Shankar & Fawzi 2011). Iron deficiency anaemia is rife in the world, with pregnant and lactating women, as well as infants being the most vulnerable (Gautam, Saha, Sekhri & Saha 2008). The most affected world regions are sub-Saharan Africa (SSA) and Asia (WHO 2015; WHO 2010; Sanghvi, Harvey & Wainwright 2010). The high prevalence of IDA is associated with substantial health and economic costs (Ugwu, Olibe, Obi & Ugwu 2014; Nobili, Alisi, Panera & Agostonic 2008; Yekta, Ayatollahi, Pourali & Farzin 2008). Iron supplementation is an under-resourced, yet affordable intervention for the alleviation of IDA among pregnant women. According to the WHO (2010), iron supplementation may help to reduce the maternal mortality rate. This will help to achieve the Sustainable Development Goal (SDG) three (UN 2015). The SDG three is a United Nations development programme aimed at improving health or well-being, as well as the standard of living for all people internationally (UN 2015). It is of concern that a substantial number of countries have not done much to address IDA, with SSA and South Asia being the most affected (DFID 2012).

According to Sanghvi *et al* (2010) and Yekta *et al* (2008), the prevalence of IDA amongst pregnant women has not declined significantly in spite of the policies within many countries that seek to provide women with iron supplements. The highest prevalence of 61.1% is found in SSA, followed by that of South East Asia (52.5%) (Sanghvi *et al* 2010; Yekta *et al* 2008). This has contributed to a high prevalence of maternal mortality and morbidity, low birth weight infants and infant mortality (Noronha *et al* 2012; WHO 2010). Therefore, the lives of many pregnant women have been put at risk because of IDA (Gebre & Mulugeta 2015; Nobili *et al* 2008; Gautam *et al* 2008). The challenge still remains in achieving SDGs one and two, which are aimed at 'eradicating extreme poverty and hunger by 2030' [UN 2015; FAO *et al* 2012; United Nations Children's Fund (UNICEF) 2011; Sanghvi *et al* 2010; Yekta *et al* 2008].

Iron is a micromineral, implying that it is needed by the body in trace amounts. A micromineral, also known as a trace mineral is defined as a mineral for which daily nutritional needs are less than 100 mg [Chemistry Explained, Foundations and Applications (CEFA) 2016; Helmenstine 2016; Zamora 2016]. In spite of iron being a micromineral, iron is still deficient in the diets of many pregnant women in developing countries. Inappropriate and inadequate dietary intake, wide variation in bioavailability, poor state of health, as well as closely spaced multiple pregnancies are also known to cause IDA [University of California San Francisco (UCSF) 2015; Noronha *et al* 2012; Peña-Rosas, De-Regil, Dowswell & Viteri 2012; Gautam *et al* 2008]. Women of child-bearing age are recommended to eat foods high in haem-iron which comes from animal sources, as well as other nutrients that enhance iron absorption, in order to prevent IDA [United States Department of Agriculture (USDA) and US Department of Health and Human Services (USDHHS) 2010].

Iron is an essential micronutrient that is found in every living cell (Helmenstine 2016; Yinon 2016; Peña-Rosas *et al* 2012). It is the fourth most abundant element on Earth, accounting for 4.7% of the Earth's crust, and having the longest history among all micronutrients [CEFA 2016; Helmenstine 2016; Iron Mineral Data (IMD) 2016; Linus Pauling Institute (LPI) 2016]. According to Helmenstine (2016), iron is an element that has been known in its pure form for a very long time. The human body derives its iron from blood though some is present in every cell bound to iron-containing enzymes. For life processes to be sustained in a human being, the body relies on blood. All the body cells, organs and even body systems can only operate with total dependence on blood. Blood is made up of a liquid component called plasma and other components called red blood cells, white blood cells, and platelets [LPI 2016; My Food Diary

(MFD) 2016; Minnesota Department of Health (MDH) 2014]. According to Gupta (2014), blood is the medium for the transportation of nutrients to body cells and it also transports oxygen and hormones. Blood is known to facilitate the removal of waste from cells together with cells that help to fight infection (LPI 2016; Rashash & Abbas 2015; Gupta 2014).

Anaemias are conditions in which the number of red blood cells is reduced or when the haemoglobin (Hb) level falls below normal (Cox 2016; WHO 2015). Haemoglobin, which is the red pigment of blood, is manufactured from iron. It is a protein that carries oxygen and enables the blood to deliver it to all parts of the body (Lukacs Jnr 2017; Gupta 2014). This implies that if there are low levels of red blood cells, the outcome would be reduced Hb levels. This may be due to a serious loss of blood or in some instances, sickle cell anaemia, where red blood cells are rendered useless (Zamora 2016; Brunori & Miele 2015; Gupta 2014). This could also be due to a decrease in the production of red blood cells due to malfunctioning bone marrow or a diet lacking in iron (Cox 2016; Zamora 2016). In some cases, anaemia results when an increase in iron requirements is not met. For example, in pregnant women, where an iron-rich diet is required to facilitate fetal growth as well as maternal needs [LPI 2016; National Institute of Health (NIH) 2016; Kawai *et al* 2011]. Iron deficiency anaemia occurs in circumstances when the concentration of red blood cells (haematocrit) in a given blood volume diminishes to levels below 34% (Cox 2016; WHO 2015; Kawai *et al* 2011).

In pregnancy, IDA is diagnosed when Hb concentration is less than 11 g/dl. It is considered severe when the Hb concentration is less than 7.0 g/dl, moderate when Hb falls between 7.0 and 9.9 g/dl and mild when the Hb is between 10.0 and 10.9 g/dl (Cox 2016; Gebre & Mulugeta 2015; Rashash & Abbas 2015). Various sociocultural problems like illiteracy, poverty, lack of awareness, cultural and religious taboos, poor dietary habits and a high prevalence of parasitic infestation are also major contributory factors to IDA in SSA (Brannon & Taylor 2017; Gebre & Mulugeta 2015; Peńa-Rosas *et al* 2012). Severe IDA has been the major cause of illness and death among many mothers and infants, as well as among low birth weight (LBW) babies (Rodriguez-Bernal, Rebagliato & Ballester 2014; Noronha *et al* 2012; Kawai *et al* 2011).

According to Brannon & Taylor (2017), iron requirements are increased during pregnancy. This means that iron requirements are greater compared to the pre-pregnant state. The higher iron requirements gradually escalate after the first trimester to meet the needs of the mother and growing fetus. The total estimated increase is 800 mg of elemental iron with 300 mg being

used for the fetus and placenta, while the remaining 500 mg is meant to increase Hb levels in the mother (NIH 2016; Gautam *et al* 2008). Gautam *et al* (2008) emphasise that the iron requirements of the placenta and the fetus are a priority, such that even if the mother is iron deficient, the dietary intake will be diverted to meet such requirements. The iron requirements of approximately 1000 mg expected during pregnancy certainly exceed the iron stores of most women, even in Western countries. All of this iron is used during the last half of the pregnancy, thereby increasing the daily iron requirements as the pregnancy progresses (Brown, Isaacs, Krinke, Lechtenberg & Murtaugh 2017, p119; LPI 2016; NIH 2016; Gautam *et al* 2008). The UCSF (2015) also confirms that there is a higher requirement for red blood cells in late pregnancy in order to meet the needs of the mother and fetus. Therefore, iron levels have to be increased since it is an essential component of haematocrit. These increased levels of iron cannot be made by the body and must be obtained from food sources. It is generally a challenge for the pregnant woman to obtain sufficient iron required during pregnancy. Failure to get enough iron during pregnancy affects both the pregnant woman and the fetus (Noronha *et al* 2012; Thomas, Grunnet, Poulsen, Christopher, Spurgeon, Inbakumari, Livingstone, Alex, Mohan, Anthonisamy, Geethanjali, Karol, Vaag & Bygbjerb 2012; WHO 2010). Iron deficiency anaemia also affects fetal growth and increases infant and maternal mortality. In cases where infants survive, the detrimental effects of under nutrition can be life-long (Rodriguez-Bernal *et al* 2014; Thomas *et al* 2012; WHO 2012; UN 2011).

Since the cost of undernutrition is high, improving nutrition is critical (DFID 2012). The percentage of mother and child undernutrition stands at 11% of total global 'Disability-Adjusted Life Years' (DALYs), which is a uniform measure of the human burden of death and illness (DFID 2012; Bhutta, Ahmed, Black, Cousens, Dewey, Giugliani, Haider, Kirkwood, Morris, Sachdev & Shekar 2008). The WHO (2012) highlights that the diets of many people, especially infants and women of child-bearing age, lack iron. Therefore the small amount absorbed will not meet all individual requirements. Brannon & Taylor (2017) state that even with a well-balanced diet, the amount of iron absorbed is usually very limited and not enough to meet the needs of pregnancy as it progresses. Although the absorption of iron increases during pregnancy, it is influenced by the form of iron consumed, as well as other dietary components, which either promote absorption or binding of iron (LPI 2016; WHO 2012).

Haem iron, which comes from meat, is more easily absorbed compared to non-haem iron from vegetables and some meat products (LPI 2016; Kawai *et al* 2011). However, haem iron food

sources are generally expensive, resulting in poor consumption in developing countries. This predisposes many people in developing countries, especially in SSA including Zimbabwe, to the risks of IDA, with mothers and infants being the most vulnerable (Stewart 2016; FAO *et al* 2012; WHO 2012). Consumption of cheaper iron sources such as offals, legumes, dark green vegetables and a variety of fruits may help to address IDA. In addition, cast iron cookware can add iron to the food (UCSF 2015; Fall, Fisher, Osmond, Margetts & Maternal Micronutrient Supplementation Study Group 2009). In light of this, women are generally encouraged to boost their iron levels and lay a strong iron foundation before entering pregnancy. Since diet alone cannot sufficiently meet maternal and infant iron needs, the deficit can only be met by iron supplementation (Da Silva Lopes, Takemoto, Garcia-Casal & Ota 2018; Ugwu *et al* 2014; WHO 2012).

The UN advocates for various nutrient supplementation interventions in order to improve the health of both mothers and infants (UN 2011). One such intervention is iron supplementation, which has been used by most third world countries to raise Hb levels and blood volume (WHO 2015; WHO 2012). Iron supplements play a critical role in boosting iron levels in pregnant women, in both developed and developing countries alike (WHO 2017; Ugwu *et al* 2014; WHO 2012; Gadaga, Madzima & Nembaware 2009). Since dietary iron is usually consumed in very small amounts, iron supplements help by quickly treating and correcting IDA in people of all races, sexes, ages and health conditions (UCSF 2015; WHO 2012). Gautam *et al* (2008) add that iron supplementation is generally affordable for pregnant women, even in developing countries. Due to the demands imposed by pregnancy, iron supplementation is recommended universally, even in non-anaemic women (WHO 2017; WHO 2012). The way in which pregnant women respond to the supplements is determined by the dosage taken and the haemoglobin level prior to pregnancy (LPI 2016; NIH 2016).

The WHO recommends that pregnant women be given 60 mg of elemental iron daily from the beginning of the second trimester (WHO 2016a; WHO 2012; Sanghvi *et al* 2010; Gautam *et al* 2008). This international recommendation was based on the fact that 115 000 maternal deaths occur worldwide per year, due to micronutrient deficiencies, including iron (WHO 2016a; WHO 2012). According to Rodriguez-Bernal *et al* (2014), women should embark on a low, then moderate dosage of iron at the onset of pregnancy, as this promotes good fetal growth and development, regardless of maternal iron status. This will also facilitate a healthy outcome in the mother, thus minimising the risks of maternal death, miscarriage and low birth weight.

Sanghvi *et al* (2010) add that iron and folate supplements, which work by increasing Hb levels, will also help to prevent disorders such as neural tube defects in infants. In other words, women should avoid conceiving when they have low iron stores; and once they are pregnant, they should gradually increase their intake of iron as the pregnancy progresses (Da Silva Lopes *et al* 2018; WHO 2010). Iron supplementation should continue well after delivery to rebuild the depleted iron stores (UCSF 2015; WHO 2016a; WHO 2012).

Fall *et al* (2009), also comment on the efficacy of multiple micronutrients (MMN), based on two reviews, where it was established that iron and folate supplementation in pregnancy yielded positive outcomes on infant birth weight. In other words, in regions where IDA remains high among pregnant women, iron supplementation remains the only key to combating IDA (WHO 2015; WHO 2012). Iron supplementation during pregnancy can reduce the extent of iron depletion in the third trimester. However, for women entering pregnancy with low iron stores, iron supplements often fail to prevent IDA (WHO 2016b; WHO 2015; WHO 2012). This therefore implies that iron supplementation at the onset of pregnancy, until delivery can help prevent iron deficiency (WHO 2015). However, according to the WHO (2012), optimal iron supplementation has been hindered by the failure of women to take supplements regularly. This may be triggered by physiological side-effects or a lack of knowledge regarding the importance of iron supplements to the health of the mother and fetus. Sometimes, the unavailability or inadequate supply of supplements can be barriers to the effectiveness of these interventions (Nisar, Alam, Aurangzeb & Dibley 2014; Ugwu *et al* 2014; WHO 2012). A review by Peńa-Rosas *et al* (2012), revealed that intermittent iron supplementation either with folate or other nutrients was a better alternative, compared to the daily intake of iron supplements. This is because intermittent iron and folic acid regimens reach the body in reduced concentrations as they are not taken daily. Thus, with intermittent regimens, there are limited disorders or side-effects as the Hb levels rise in the last half of pregnancy (WHO 2016b; WHO 2015; WHO 2012).

Zimbabwe is one of the developing countries in SSA. The economy of the country is still developing and as such, is still poor in a number of areas, such as the availability of adequate nutrition education and resources in the health sector. The country faces procurement and delivery challenges with supplies, such as iron supplements to healthcare centres. The availability of adequate balanced diets among households is usually disturbed by poverty and inadequate nutrition information, with women and children being the most affected by

malnutrition. The Food and Nutrition Policy launched in Harare on 17 May 2013 revealed that 47% of Zimbabwean women in the childbearing category were undernourished, and 52% were anaemic [Food and Nutrition Council (FNC) 2013]. These statistics pose a threat to the health of the nation because anaemic women will also give birth to anaemic infants. There is a lack of information regarding why iron supplementation remains a challenge, even in cases where supplements are readily available [Dwyer, Coates & Smith 2018; Ministry of Health and Childcare (MOHCC) 2012]. The majority of pregnant women were not aware of the reasons why they were being given the iron supplements or when they should start or stop taking the supplements [Dwyer *et al* 2018; Food and Drug Administration (FDA) 2017]. Others feel it is for those with compromised health, while others affiliate to religions that do not permit the use of medications, including supplements. This has contributed to high infant and maternal mortality and morbidity rates in developing countries, including Zimbabwe (FDA 2017; DFID 2012; FAO *et al* 2012; WHO 2010). There is a lack of research on knowledge, acceptance and barriers to optimal use of iron supplements amongst pregnant women attending Mutare City Clinic in Manicaland, Zimbabwe. Therefore there was a need for this study amongst pregnant women attending Mutare City Clinic in Manicaland, Zimbabwe.

1.2 Aims of the study

A lack of iron during pregnancy is known to cause IDA, low birth weight and increased maternal and infant morbidity and mortality (Cox 2016; Stewart 2016; Gupta 2014). This is especially so in developing countries, like Zimbabwe. Iron is obtained from the foods eaten, which are usually not enough to meet the needs of pregnant women. Therefore, there is a need for pregnant women to take iron supplements during pregnancy in order to prevent IDA (WHO 2012). The aim of this study was to assess the knowledge and acceptance of iron supplements among pregnant women, attending Mutare City Clinic, Manicaland, Zimbabwe. The study also aimed to identify possible barriers to optimal use of iron supplements by pregnant women. A further aim of the study was to develop and test a nutrition education tool with the aim of creating awareness regarding the importance and use of iron supplements among pregnant women, thus improving acceptance and use of the supplements.

1.3 Objectives of the study

The study objectives were as follows:

1.3.1 To assess knowledge on the importance of iron supplements during pregnancy amongst pregnant women attending Mutare City Clinic, Manicaland, Zimbabwe.

1.3.2 To assess the acceptance levels of iron supplementation given during pregnancy amongst pregnant women attending Mutare City Clinic, as perceived by nurses and pregnant women attending Mutare City Clinic for ante-natal care (ANC).

1.3.3 To identify the barriers to optimal iron supplementation by pregnant women attending Mutare City Clinic.

1.3.4 To ascertain from pregnant women attending Mutare City Clinic, the form of the nutrition education tool to be developed, the importance of the tool, information and language to be used in the tool.

1.3.5 To develop a nutrition education tool for pregnant women attending Mutare City Clinic with the purpose of creating awareness of iron supplements.

1.3.6 To test the developed nutrition education tool to determine its user-friendliness and acceptability among pregnant women attending the Mutare City Clinic.

1.4 Study parameters and general assumptions

This study only included pregnant women in their second and third trimesters who were receiving ANC from Mutare City Clinic, Manicaland Province, Zimbabwe. Mutare City Clinic was the only study site used as it is central to the residents of Mutare and caters for the majority of residents and because there is a lack of published data on iron supplement use by pregnant women in this area. It was assumed that the pregnant women who were included in this study ranged from low to medium socio-economic status, thus representing the majority of the citizens. The researcher requested honest responses after explaining to the participants that the purpose of the study was not only academic, but was also driven by a great need in the Mutare community and in the scientific world at large. It was assumed that the majority of the participants gave honest responses.

1.5 Definitions of key terms

Acceptance: The act of agreeing to receive or take something offered (The Free Dictionary 2019).

Anaemia: A haemoglobin concentration more than two standard deviations below the mean for healthy individuals of the same age and stage of pregnancy (Harper 2019).

Ante-natal care: The care provided by skilled healthcare professionals to pregnant women and adolescent girls in order to ensure the best health conditions for both mother and baby during pregnancy (WHO 2016a).

Barriers: An obstacle or obstruction that restrains progress or access (Cambridge University Press 2019a).

Bioavailability: The proportion of a nutrient the human body is able to efficiently absorb and use (Group 2017).

Biofortification: A feasible, cost effective means of increasing bioavailability and concentration of micronutrients in crops through conventional plant breeding and recombinant deoxyribonucleic acid (DNA) breeding (Bouis 2018).

Compliance: The ability to act according to an order, set of rules or requests (Cambridge University Press 2019a).

Convenience sampling: A type of non-probability sampling where participants are taken from a group of people, who are easy to reach or to contact (Crossman 2018).

Developing countries: Low and medium income countries that are less developed industrially with a lower human development index, when compared to other countries (World Population Review 2019).

Fetus: An unborn offspring that develops inside the uterus (womb) from the embryo stage (eighth week after conception) until birth (National Cancer Institute 2019).

Fortification: Addition of micronutrients to foods to enrich or improve the nutritional status of a population (British Nutrition Foundation 2013).

Haemoglobin: A protein which is the main constituent of the red blood cells, serving as the oxygen carrying protein (Vutturi 2016).

Haem iron: Iron found in animal foods such as meat, seafood, and poultry. It is easily absorbed by the body (Kohn 2017).

Iron: A mineral and important component of haemoglobin, the main purpose of which is to carry oxygen in the haemoglobin of the red blood cells from the lungs to the tissues (Kohn 2017).

Iron deficiency anaemia: A severe nutritional deficiency whereby the body's iron stores become too low to support normal red blood cell production to carry oxygen efficiently (Harper 2019).

Iron supplementation: A preventive public health intervention of 60 mg/day elemental iron for six months among pregnant women in the second and third trimesters (WHO 2016b).

Knowledge: Familiarity or conversance with a particular subject or branch of learning (The Free Dictionary 2019).

Micronutrients: Nutrients needed by the body in small amounts and are critical for several important functions. These include vitamins and minerals (Streit 2018).

Minerals: Inorganic substances existing in soil or water that are required by the body in small amounts for a variety of functions, including bone and tooth formation and as constituents of body fluids and tissues (Streit 2018).

Non-compliance: Failure or refusal to obey or adhere to a set of rules or requests (Cambridge University Press 2019a).

Non-haem iron: Iron existing in plant foods such as spinach, legumes and grains. It is not as easily absorbed as haem iron (Kohn 2017).

Nurse: A professional who is trained to take care of individuals of all ages, families and communities, sick or well and in all settings to ensure promotion of health and prevention of illness (International Council of Nurses 2019).

Nutrition education: Any set of learning experiences designed to facilitate the voluntary adoption of eating and other nutrition related behaviours conducive to health and well-being (Food and Health Communications 2019).

Nutrition education tool: Materials or apparatus developed for use in nutrition education interventions to aid comprehension in the form of social media, mass media or print materials (Food and Health Communications 2019).

Optimal: The best or most effective that is possible in a particular situation (Cambridge University Press 2019b).

Pamphlet: A nutrition education tool consisting of a single sheet of paper printed on both sides, written in simple language, giving information on a particular subject and ideal for promoting awareness (Carter 2014).

Perinatal: The period commencing at 22 completed weeks (154 days) of gestation and ends seven completed days after birth (WHO 2019).

Postpartum: The period just after delivery or childbirth (Shiel 2018).

Prevalence: A statistical concept referring to the proportion of individuals in a population having a disease or the number of cases of a disease that are present in a particular population at a given time (Shiel 2018).

Pregnancy: The state of carrying a developing embryo or fetus inside a woman's womb or uterus over a period of 40 weeks (just over nine months). It is conventionally divided into three stages called trimesters (Shiel 2018).

Purposive sampling: A non-probability, judgemental or subjective selection of participants based on the characteristics of a population and objectives of the study (Crossman 2018).

Side-effects: Unwanted symptoms or adverse reactions that occur when treatment goes beyond the desired effect, ranging from mild to life threatening (NIH 2018).

State registered nurse: A person who has completed a program of basic generalised nursing education and is authorised by the appropriate regulatory authority to practice in his or her country (ICN 2019).

Sub-Saharan Africa: The geographical divide between northern Arab countries with the rest of Africa (Tapon 2019).

Trimester: One of the three divisions of three months each during pregnancy, in which different phases of fetal development take place (Shiel 2018).

Undernutrition: A nutrient deficiency from consumption of inadequate nutrients affecting the balance of all nutrients in the body (Parks 2019).

1.6 Thesis outline

The thesis is presented as follows:

Chapter 1: Introduction, the problem and its setting.

Chapter 2: Review of related literature.

Chapter 3: Study design, background to the study site and ethical approvals.

Chapter 4: Perceptions of nurses and pregnant women on knowledge and use of iron supplements during pregnancy.

Chapter 5: Barriers to optimal iron supplementation by pregnant women attending Mutare City Clinic, Manicaland, Zimbabwe.

Chapter 6: Development of a nutrition education tool on iron supplementation for pregnant women.

Chapter 7: Conclusions, study limitations and recommendations

The referencing style used in this thesis is in line with the guidelines of the Discipline of Dietetics and Human Nutrition, University of KwaZulu Natal, Pietermaritzburg.

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CHAPTER 2
REVIEW OF RELATED LITERATURE

This chapter reviews literature on the trace mineral iron, providing an overview, chemistry, sources and functions of iron. The prevalence, causes and effects of IDA in pregnant women are also discussed. Strategies for preventing IDA in pregnancy are also identified and deliberated. The critical role of iron supplementation in pregnancy is discussed together with possible barriers to optimal iron supplementation by pregnant women. Strategies for overcoming barriers to optimal iron supplementation in pregnancy are also deliberated. The chapter also reviews the role of nutrition education tools in improving compliance with iron supplementation regimens, as well as the procedures for developing such tools for use by pregnant women.

2.1 Overview of iron

According to the Linus Pauling Institute (LPI) (2016), iron has the longest and best-described history among all micronutrients. This element has been known in its pure form for at least 5000 years. Its date of discovery is known to the ancients, however, the discoverer is unknown [Helmenstine 2016; The Royal Society of Chemistry (RSC) 2016; Yinon 2016]. Iron was first recognised as a body constituent in 1713 and later identified in the metalloprotein haemoglobin. Haemoglobin is now known to bind to oxygen molecules, thus facilitating oxygen transport in blood. The name ‘iron’ comes from the Anglo-Saxon word ‘iren’ and Scandinavian “iarn” for metal [Helmenstine 2016; Iron Mineral Data (IMD) 2016; RSC 2016]. The element symbol for iron is ‘Fe’ and is derived from the Latin word ‘ferrum’, which means iron [Australian Government Geoscience (AGG) 2016; Helmenstine 2016; IMD 2016; Yinon 2016]. Iron is one of the most plentiful elements and is the fourth most abundant element in the earth’s crust, estimated to range from 4.7 to 5.6% [Chemistry Explained, Foundations and Applications (CEFA) 2016; Helmenstine 2016; Gupta 2014].

2.1.1 Chemistry of iron

Iron is a trace mineral element which is needed in small quantities of less than 20 mg daily (CEFA 2016; Gupta 2014). The chemical and empirical formulae for iron is Fe and Fe^{0+}, respectively, while the molecular weight is 55.85 g. Iron has an atomic number of 26, with four energy levels and 30 neutrons (CEFA 2016; Yinon 2016). It has eight isotopes and its average density @ 293K is 7.86/cm^3. The melting point for iron ranges from about 1 535°C to 1 538°C, while its boiling point ranges from 2 750°C to 2 861°C (CEFA 2016; IMD 2016; RSC 2016;

Stewart 2016; Yinon 2016). Iron has a cubic crystal structure and its colour ranges from iron black, dark grey, blue-grey and steel grey to silvery grey (IMD 2016; RSC 2016; Yinon 2016). It is a group eight transitional metal, found in steel and many other alloys, as well as in the pure form (Figure 2.1) [Helmenstine 2016; IMD 2016; National Institute of Health (NIH) 2016].

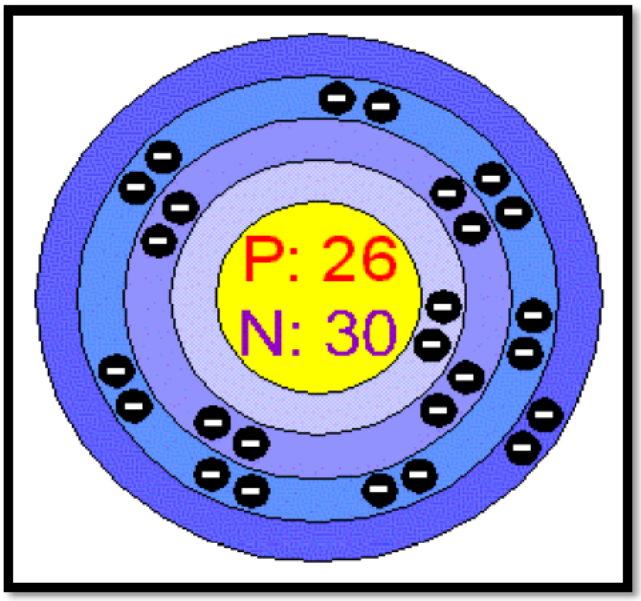

Figure 2.1: Atomic structure of iron (Yinon 2016)

Iron primarily forms compounds with +2 and +3 oxidation states. When iron is oxidised from ferrous ion to ferric ion ($Fe^{2+} \rightarrow Fe^{3+}$), there is a loss of one extra electron. As a result, the ferric ion (Fe^{3+}) has a smaller size than the ferrous ion (Fe^{2+}) (AGG 2016; CEFA 2016; Gupta 2014). The most common iron compounds are iron oxide (Fe_2O_3), iron sulphide (FeS), iron chloride ($FeCl_3$), iron fluoride (FeF_3) and iron bromide ($FeBr_3$) (AGG 2016; Helmenstine 2016). According to Gupta (2014), most trace minerals occur in the body bound to organic compounds on which they depend for transport, storage and functioning. In this case, iron is found in the haem portion of haemoglobin (Hb). Haemoglobin can exist in the oxygenated or deoxygenated form and binds oxygen less tightly than myoglobin in muscle tissues. Iron can also occur in transferrin, ferritin, iron containing porphyrins and myoglobin. Virtually all of the body's iron exists in combination with protein molecules (Zamora 2016; Gupta 2014). According to Vutturi (2016), haemoglobin and myoglobin are dioxygen-binding metalloproteins containing an iron porphyrin system. They both contain Fe (ii) ions (Vutturi 2016; Williams 2011, p15). Haemoglobin releases oxygen in areas of low concentration such as tissues, thus effectively transporting oxygen throughout the body. It contains four haem units, each embedded in a

globular protein sub-unit. There are two types of protein sub-units, α and β in the structure of haemoglobin, as illustrated in Figure 2.2a. Figure 2.2b illustrates the oxygenated and deoxygenated forms of haemoglobin.

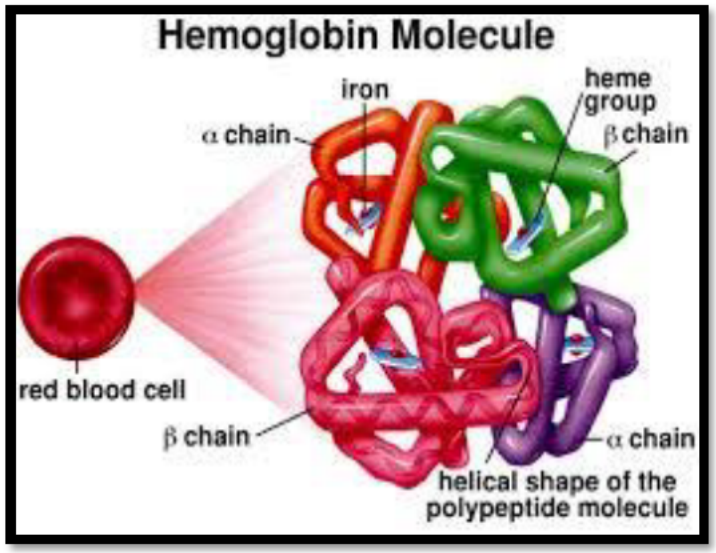

Figure 2.2a: Structure of haemoglobin (Lukacs Jnr 2017)

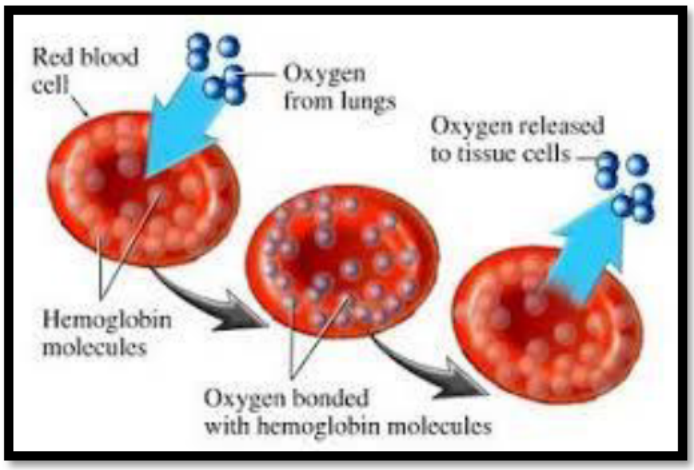

Figure 2.2b: Oxygenated and deoxygenated haemoglobin (Lukacs Jnr 2017)

Figure 2.3 illustrates the structure of myoglobin, in which iron can occur. Myoglobin is a dioxygen-binding metalloprotein, like haemoglobin (Vutturi 2016; Gupta 2014).

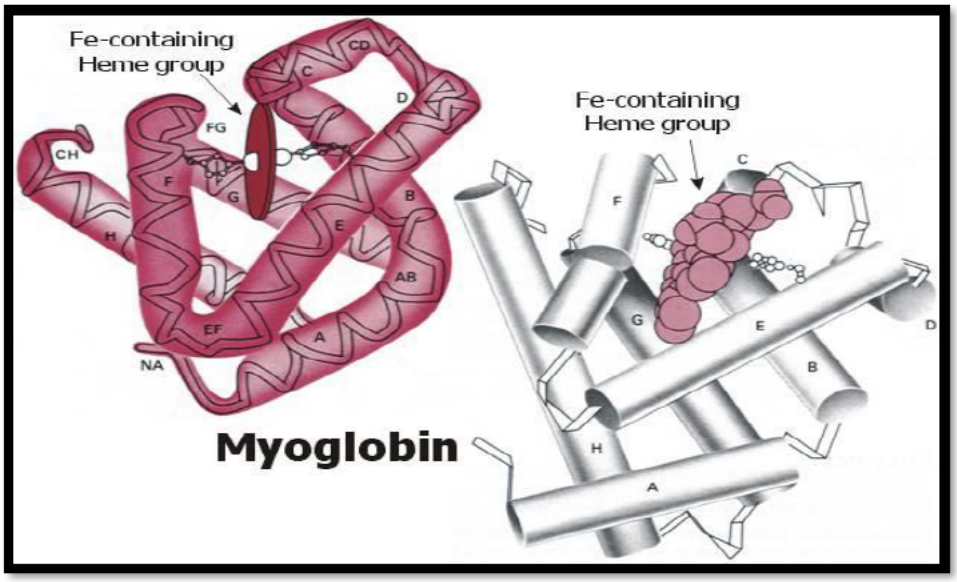

Figure 2.3: Structure of myoglobin (Lukacs Jnr 2017)

2.1.2 Stability of iron

According to Hutto (2017), minerals such as iron and zinc are not affected by temperature and are regarded as heat stable. They cannot be destroyed by light, water, heat or food-handling processes (LPI 2016). In fact, the little bit of ash that remains when any food is completely burned, is the mineral content. While cooking and food processing have the potential to alter the nutritional quality of foods, the bioavailability of some minerals, for example iron, may actually be increased by cooking (Hutto 2017; Pereira, Carvalho, Dellamora-Ortiz, Cardoso, Carvalho, Viana, Freitas & Rocha 2014). According to Hutto (2017), there is a five-fold increase in the iron content of foods cooked in cast iron cookware. Thus, the use of iron cookware could be a simple way of increasing dietary iron intake. Studies on mineral retention in cooked meats, revealed that zinc, copper and iron are the most stable minerals. This implies that because most meats are rich sources of iron, their bioavailability is guaranteed (Hutto 2017; Pereira *et al* 2014). When iron and temperature are increased together, the resulting interactive effects are greatly magnified. A negative result is observed on the effect of acids on the oxidation of ferrous sulphate accordingly, implying that iron is a very stable mineral (LPI 2016; Rose, Feng, Di Tullio, Dunbar, Hare, Lee, Lohan, Long, Smith Jr, Sohst, Tozzi, Zhang & Hutchins 2009; Kim, Pradhan, Park, Ahn & Lee 2008).

2.1.3 Sources of iron

According to the NIH (2016), iron is a mineral that is naturally present in many foods, added to some food products and available as a dietary supplement. There are two types of iron in the

human diet; haem iron and non-haem iron. Haem iron is derived from the breakdown of haemoglobin and is only found in meat and animal products. Non-haem iron is found in plant-based foods such as fruit, vegetables and beans, as well as in animal products such as milk and eggs [Marini 2017; My Food Diary (MFD) 2016; Minnesota Department of Health (MDH) 2014; Stoltzfus 2011]. According to the NIH (2016), plant and iron-fortified foods contain non-haem iron only, whereas, meat, seafood and poultry contain both haem and non-haem iron. Haem iron forms 10% to 15% of the total iron intakes in Western populations (Marini 2017; MFD 2016; NIH 2016). Since animal sources contain haem iron, which is the most bioavailable form, they are the best sources of dietary iron. Liver is the richest source of iron, with 200 g of liver providing a one day supply of iron for an adult (Marini 2017; Petre 2017; Mikstas 2016; Williams 2011, p15). Other very good sources include organ meats such as kidney as well as red meat, chicken, pork and seafood such as oysters. Good plant food sources include spinach and legumes such as soyabeans, kidney beans and chickpeas. Tofu, strawberries, iron-enriched breads, fortified cereals and ready-to-eat breakfast cereals are also good iron sources. Other good sources of iron include lean meats, shellfish, poultry, egg yolks, nuts, dark green leafy vegetables, broccoli, turnip greens, beet greens, carrot, apricots, whole grains, poultry, fish and dried fruit (Petre 2017; MFD 2016; Mikstas 2016; Zamora 2016; Williams 2011, p15). Marini (2017) also identified sesame seeds, pumpkin seeds and lentils as important iron sources. The consumption of a wide variety of foods in balanced proportions guarantees a balanced diet which provides all of the essential minerals, including iron (Marini 2017; Mikstas 2016).

2.1.4 Functions of iron in the body

Iron is probably the most widely used metal today and no other metal is available to replace it in its functions. It has numerous functions vital for body processes. It is thus indispensable for human life (Gupta 2014). Iron is necessary for improvement in health or growth and is needed in sufficient amounts commensurate with the normal functioning of the body. The major functions of iron are discussed further in this section.

2.1.4.1 Oxygen transport (haemoglobin)

Iron is a key element in the metabolism of almost all living organisms and is present in each body cell for healthy functioning (AGG 2016; LPI 2016; MFD 2016; Gupta 2014). The MDH (2014), states that iron gives red blood cells the capacity to carry oxygen to all organs. As such, a constant and small intake of iron in food is needed to replace erythrocytes that are destroyed in the body, in a process called haematopoiesis (Gupta 2014). Iron is found in larger amounts

in the blood than any other mineral (Culvert & Brody 2016). It is the metal complex that binds molecular oxygen in the lungs and carries it to all cells in the body (LPI 2016; Gupta 2014). About 70% of the body's iron is found in the red blood cells as part of haemoglobin and in muscle cells as myoglobin [Mursa & Kathleen 2017; University of California San Francisco (UCSF) 2017; AGG 2016; Cox 2016; LPI 2016]. Iron is involved in oxygen transportation. It is distinguished as an essential component in the synthesis of haemoglobin, an erythrocyte protein that picks up oxygen in the lungs and transfers it from the lungs to the tissues and to every cell in the body (Mursa & Kathleen 2017; CEFA 2016; Culvert & Brody 2016; NIH 2016; Gupta 2014). In the cells, oxygen is used to produce the energy that the body needs to survive, to grow and stay healthy (CEFA 2016). The vital role of haemoglobin in transporting oxygen is derived from its unique ability to acquire oxygen rapidly during the short time it spends in the lungs, and to release oxygen as needed during its circulation through the tissues (LPI 2016). Iron is widely distributed in the red blood cells with almost two thirds of the body's iron found in haemoglobin. Some iron is stored in the bone marrow and only a small portion goes to other cells in the liver, blood and spleen (CEFA 2016; LPI 2016; Stewart 2016; Gupta 2014).

2.1.4.2 Oxygen storage (myoglobin)

Iron, being a component of myoglobin, supports metabolism (Brown, Isaacs, Krinke, Lechtenberg & Murtaugh 2017, p119; Stewart 2016). According to Stewart (2016), myoglobin is a water-soluble, 153 single-polypeptide chain that helps to store oxygen in muscles. It is a very compact globular monomeric storage protein, mainly found in skeletal muscle tissue. Myoglobin consists of an eight α-helical chain linked with an oxygen-binding site (Figure 2.3). It yields a unique topology, referred to as the globin fold (Culvert & Brody 2016; Brunori & Miele 2015; Gupta 2014). Myoglobin possesses a haemo-prosthetic group which transports oxygen molecules to muscle tissues, thus helping to match the supply of oxygen to the demand of working muscles. It can exist as deoxy-myoglobin or as oxy-myoglobin and is mainly responsible for the red colour of muscle and blood (Culvert & Brody 2016; Stewart 2016; Brunori & Miele 2015; Gupta 2014; Williams 2011, p15).

Ferritin is a protein that stores iron and releases it in a controlled way to facilitate oxygen transportation in the blood (Brunori & Miele 2015; Gupta 2014). Oxygen carriers are needed because oxygen is a highly reactive element, which readily oxidises with metals in a two-oxidation state, due to its bi-radical electron configuration (Mursa & Kathleen 2017; Gupta

2014). It cannot diffuse very easily because humans have a thick layer of skin. There is also enough oxygen in blood to meet metabolic demands. Therefore, a good oxygen carrier binds to oxygen at a high affinity, does not oxidise cellular components but gives up oxygen on demand. Haemoglobin needs to have high affinity to bind oxygen in the lungs, but requires low affinity to unload to myoglobin (Vutturi 2016). The haemoglobin binds oxygen and not the protein. In this case, the role of the protein is to provide a crevice and prevent haemoglobin from oxidising (Brunori & Miele 2015; Gupta 2014). Both myoglobin and haemoglobin bind well when the concentration of oxygen in the lungs is high. However, myoglobin only releases oxygen in extreme conditions. It has a strong affinity for oxygen that does not change with concentration, and thus effectively stores oxygen in muscle tissue. This is particularly useful when the body is starved of oxygen, as in the case of anaerobic exercise (Vutturi 2016; Zamora 2016; Brunori & Miele 2015; Gupta 2014).

2.1.4.3 Regulation of growth, immune system, cell differentiation and electron transport

Iron is necessary for the regulation of growth and development, normal cell differentiation and maintenance of a healthy immune system (NIH 2016; Stewart 2016; Gupta 2014). Iron is also essential for respiration, immune function and cognitive development (Petre 2017; UCSF 2017). Iron is a constituent of cytochromes and other components of respiratory enzyme systems (CEFA 2016). Cytochromes are haem-containing compounds that have important roles in mitochondrial electron transport and are therefore critical in cellular energy production. They serve as electron carriers during the synthesis of adenosine tri-phosphate (ATP), which is the primary energy storage compound in cells (LPI 2016; Gupta 2014). As part of the immune response, some white blood cells engulf bacteria in order to kill them. This is catalysed by the haem-containing enzyme, myelo-peroxidase (LPI 2016). Iron salts and complexes, including ferrocholinate, ferrous fumarate, ferrous gluconate, ferrous sulphate and iron dextran, are used to treat IDA (Petre 2017; LPI 2016; Gupta 2014).

2.1.4.4 Enzyme, co-enzyme and antioxidant action

Iron forms a part of many enzymes and some proteins and compounds used by cells in energy production (UCSF 2017). Culvert & Brody (2016), highlight that minerals also function as co-enzymes. Since iron is a part of many enzymes, it participates in all enzyme reactions in the body, helping in the absorption and use of other nutrients (Culvert & Brody 2016; NIH 2016; MDH 2014). In humans, iron is also crucial in the synthesis of many proteins, hormones,

connective tissue and enzymes such as catalases, peroxidases and various cytochromes (LPI 2016; NIH 2016). Iron is critical for antioxidant functions. Catalases and peroxidases are haem-containing enzymes that protect cells against the accumulation of hydrogen peroxide, which is a potentially damaging reactive oxygen species (LPI 2016). According to LPI (2016), these enzymes achieve this by catalysing a reaction that converts hydrogen peroxide to water and oxygen.

2.1.4.5 DNA synthesis

Iron is also important in deoxyribonucleic acid (DNA) synthesis because ribonucleotide reductase is an iron-dependent enzyme. The proteins needed for DNA synthesis and cell division also rely on iron (Gupta 2014). Thus, iron is required for many vital functions, including growth, reproduction and healing (LPI 2016).

2.2 Iron deficiency anaemia

2.2.1 Definition

Iron deficiency anaemia (IDA) is the most common form of malnutrition in adults, most frequently found in women of childbearing age (Rashash & Abbas 2015; WHO 2015a). According to the WHO (2015a), IDA is characterised by low levels of Hb. It is a severe stage of iron deficiency (ID) in which Hb or haematocrit fall below the normal cut-off values (Hb is below 11.0 g/dL and haematocrit is below 33%) (Cox 2016; Rashash & Abbas 2015; Stoltzfus 2011; Gadaga, Madzima & Nembaware 2009). Iron deficiency anaemia occurs when body iron stores or the number of red blood cells are exhausted (LPI 2016). Haemoglobin enables red blood cells to carry oxygen from the lungs and deliver it to all parts of the body (Gupta 2014). Because anaemia reduces the number of red blood cells or Hb in them, the blood is unable to carry an adequate supply of oxygen, thus compromising the supply of iron to the tissues. During pregnancy this leads to increased maternal mortality and increased obstetrical complications (LPI 2016; Rashash & Abbas 2015; Stoltzfus 2011). Iron deficiency anaemia is also defined by a Hb level lower than two standard deviations below the mean distribution, in a healthy matched population. However, there are variations in what is considered normal values for pregnancy [UCSF 2017; Cox 2016; NIH 2016; Preedy, Srirajaskanthan & Patel 2013; Pavord, Myers, Robinson, Allard, Strong & Oppenheimer 2011].

2.2.2 Prevalence

Iron deficiency anaemia is the most common form of malnutrition worldwide, affecting almost two billion people globally (Stewart 2016; WHO 2015b; Ugwu, Olibe, Obi & Ugwu 2014; Pavord *et al* 2011; Stoltzfus 2011; Jönsson & Guha-Sapir 2009). It is most prevalent and severe in young children and women of reproductive age, which include menstruating, pregnant and lactating women (LPI 2016; MFD 2016; Stewart 2016; WHO 2015a; Raut, Jha, Shrestha, Sah, Sapkota, Byanju & Malla 2014; Ugwu *et al* 2014; Stoltzfus 2011). The prevalence of IDA among pregnant women in developing countries has remained unacceptably high over the past three decades (WHO 2015b; WHO 2012). A study of nine countries revealed that anaemia is widespread, affecting more than 45% of women in countries such as the Ivory Coast, The Gambia and Malawi (Mwangi, Phiri, Abkari, Gbane, Bourdet-Sicard, Braesco, Zimmermann & Prentice 2017).

The WHO estimates that approximately 58% of pregnant women in developing countries, are anaemic (WHO 2015b; Raut *et al* 2014; Ghada, Abdel-Moety & Yossra 2012; Yekta, Ayatollahi, Pourali & Farzin 2008). In the developing world, 47% of pregnant women in Africa, 39% in Latin America, 80% in South Asia, 65% in the Eastern Mediterranean and 40% in the West Pacific are estimated to be anaemic (WHO 2015b). This is despite the fact that most health ministries in developing countries have implemented policies to provide pregnant women with routine iron supplementation, to prevent maternal anaemia (WHO 2015b; Ugwu *et al* 2014; Yekta *et al* 2008).

The WHO and World Bank categorised countries based on the prevalence of anaemia into four groups. Normal prevalence countries (<5% prevalence) include Canada, Italy, Germany and France; low prevalence countries (5-19.9%) include England, the United States (US), New Zealand, Japan and Australia; medium prevalence countries (20-39.5%) include Iran, Pakistan and countries in North Africa and parts of central America, while high prevalence countries (more than 40% IDA prevalence) include India, central and southern Africa (WHO 2015b). Three quarter of deaths in Africa and Asia and 2.4% of disability-adjusted life years (DALYs) have been associated with anaemia (WHO 2015a; WHO 2015b; Ugwu *et al* 2014; Fathi Najafi, Latifnejad Roudsori & Hejazi 2014).

According to Jönsson & Guha-Sapir (2009), in Zimbabwe, the prevalence of anaemia during pregnancy has increased, with Hb levels falling below the expected levels. The normal level of

Hb during pregnancy should be at least 11 g/dl and haematocrit should not be less than 33% (WHO 2015a). During lactation, the Hb levels should not fall below 12 g/dl. However, Gadaga *et al* (2009), observed that in Zimbabwe, 33% of pregnant women and 29.6% of lactating women had Hb levels of 9 g/dl and <11 g/dl, respectively. According to the Ministry of Health and Childcare (MOHCC), Zimbabwe Food and Nutrition Report (2012, p42), the prevalence of IDA in women 15-49 years old was 61%, while the prevalence of anaemia was 26% for the same age group. The prevalence of anaemia among pregnant women in Manicaland province, Zimbabwe is 28.2% [United States Agency International Development (USAID) 2015]. These rates are high and above the global threshold, suggesting that IDA is a public health concern in Zimbabwe (WHO 2015b; WHO 2012; Jönsson & Guha-Sapir 2009).

2.2.3 Onset

Iron deficiency anaemia usually develops gradually and in well-defined sequences. The signs and symptoms of IDA develop in later stages. Iron deficiency anaemia presents a progression ranging from depletion of iron stores, to IDA and three phases of iron deficiency are generally identified (LPI 2016; Rashash & Abbas 2015; Pavord *et al* 2011).

In the first phase, known as storage iron depletion, there is mild deficiency and the levels of iron in bone marrow (measured by serum ferritin concentration), are depleted. Iron loss exceeds intake, thereby depleting iron reserves primarily in bone marrow. However, the amount of transport and functional supply is not affected (LPI 2016; Rashash & Abbas 2015). This is followed by increased iron absorption resulting in increased iron binding capacity or low transferrin saturation levels. Those with iron depletion have no iron stores to mobilise when the body requires additional iron (Rashash & Abbas 2015).

The next phase of marginal deficiency is known as early functional iron deficiency or iron deficiency erythropoiesis (erythrocyte production). Iron stores are extremely exhausted and transport iron, measured by transferrin saturation, is reduced further (LPI 2016). The supply of functional iron is low enough to impair red blood cell formation and Hb synthesis, but not low enough to cause measurable anaemia. The amount of iron absorbed is not sufficient to replace the amount lost or to provide the amount needed for growth, oxygen transportation and storage functions (Pavord *et al* 2011). This results in increased erythrocyte protoporphyrin concentration, which then accumulates in red blood cells (LPI 2016).

In the final stage of IDA, which is the most severe form of ID, there are inadequate and exhausted iron stores, affecting the transportation and functioning of iron needed to support normal red blood cell formation (Rashash & Abbas 2015). The bone marrow tries to compensate for the lack of iron by speeding up cell division, but ultimately produces very small (microcytic) red blood cells, which cause typical IDA. The diminished red blood cells result in reduced Hb, low serum ferritin, low transferrin saturation, increased erythrocyte and protoporphyrin concentration, resulting in anaemia (Pavord *et al* 2011). Anaemia resulting from iron deficiency is characterised by microcytic, hypochromic red blood cells with low Hb concentrations (LPI 2016; NIH 2016; Rashash & Abbas 2015).

2.2.4 Causes

In developing countries, iron deficiency is generally associated with poor diet, malabsorption disorders, and blood loss associated with gastrointestinal parasites [NIH 2016; National Rural Health Mission (NRHM) 2014]. A study by Mwangi *et al* (2017), revealed that in selected African countries including Malawi, South Africa and Morocco, low dietary intake was a major cause of IDA. People with ID usually have other nutrient deficiencies as well. Iron deficiency is not the only cause of anaemia, but is usually the most common cause (Brown *et al* 2017, p119). Dwumfour-Asare & Kwapong (2013) identify a poor and unbalanced diet as the main cause of anaemia. Other causes include malarial infections, worm infestation and age. Causes specific to developing countries are insufficient dietary intake and poor iron bioavailability, owing to the low consumption of absorption enhancers and high consumption of absorption inhibitors. Absorption enhancers include vitamin C, meat, fish, poultry, dark leafy green vegetables and organic acids. On the other hand, absorption inhibitors include phytic acid, tannins, vegetable fibres, zinc and calcium. According to Stewart (2016), when the diet does not contain enough iron, iron reserves are used, resulting in iron depletion, low Hb levels and finally anaemia.

However, there are non-nutritional causes as well. Although the body conserves iron efficiently, ID can arise when iron intake fails to meet its needs. Requirements are increased at certain stages in the life cycle, for instance during pregnancy and adolescence (Yussolf, Wan Daud & Ahmad 2013). According to Yussolf *et al* (2013), premenopausal monthly menstrual bleeding, frequent pregnancies and childbirth in rapid succession, may cause ID. Excessive bleeding decreases red blood cell production or increases red blood cell destruction (haemolysis) (Yussolf *et al* 2013). Parasites, mostly hookworm, chronic and recurrent infections such as

diarrhoea, malaria, sickle cell anaemia and human immunodeficiency virus (HIV), are other causes of ID (NRHM 2014; Yussolf *et al* 2013).

Cultural and religious beliefs and practices in food and supplement restrictions depriving pregnant women of certain nutritious foods, also contribute to IDA (NRHM 2014; Dwumfour-Asare & Kwapong 2013). A study by Setyobudihono, Istiqomah & Adiningsih (2016), revealed that most religions, though diverse, generally teach women to respect and obey their husbands completely as the priests of their homes. Women are thus expected to submit to the authority of their husbands, even when the men discourage their wives from taking supplements. There are some cases where husbands have instructed their wives to stop taking iron supplements and to replace them with milk or herbs, as they believed supplements caused illness (Setyobudihono *et al* 2016).

2.2.5 Symptoms

Iron deficiency generally develops slowly and insidiously. It is not clinically apparent until anaemia is severe, even though functional consequences may already exist. Because ID is often accompanied by deficiencies of other nutrients, the signs and symptoms of iron deficiency can be difficult to isolate (NIH 2016). Many people affected by ID experience no obvious problems other than vague symptoms, such as headaches, constipation and fatigue (LPI 2016).

A consequence of iron deficiency is decreased myoglobin levels in muscle cells, limiting the amount of oxygen delivered to the mitochondria for oxidative metabolism. This implies that iron depletion also decreases the oxidative capacity of muscle by diminishing the mitochondrial content of cytochromes and other iron-dependent enzymes required for electron transport and ATP synthesis (LPI 2016; Yussolf *et al* 2013). Lactic acid production increases with iron deficiency and other sub-optimal functions of iron-dependent enzymes (LPI 2016). Storage iron is depleted before there is a reduction in Hb and as iron is an essential element in all cells, symptoms of ID and IDA may occur even without anaemia. Inadequate oxygen delivery to active tissues owing to reduced Hb content, low haematocrit and low red blood cell count, are also major symptoms of ID (LPI 2016; NRHM 2014).

Fatigue, tiredness, weakness, headache and light-headedness, irritability or depression, pale appearance (pallor), dizziness, hair loss and gastrointestinal disturbances are symptoms of IDA. Achlorhydria (low levels of HCl in the stomach), constipation and diarrhoea are some of the

physical symptoms most frequently associated with IDA (LPI 2016; NIH 2016; Yussolf *et al* 2013; Pavord *et al* 2011). Iron deficiency anaemia is also characterised by a rapid heart rate, palpitations and rapid breathing upon exertion, shortness of breath, dyspnoea (difficulty or laboured breathing), impaired athletic performance, inability to exercise and reduced physical work capacity or performance. In severe cases, stroke may develop, leading to a heart attack. The immune system is suppressed resulting in poor resistance to infection (Brown *et al* 2017, p119; MFD 2016; NIH 2016; Pavord *et al* 2011).

Iron deficiency anaemia may result in impaired cognitive function resulting in poor concentration or reduced attention span, mental retardation or decreased mental functioning (Brown *et al* 2017, pp119-120; NIH 2016). Developmental delay and impaired social development in children are some of the major consequences of deficiencies in iron (Brown *et al* 2017, pp119-120; MFD 2016; NIH 2016; NRHM 2014). Iron deficiency anaemia may also impair temperature regulation and cause increased sensitivity to cold or feeling colder than normal. The ability to maintain normal body temperature in a cold environment is also poor in iron deficient individuals (LPI 2016; MFD 2016; NIH 2016; Talaulikar 2012).

Severe IDA leads to brittle, spoon-shaped nails (koilonychia), sores and cracks at the corners of the mouth (cheilosis), taste bud atrophy and tongue irritation (glossitis), resulting in a smooth, swollen or sore tongue (Talaulikar 2012). This may cause difficulty in swallowing due to the formation of webs of tissue (Plummer-Vinson Syndrome) in the throat and oesophagus (LPI 2016; MFD 2016; Talaulikar 2012). Pica, which is a behavioural disturbance characterised by craving and consuming non-food items such as ice, dirt and pure starch, may also develop. It may be a symptom and a cause of IDA (Pavord *et al* 2011).

2.3 Iron deficiency anaemia in pregnancy

Pregnant women are more susceptible to IDA than non-pregnant women, due to increased demands in red blood cell mass and growth of the placenta (Cox 2016). Thus, there is a need for increased iron intake through diet and supplements, in order to sustain normal growth of the fetus (WHO 2015a). Effects of IDA in pregnancy are mostly observed in SSA, where Zimbabwe is situated (WHO 2015a; WHO 2012). Statistics from USAID (2015) reveal that in 2011, only 4.9% of pregnant women in Zimbabwe took iron supplements for at least three months, despite the six months recommended by the WHO (2012). This is a clear indication that the severity of IDA is a serious public health concern in Zimbabwe (USAID 2015).

2.3.1 Syndemics in pregnancies amongst women in sub-Saharan Africa

A syndemic is a synergistic epidemic, characterised by disease concentration and interaction with underlying social forces. Syndemics involve both the biological and social factors, their pathways of interactions, mechanisms and disease promotion (Singer 2013; Lindsay, Gibney & Mcauliffe 2012). It is the aggregation of two or more disease clusters in a population with biological interactions. According to Singer (2013), there are shortcomings in addressing maternal health in sub-Saharan Africa (SSA). Syndemics constitute a significant additional source of maternal morbidity and mortality accounting for approximately 69% of maternal deaths in SSA (Lindsay *et al* 2012). There is a high prevalence of undernutrition, including deficiencies of iron, folate, calcium, vitamin D and vitamin A. Subsequently, obstetric complications, anaemia, low birth weight, maternal and neonatal mortality are common in SSA (Maju, Sharma, Beeram & Ostrach 2019; Singer 2013).

Pregnant women in SSA countries are at risk of poor nutritional status and adverse outcomes as a result of poverty, food insecurity, gendered economic marginalisation, social disruptions, political and economic instabilities, sub-optimal health facilities, frequent infections and pregnancies (Lindsay *et al* 2012). Singer (2013) also asserts that the clustering of diseases in populations and the enhanced vulnerability of particular groups is often a result of social conditions and the unequal structure of social relationships. The low status of women and poverty are the major driving factors leading to dietary inadequacy (Singer 2013; Lindsay *et al* 2012). Gender-based violence and exposure to workplace hazards are additional and often under-estimated public health problems (Lincetto, Mothebesoane-Anoh, Gomez & Munjanja 2019). The syndemic production model posits that the greater the number of conditions in a syndemic interaction, the more adverse the health outcomes (Singer 2013). Since IDA is the major cause of anaemia in SSA, it is important to note its many causes and the underlying social factors in order to reduce maternal and infant mortality (Maju *et al* 2019; Singer 2013).

2.3.2 Effects of iron deficiency anaemia on the pregnant woman

Significant effects of IDA during pregnancy include high maternal morbidity and mortality as well as cardiovascular consequences (Pavord *et al* 2011; Stoltzfus 2011). According to Gadaga *et al* (2009), anaemia is a serious risk to pregnant women, with many dying during childbirth because of severe anaemia. Anaemia is a major contributor or sole cause in 20-40% of maternal deaths [NRHM 2014; Food & Agriculture Organization of the United Nations (FAO) 2013a]. Iron deficiency anaemia in pregnancy is a significant public health problem in SSA and is

associated with serious adverse health outcomes (Ba, Ssentongo, Kjerulff, Na, Liu, Gao & Du 2019). It may contribute to maternal morbidity through effects on immune function, which may increase susceptibility to or severity of infections, poor work capacity and performance, and disturbance of postpartum cognition and emotions. According to Pavord *et al* (2011), there is little information regarding the Hb thresholds below which mortality increases, although this may be as high as 8.9 g/dl. However, severe anaemia is likely to have multiple causes and the direct effect of the anaemia itself is unclear (Pavord *et al* 2011). Pregnant women with mild or moderate anaemia often tend to be asymptomatic and anaemia is detectable through screening alone. Some of the effects on the pregnant women with advancing anaemia include frontal headaches, pica or unusual cravings, blue sclera, pale conjunctiva, leg oedema and shortness of breath (Talaulikar 2012; Pavord *et al* 2011; Stoltzfus 2011). The risk of preterm delivery is extremely high (Talaulikar 2012; Stoltzfus 2011).

2.3.3 Effects of iron deficiency anaemia in the fetus and infant

According to Brown *et al* (2017, p119), iron reserves in full-term infants reflect the prenatal iron stores of the mother. Women with IDA during pregnancy pass on less iron to the fetus, which may increase risk of anaemia during infancy. Thus, according to Pavord *et al* (2011), maternal iron depletion increases the risk of ID in the fetus in the first three months of life, by a variety of mechanisms. It reduces the oxygen supply to the fetus, causing intrauterine growth retardation and impaired psychomotor and mental development. Talaulikar (2012) confirms that when iron supply does not meet demand, the fetal brain may be at risk. This is because anaemia adversely affects cognitive performance, behaviour and physical growth of infants and children. Iron deficiency anaemia is related to lower scores in intelligence, language, gross-motor and attention tests in affected children, whose overall development may also be at risk (Brown *et al* 2017, p119). Upregulation of placental iron transport proteins may only partially protect the fetus from the effects of ID (Brown *et al* 2017, p119; Talaulikar 2012; Pavord *et al* 2011).

Maternal ID can cause decreased oxygen delivery to the placenta and fetus, as well as increased rates of infection (Brown *et al* 2017, p119). Thus, there is a strong causal relationship between maternal ID and increased preterm delivery, low birth weight, possible placental abruption and increased peripartum blood loss (Ghada *et al* 2012; Pavord *et al* 2011). However, it has been noted that maternal nutrition and healthcare during pregnancy are the strongest determinants of fetal growth and birth weight (MOHCC 2012).

2.3.4 Iron absorption during pregnancy

According to the WHO (2012), optimal absorption of iron supplements by pregnant women helps to ensure normal regulation of fetal growth. The absorption of iron from multi-mineral supplements is substantially lower than iron absorption from supplements containing iron only (Brown *et al* 2017, p119). The amount of iron absorbed depends on the amount of iron in the diet, its bioavailability and physiological requirements (Brown *et al* 2017, p119; LPI 2016; Pavord *et al* 2011). The amount of iron absorbed from supplements decreases substantially as the dose of iron increases. Iron is absorbed in the intestines and stored in the liver (Williams 2011, p15). Iron absorption is enhanced in women with low iron stores during pregnancy (LPI 2016). Individuals who are anaemic or iron-deficient absorb a larger percentage of the iron consumed (especially non-haem iron), than individuals who are not anaemic and have sufficient iron stores. Women entering pregnancy with adequate iron stores tend to absorb about 10% of the total iron ingested, while those with low stores absorb more (about 20% of the iron consumed). The largest percentage of iron absorption (40%) occurs in women who enter pregnancy with IDA (Brown *et al* 2017, p119; WHO 2012).

During pregnancy, iron absorption varies according to trimesters, with a progressive rise in absorption as the pregnancy advances. Iron absorption is low during the first trimester probably because of lower iron requirements (WHO 2017b; NRHM 2014). Absorption is highest after the 13th week of pregnancy when the greatest amount of iron transfer to the fetus occurs. It rises during the second trimester and continues to increase throughout the remainder of the pregnancy. Absorption remains elevated during the first months after delivery, thereby allowing for some reconstitution of body iron stores. Iron absorption from a diet with very high iron bioavailability has been estimated to be 0.4, 1.9 and 5 mg/day during the first, second and third trimesters, respectively (WHO 2017b; NRHM 2014).

Iron supplements should be taken without food because this enhances iron absorption almost two-fold. According to Preedy *et al* (2013), the form of iron in foods influences how much is absorbed, the need for it and a variety of other factors. Consuming haem iron and non-haem iron together increases non-haem iron absorption. Both plant and meat foods can be good sources of iron (Stewart 2016). About 40% of the total iron in animal flesh is in the form of Hb (the same form as in red blood cells) and myoglobin (pigment found in muscle cells). Its absorption is less affected or influenced by other dietary factors because it is absorbed by a different mechanism than non-haem iron (LPI 2016; Preedy *et al* 2013; Williams 2011, p15).

Although haem iron accounts for only 10-15% of the iron found in the diet, it may provide up to one third of total absorbed dietary iron (Brown *et al* 2017, p119). The absorption of non-haem iron is strongly influenced by enhancers and inhibitors present in the same meal (LPI 2016; Williams 2011, p15).

2.3.4.1 Enhancers of non-haem iron absorption

Vitamin C (ascorbic acid) strongly enhances the absorption of non-haem iron by keeping iron in its most absorbable form, especially as the mineral travels through the alkaline environment of the small intestine (LPI 2016; Williams 2011, p15). When vitamin C-rich foods are eaten together with iron-rich foods, vitamin C significantly reduces dietary ferric ion (Fe^{3+}) to ferrous ion (Fe^{2+}). This triggers the formation of an absorbable, iron-ascorbic acid complex. The size of this effect increases with the quantity of vitamin C in the meal (LPI 2016). Drinking fruit juices high in vitamin C such as orange, kiwi or strawberry with a meal or when taking an iron supplement, enhances the iron absorbed from the meal or supplement (Petre 2017; Stewart 2016; Talaulikar 2012; Williams 2011, p15). The consumption of dark leafy green vegetables is also beneficial as they contain both iron and vitamin C (Preedy *et al* 2013; Pavord *et al* 2011).

Besides providing highly absorbable haem iron, meat, fish and poultry also enhance non-haem iron absorption. Approximately 95% of dietary iron intake is from non-haem iron sources (Marini 2017; LPI 2016; Stewart 2016; Pavord *et al* 2011). According to Stewart (2016), eating meat with vegetables boosts non-haem iron absorption. Meat also contains organic compounds or a protein factor that promotes the absorption of iron from other less bioavailable non-haem iron sources. The addition of grain products to meat and vegetables enhances absorption of all non-haem iron present. Other organic acids such as citric, malic, tartaric and lactic acid may enhance non-haem iron absorption (LPI 2016). Germination and fermentation of cereals and legumes improve the bioavailability of non-haem iron by reducing the content of phytate, which inhibits iron absorption (Marini 2017; LPI 2016; Pavord *et al* 2011).

2.3.4.2 Inhibitors of non-haem iron absorption

Many factors are known to interfere with the absorption of non-haem iron. These are called absorption inhibitors. These inhibitors include phytic acid (phytates) and other factors in grain fibres (Williams 2011, p15). These are present in legumes, whole grains, bran and rice. They inhibit non-haem iron absorption by binding to it. Iron is poorly absorbed from high extraction flours because of the presence of phytate and other inhibitory factors [Department of

International Development (DFID) 2013; Talaulikar 2012; Williams 2011, p15]. Small amounts of phytic acid (5-10 mg) can reduce non-haem iron absorption by 50%. The absorption of iron from legumes such as soybeans, black beans, lentils, mung beans and split beans has been shown to be as low as 2% (LPI 2016; Stewart 2016; Gupta, Gangoliya & Singh 2015; Talaulikar 2012). Therefore, phytic acid content needs to be lowered in order to increase iron absorption from most legumes. It can be drastically reduced during soaking and cooking of legumes (Gupta *et al* 2015).

Polyphenols (tannins) found in tea, coffee, wines, some fruits, vegetables and spices, can markedly inhibit or reduce the absorption of non-haem iron. Consumption of tea or coffee with a meal or shortly after a meal inhibits iron absorption (Pavord *et al* 2011; Williams 2011, p15). This effect is reduced by the presence of vitamin C (LPI 2016; Stewart 2016; Talaulikar 2012). On the other hand, soy protein such as that found in tofu has an inhibitory effect on iron absorption, independent of its phytic acid content (LPI 2016). Oxalic acid in vegetables can also bind to iron and reduce non-haem iron absorption (Preedy *et al* 2013). Vegetable fibres, phosphates and bran decrease the absorption of iron by binding to it. Zinc supplements also interfere with non-haem iron absorption because zinc competes with iron for absorption. Calcium found in dairy products also inhibits non-haem iron absorption (Mikstas 2016; Preedy *et al* 2013; Talaulikar 2012).

2.4 Prevention of iron deficiency anaemia in pregnancy

Iron deficiency anaemia often occurs towards the end of pregnancy, even among women who enter pregnancy with adequate iron stores. Anaemia in pregnancy needs prompt attention by adopting strategies that can comprehensively fight it (Dwumfour-Asare & Kwapong 2013). Several interventions are noted to be effective in combined forms. These include iron supplements for pregnant women, food fortification, biofortification, nutrition education and training to increase awareness of the importance of iron supplements during pregnancy. Other strategies include the use of insecticide-treated bed nets, intermittent preventive treatment (IPT) against malaria and effective deworming (Mwangi *et al* 2017; Dwumfour-Asare & Kwapong 2013; WHO 2012). Provision of improved water, sanitation and hygiene services and influencing positive beliefs, practices or behaviour modifications are also critical (NRHM 2014; Dwumfour-Asare & Kwapong 2013; WHO 2012; WHO 2010). According to Talaulikar (2012), prepregnancy counselling, dietary advice and therapy are very important for women to improve iron intake and absorption to ensure the best pregnancy outcomes. The NRHM (2014) stress

the importance of dietary diversification as an essential strategy for preventing and correcting IDA. The use of IPT with education reduces placental malaria and maternal anaemia. This is beneficial because malaria is the main cause of severe anaemia in pregnancy, in SSA (Dwumfour-Asare & Kwapong 2013).

2.4.1 Nutrition education

Nutrition education on the importance of iron supplements during pregnancy is critical (FAO 2013b). According to Gautam, Saha, Sekhri & Saha (2008), dieticians should educate pregnant women about careful selection of food, meal planning and preparation during their routine ante-natal check-ups. A similar study by Ba *et al* (2019), revealed that many women in SSA countries did not adhere to iron supplementation during pregnancy due to a lack of knowledge about anaemia. Education and counselling regarding diet may improve iron intake and absorption (Pavord *et al* 2011). Even simple alterations in food habits like separating tea-drinking from meal times can increase iron absorption (NIH 2016; Osungbade & Oladunjoye 2012; Pavord *et al* 2011). However, the degree of change achievable remains a challenge because habits are not easy to change, especially when nutrition education is still inadequate. All women should be counselled on diet in pregnancy, including details of iron-rich food sources and factors that may inhibit or promote iron absorption and the importance of adequate iron stores in pregnancy (NIH 2016; NRHM 2014; Gautam *et al* 2008). According to Sambili, Kimambo, Peng, Ishunga, Matasha, Matumu, Noronha & Ngilangwa (2016), intensive community education and further qualitative research and administration of medication through directly-observed-therapy (DOT), are recommended to address the IDA challenge among pregnant women.

2.4.2 Food fortification

According to Gautam *et al* (2008), food fortification with iron is probably the most practical, sustainable, and cost-effective long-term solution to the control of ID at a national level. The WHO recently issued guidelines on the technical aspects of food fortification, which involves the addition of micronutrients to processed foods (NRHM 2014). This usually leads to relatively rapid improvements in the micronutrient status of a population at a very affordable cost. Fortification interventions for certain micronutrients through rigorous, randomised controlled trials have been found to be very effective (DFID 2013; Stoltzfus 2011; Williams 2011, p15). Foods most often used for mass fortification are staple cereal flours. Fortifying staple foods such as flour or cereals with iron has proved to be effective in increasing Hb levels

and reducing the risk of anaemia by up to 63% (NRHM 2014). According to Mwangi *et al* (2017), since most African countries fortify flour, there is also a need to provide nutrition education and training to population groups. Appropriate educational messages on the fortification of staple foods have also been highlighted and understood to improve the dietary intake of children at a population level [DFID 2013; Institute of Public Health Nutrition (IPHN) 2007].

Mandatory fortification of some staple foods may help to improve the nutritional status of consumers (Gadaga *et al* 2009). From the food consumption studies previously done in Zimbabwe, mandatory fortification is in place with foods that are commonly consumed by vulnerable groups in the population. According to the WHO (2017a), Zimbabwe launched a national food fortification strategy to prevent micronutrient deficiencies. Maize meal and wheat flour were fortified with iron; sugar with vitamin A; cooking oil with vitamin A and D; and salt with iodine (WHO 2017a; Gadaga *et al* 2009). This aims to reduce and eventually eliminate most micronutrient deficiencies. The fortification of maize meal and flour with iron and folate is feasible, inexpensive, safe and likely to be beneficial (Stoltzfus 2011; Williams 2011, p15; Gadaga *et al* 2009). Non-haem iron is added to grain products during the enrichment process and is also present in eggs, milk, vegetables, grains and other plant foods (NRHM 2014; Williams 2011, p15).

However, the fortification of foods with iron is more difficult than it is with other nutrients such as iodine and salt. The most bioavailable iron compounds are soluble in water or diluted acid, but these compounds often react with other food components. They change flavours and colour, causing fat oxidation. Thus, less soluble forms of iron, although less well absorbed, are often chosen for fortification, to avoid unwanted sensory changes (DFID 2013; Gautam *et al* 2008). Fortification with low iron doses is more similar to the physiological environment than supplementation, and may be the safest intervention (USAID 2016).

2.4.3 Biofortification

Biofortification of food with iron is another alternative useful strategy in the prevention of IDA during pregnancy. It is a new and emerging strategy, also referred to as plant breeding and aims to achieve iron-rich crop varieties (Bouis & Saltzman 2017; Stoltzfus 2011; Gautam *et al* 2008). According to the FAO (2014), biofortification is an agricultural approach to improve nutrition using conventional breeding to select for higher vitamin and mineral contents of staple crops. Biofortification focuses on three micronutrients that are most limiting. These three

micronutrients are vitamin A, zinc and iron. Thus, biofortification is an effective approach to enhance the bioavailability of iron, without changes in the overall dietary patterns. Biofortification targets people who eat large amounts of staple foods such as rice and millet, and legumes like beans. These crops need to be developed with high iron content, which is bioavailable (Stoltzfus 2011; Gautam *et al* 2008). However, most of the iron is removed during the milling process, while iron absorption from other cereals and legumes is low because of the high phytate and polyphenol content in these foods. Phytic acid content may need to be lowered by more than 90% to increase iron absorption from the monotonous cereal-based diets consumed in many developing countries (Stoltzfus 2011; Gautam *et al* 2008). The FAO and HarvestPlus launched a biofortification program in Zimbabwe, where maize has been nutritionally enhanced with provitamin A carotenoids, while iron and zinc-enriched dried beans have been introduced to address the micronutrient deficiencies in the country (FAO 2013a). However, this has not replaced the need for iron supplements in pregnancy, because diet alone is inadequate. However, biofortification is beneficial because it involves a once-off research investment to develop crops at low costs, for consumption by a large number of people (Bouis & Saltzman 2017; FAO 2014; FAO 2013a).

2.4.4 Dietary diversification

According to Gadaga *et al* (2009), household food insecurity forces people to consume less food with very little scope for dietary diversification. Dietary diversification is a key aspect that entails linking cultivation of staple foods with high mineral and vitamin content and education to produce better consumer behaviour (Trentmann, Reinhard & Vierck 2015). It encourages the consumption of micronutrient-rich foods such as dark green leafy vegetables, lentils and vitamin C-rich fruits, which may be available, but are underutilised. According to the FAO (2014), many people lack adequate amounts of foods that are rich in the nutrients needed for a healthy and productive life. Strategies for food and dietary diversification include the consumption of underutilised traditional foods and home gardens, raising small livestock, improved preservation and storage of fruits and vegetables so as to reduce waste and post-harvest losses. Success depends on combining diversified crops, nutritional advice and short-term nutrition intervention (USAID 2016; UNICEF 2015; Trentmann *et al* 2015; MOHCC 2014).

2.4.5 Iron supplementation during pregnancy

Iron supplementation to prevent anaemia in all pregnant women receiving ante-natal care (ANC) services is highly recommended (Sambili *et al* 2016; Stoltzfus 2011). The WHO (2015b), estimates that 58% of pregnant women in developing countries are anaemic (Raut *et al* 2014; Ghada *et al* 2012). In Zimbabwe, the prevalence of IDA in women 15-49 years is 61% (MOHCC 2012; Jönsson & Guha-Sapir 2009). As IDA prevalence is high in most developing countries, supplementation may be the most effective way to treat pregnant women with ID. According to Gadaga *et al* (2009), a developing fetus uses iron obtained from the pregnant mother, thus making iron supplements essential. Iron supplementation increases Hb and ferritin levels during pregnancy and also improves maternal iron stores, even after delivery (NRHM 2014; Ugwu *et al* 2014; WHO 2010). Consequently, iron used for fetal development and that, which is lost, must be replaced by iron supplements. The WHO has recommended a daily supplemental dose of 60 mg iron for six months during pregnancy, as a prophylactic measure, until six weeks post-partum (WHO 2017b; WHO 2012; Habib 2009). A similar study by Peńa-Rosas, De-Regil, Dowswell & Viteri (2012), revealed that prophylactic iron supplementation reduced the risk of maternal anaemia at term by 70% and low birth weight by 16%, compared with no supplementation.

2.5 Iron requirements and supplementation during pregnancy

2.5.1 Iron requirements during pregnancy

Pregnant women have the highest demand for iron among all groups of people. The iron requirement is significantly high owing to increased iron utilisation by the developing fetus and placenta, as well as blood volume expansion (LPI 2016). The NIH (2016) concurs with the LPI (2016) that during pregnancy, plasma volume and the red blood cell mass expand as a result of dramatic increases in maternal red blood cell production. Red blood cell mass increases substantially by about 20%-30%, while blood volume expands gradually to approximately 150% of normal volume (LPI 2016; NIH 2016; Brown *et al* 2017, p119). The higher increase in plasma volume compared to red blood cell mass, makes it appear as if levels of Hb, ferritin and packed red blood cells have decreased (LPI 2016). This decrease is as a result of the dilution and large increase in plasma volume. This is called haemodilution or physiological anaemia (Brown *et al* 2017, p119; NIH 2016). In this condition a pregnant woman has a lower ratio of red blood cells to total blood volume (LPI 2016; NIH 2016). It may be impossible to prevent the decline in Hb level during pregnancy as it is a normal response to

pregnancy, and not a result of inadequate nutrient intake (NIH 2016; Brown *et al* 2017, p119-120).

Haemoglobin concentration normally decreases until the middle of the second trimester and then rises slightly in the third trimester. Owing to the dilution effects of increased plasma volume, changes in Hb levels tend to be more indicative of plasma volume expansion, rather than iron status. Haemoglobin and serum ferritin are commonly used to assess iron status in pregnant women. Low levels of Hb or serum ferritin may be associated with high plasma volume expansion (hypervolemia) and high Hb levels are related to low plasma volume expansion (hypovolemia). Low levels of plasma volume expansion are associated with reduced fetal growth, whereas women with higher levels of plasma volume expansion have infants with a higher birthweight (NIH 2016; NRHM 2014).

In the first trimester of pregnancy, iron requirements are usually low because menstruation stops, representing a median saving of about 0.56 mg per month, for three months. The Hb levels should not be <11.0 g/dL in the first and third trimesters, while the serum ferritin should be ≥ 35% (WHO 2017b; WHO 2016). The first trimester is characterised by haemodynamic changes including generalised vasodilation, some increase in plasma volume and red blood cell di-phosphoglycerate concentrations and reduced erythropoietic activity. In the second trimester, iron requirements increase and Hb levels should not be less than 10.5 g/dL (WHO 2017b). Requirements continue to rise throughout the remainder of pregnancy, with increased oxygen utilisation by both mother and fetus owing to haematologic changes (Brown *et al* 2017, p119). The third trimester is characterised by a large amount of iron accumulation. Iron requirements for fetal growth rise steadily in proportion to the weight of the fetus (Brown *et al* 2017, p119; LPI 2016; WHO 2016). In determining iron requirements during pregnancy, the losses incurred during childbirth must also be considered. These include an average maternal blood loss equivalent to 150 mg Fe and a further 90 mg present in the placenta and umbilical cord (LPI 2016; NIH 2016). In the period after delivery, there is a small iron loss of 0.3 mg/day through lactation, but this is usually offset by the absence of menstruation, except when breastfeeding is continued long after the return of menstruation (LPI 2016; NIH 2016).

2.5.2 Iron supplementation during pregnancy

During pregnancy, it is usually difficult for the diet alone to meet the increased iron requirements, thus, the WHO has strongly recommended a daily dose of 60 mg of elemental iron supplementation for all pregnant women universally (WHO 2017b; UNICEF 2015; WHO

2012; Stoltzfus 2011). Iron supplementation should be commenced at the beginning of the second trimester (Talaulikar *et al* 2012). According to the MOHCC (2012), in Zimbabwe, this prophylactic dose is given at the first contact with nurses during ANC visits, and should continue for at least six months during pregnancy, until six weeks post-delivery. The iron dose is kept low so that it is both compatible and effective to help reduce the side-effects of iron therapy. Side-effects can seriously limit compliance with iron supplements during pregnancy. However, the iron dose can be doubled to 120 mg daily if a woman is diagnosed with IDA. This should be combined with nutrition education (WHO 2017b; USAID 2016; MOHCC 2012).

Iron supplements are available in a variety of forms such as ferrous fumarate, ferrous sulfate, and ferrous gluconate. However, ferrous sulfate ($FeSO_4$) seems to be the most effective and is also the least expensive (Stewart 2016; NRHM 2014). When there is adequate iron supplementation, it becomes possible to achieve a haemoglobin level of at least 11 g/dL at term (WHO 2017b; MOHCC 2012). Table 2.1 presents the suggested dose for daily iron and folic acid supplementation in pregnant women (WHO 2012).

Table 2.1: Suggested guidelines for daily iron and folic acid (IFA) supplementation for pregnant women

Supplement composition	Iron: 30-60 mg of elemental iron. Folic acid: 400 µg (0.4 mg).
Frequency	One iron and folic acid supplement daily.
Duration	Throughout pregnancy. Iron and folic acid supplementation should begin as early as possible.
Target group	All pregnant adolescents and adult women.
Settings	All settings.

2.5.3 Barriers to optimal iron supplementation in pregnancy

Barriers to optimal iron supplementation refer to hindrances or disturbances that affect the intake of iron supplements by pregnant women. These barriers, leading to poor adherence to iron supplementation, constitutes a serious public health issue in SSA (Ba *et al* 2019). They are varied and range from forgetting to take iron supplements consistently, non-availability, limited financial capacity and considering them as contraceptives (Nisar, Alam, Aurangzeb &

Dibley 2014). Yekta *et al* (2008) also note a lack of supply, non-compliance, poor infrastructure, culture and religion as barriers to adequate supplementation. Other barriers include lack of ante-natal services, family members not allowing use of supplements, lack of education on benefits, fear, side-effects, unwillingness to take supplements, as well as a shortage of iron enhancers in the diet (Sambili *et al* 2016; Nisar *et al* 2014; Noronha, Khasawneh, Sheshan, Ramasubramaniam & Raman 2012; Yekta *et al* 2008). Poor adherence to iron supplement regimens was reported to be as low as 22% in some SSA countries, as compared to high income countries, where adherence ranged from 77% in Denmark to 85% in Sweden (Ba *et al* 2019).

Yekta *et al* (2008) suggest that the most important reason for the failure of supplementation programmes is a lack of supply and poor distribution. Nisar *et al* (2014) and Stoltzfus (2011) also reiterate that the non-availability of supplements and erratic or insufficient supply of iron and folic acid (IFA) pills, are the most notable barriers to supplementation. Limited financial capacity to buy supplements is another barrier (Nisar *et al* 2014). Iron supplement supplies are generally erratic, yet pregnant women need to have a consistent supply, thus making it necessary to buy from private pharmacies. However, the challenge in Zimbabwe is that most family incomes are at or below the poverty datum line. This makes it difficult for most pregnant women to buy supplements from private pharmacies (MOHCC 2012).

According to Ugwu *et al* (2014), non-compliance or poor compliance with iron supplements is another major problem and it is thought to be a potential cause of the persistent high prevalence of anaemia. Compliance with preventive treatment remains low among women in sub-Saharan Africa (Sambili *et al* 2016; Osungbade & Oladunjoye 2012). Some women receive iron supplements, but do not take the correct dose, whereas others often fail to take the supplements regularly (Yekta *et al* 2008). Non-compliance can be a result of a negative experience or an aversion to side-effects culminating from taking iron supplements. It can also be caused by pregnant women forgetting to take supplements (Nisar *et al* 2014; Osungbade & Oladunjoye 2012).

Healthcare workers with limited knowledge on the effectiveness of supplementation interventions and a lack of adequate knowledge about IDA among pregnant women are other barriers (Yekta *et al* 2008). Women may lack information or motivation on the use and benefits of iron supplements, especially in the face of common side-effects (Nisar *et al* 2014; Stoltzfus 2011). Many primary healthcare systems may fail to adequately motivate both healthcare providers and pregnant women to issue and use sufficient iron supplements (Nisar *et al* 2014;

Yekta *et al* 2008). Osungbade & Oladunjoye (2012) note that partial implementation of preventive treatments hinder the effective use of supplements. Nurses may also have poor interpersonal skills, resulting in inadequate counselling regarding the benefits of iron supplements and strategies for managing side-effects (FAO 2014; Nisar *et al* 2014; Noronha *et al* 2012; Stoltzfus 2011; Yekta *et al* 2008).

Poor or inadequate infrastructure of the healthcare system can be a major barrier to effective iron supplementation in pregnancy (Osungbade & Oladunjoye 2012). Geographic distance or poor access to prenatal care and problems related to costs and logistics, also affect the supply of iron supplements (Stoltzfus 2011; Yekta *et al* 2008). Poor utilisation of prenatal healthcare services and difficult access result in pregnant women failing to obtain ante-natal care (Nisar *et al* 2014).

Another barrier to effective supplementation is the disapproval by male partners (Sambili *et al* 2016). Some husbands may discourage their wives from taking supplements, as they may not see the need for their wives to take supplements. According to Nisar *et al* (2014), some family members may not allow the use of supplements by pregnant women. The most influential family members have been the husband and the mother-in-law (Sambili *et al* 2016; Nisar *et al* 2014).

Religious and cultural beliefs that discourage the use of medications during pregnancy may negativley impact on the way some pregnant women take iron supplements (Group 2016; Onyeneho, I'Aronu, Chukwu, Agbawodikeizu, Chalupowski & Subramanian 2016; Setyobudihono *et al* 2016). According to Setyobudihono *et al* (2016), religion puts some women in a submissive position to their husbands. Women cannot decide to commence iron supplementation without first seeking approval from their husbands: thus compliance with iron supplements is determined by the beliefs, knowledge or perceptions of their husbands. In some cultures, pregnant women are discouraged from using iron supplements as the supplements are believed to cause large newborns who cannot be delivered easily and normally. Delivery through a caesarean section is believed to cause an unnecessary burden for the family and should be avoided (Group 2016; Onyeneho *et al* 2016; Setyobudihono *et al* 2016; Dwumfour-Asare & Kwapong 2013). Therefore, the norms and values of the family may determine the use or non-use of iron supplements by some pregnant women (Group 2016).

Unwillingness by pregnant women to take iron supplements is another barrier, which can negatively affect the health of women (Nisar *et al* 2014). Sambili *et al* (2016) stated that some women do not like the iron supplements. According to Nisar *et al* (2014), some women regarded iron supplements as contraceptives and found them unnecessary or undesirable. Poor quality of supplies is another barrier to optimal supplementation by pregnant women. Poor quality supplements from the clinic or pharmacies may have low bioavailability (Stoltzfus 2011). According to Stoltzfus (2011), some iron supplements may have more side-effects than others, and as such, women may stop taking them.

2.5.4 Overcoming barriers to optimal iron supplementation in pregnancy

To reduce IDA, the WHO (2017b) recommends IFA supplementation interventions for at least six months during pregnancy. At least 49 countries have already implemented the supplementation programmes, but with numerous obstacles (Yekta *et al* 2008). According to Nisar *et al* (2014), due to the various barriers to optimal iron supplement use by pregnant women, there are strategies that merit consideration in efforts to reduce barriers associated with iron supplementation.

Nisar *et al* (2014), note that interventions for overcoming IDA among pregnant women need to be focused on providing adequate awareness and good quality counselling. There is a need for implementation of behaviour change communication strategies (BCC) (WHO 2012). The side-effects of iron supplementation can be reduced by introducing programmes that help to modify dietary habits and also promote diversification. According to UNICEF (2015), strategies for overcoming barriers to optimal iron supplementation should involve educating pregnant women about appropriate feeding practices and improving the use of locally available foods. Iron biofortification as well as mass and home-fortification of foods, are other interventions. An advantage of fortification is that it can be applied on large population groups at low cost (USAID 2016; UNICEF 2015; FAO 2014; MOHCC 2014).

According to the WHO (2012), the frequency and severity of side-effects associated with iron supplementation depends on the amount of elemental iron released in the stomach, as side-effects are dose-related. The WHO (2015b) explains that the use of iron sulfate is associated with gastrointestinal side-effects. Therefore, the concentration and frequency of the oral dose can be reduced or else administered in a form that is both easily and adequately absorbed, with fewer side-effects (Milman, Paszkowski, Cetin & Castelo-Branco 2016; WHO 2012). Intermittent iron supplementation therapy, where supplements are taken once or twice weekly,

is a more rational and cost-effective alternative approach with fewer side-effects (Milman *et al* 2016; WHO 2015b; WHO 2012). However, the WHO (2012) stresses that daily iron supplementation reduces the risk of maternal anaemia by 70% and also lessens the risk of low birth weight infants. Reminder messages also help pregnant women to remember to take their iron supplements (Nisar *et al* 2014). Therefore, cordial relationships need to exist between nurses and pregnant women. Consistent availability of supplements free of charge at the clinics throughout pregnancy will also help to reduce the need to purchase iron supplements (WHO 2015b; Nisar *et al* 2014; WHO 2012).

There is a need to develop and implement strategies to reduce side-effects related to iron supplementation (Nisar *et al* 2014; Ugwu *et al* 2014). For instance, the WHO (2012) indicated that gastrointestinal distress is a common observation in women consuming iron, especially when taken on an empty stomach. Women should be advised to take iron supplements with food or immediately after a meal. This would help to minimise side-effects and improve the acceptance and intake of supplements by women (Nisar *et al* 2014). However, Pavord *et al* (2011) stress that women should be counselled to take oral iron supplements on an empty stomach, at least an hour before meals, with a source of ascorbic acid to maximise absorption.

2.5.5 Strategies for controlling iron deficiency anaemia among pregnant women in developing countries

There is no doubt that iron supplementation is critical for controlling IDA in pregnant women. However, improving the effectiveness of supplementation programmes and strategies remains a challenge in many developing countries (Osungbade & Oladunjoye 2012; Yekta *et al* 2008). Fathi Najafi *et al* (2014) have identified various strategies for controlling IDA in pregnant women. These include improvement of public health and health indicators, decreasing malnutrition, as well as controlling parasitic diseases and malaria. Ugwu *et al* (2014) suggest that IDA can be controlled by offering the iron supplements free of charge to pregnant women. On the other hand, Yekta *et al* (2008) cites information, education and communication (IEC) programmes as the best approaches for improving the effectiveness of iron supplementation interventions. The strategies for improving iron supplementation in developing countries should include food fortification and biofortification with iron (USAID 2016; FAO 2014; Osungbade & Oladunjoye 2012). The FAO (2014) recommends dietary diversification and modification (DDM) strategies at community and household levels. These strategies are believed to have the potential to increase the intake of total and/or bioavailable nutrients.

Strategies such as small livestock production and aquaculture can also improve the micronutrient density of foods, especially haem iron (FAO 2014). Specific strategies for Zimbabwe also include workshops on health and nutrition, education and nutrition, food fortification and early warning food and nutrition security information systems (USAID 2016; MOHCC 2014).

2.5.5.1 Impact of indigenous knowledge systems (IKS) in controlling iron deficiency anaemia during pregnancy

According to Mothiba, Davhana-Maselesele & Lebese (2015), indigenous knowledge (IK) is critical in establishing the use of certain foodstuffs and medications by pregnant women. IK is shared and communicated verbally through different cultures, leading to many food restrictions, thus contributing to IDA in pregnant women. Many young Africans undermine indigenous practices and prefer western practices (Onyeneho *et al* 2016; Setyobudihono *et al* 2016; Mothiba *et al* 2015). However, most elderly people do not support the western practices and thus discourage pregnant women from taking iron supplements. Instead, women are given other alternatives, such as anthill soil and traditional concoctions prepared by elderly women (Setyobudihono *et al* 2016).

According to Lindsay *et al* (2012), traditional beliefs regarding foods to be avoided during pregnancy are a major limiting factor in diet quality amongst pregnant women. There are many food restrictions in many African communities based on their IKS (Setyobudihono *et al* 2016; Mothiba *et al* 2015). Some cultures prohibit pregnant women from eating sugarcane, leftover food and eggs. Eggs are believed to cause stuttering in the infant and may also block the delivery passage (Sey-Sawo & Tunkara-Bah 2016; Mothiba *et al* 2015). Body building foods such as snail, eggs, meat, liver and fish are discouraged in some communities during pregnancy (Lindsay *et al* 2012). Due to the variety of meats avoided, pregnant women are denied food sources of high quality iron. However, Mothiba *et al* (2015) argues that, even though some IKS are not scientifically proven, long before the western practices were adopted, IKS was used to ensure healthy pregnancy outcomes. According to Mothiba *et al* (2015), in southern Africa, the use of IKS ensured that women got some healthy foods, which were nutrient dense, apart from eating healthy wild insects, fruits, indigenous vegetables, as well as game meat. They did not experience malnutrition challenges such as IDA, or low birth-weight babies or difficulty during delivery, thus justifying the critical role of IKS in pregnancy (Mothiba *et al* 2015; Lindsay *et al* 2012).

2.6 Nutrition education tools for pregnant women

2.6.1 The role of nutrition education tools in improving iron supplementation during pregnancy

According to Malcolm Knowles (1913-1997), teaching is an effective way of imparting knowledge to adults [Teaching Excellency in Adult Literacy (TEAL) 2011]. Knowledge retention in adult learning is approximately 90% through good teaching, thus justifying the need for nutrition education (FAO 2012). The growing need for good health education has made it necessary to develop effective nutrition education tools. Nutrition education tools for adults are more effectively developed based on principles from the Andragogy Adult Learning Theory by Malcolm Knowles (TEAL 2011). Nutrition education during pregnancy can improve knowledge and practices of pregnant women, which may result in improved dietary intake and enhanced adherence to supplements (Zelalem, Endeshaw, Ayenew, Shiferaw & Yirgu 2017). Therefore, the development of nutrition education tools for use by pregnant women is an effective way of improving iron supplementation among pregnant women (Pavord *et al* 2011). Thus, there is need to promote nutrition education during ANC visits for pregnant women to get reliable and accurate information from health professionals (Zelalem *et al* 2017). Health ministries and other concerned organisations should broaden the current focus on iron supplementation during pregnancy to practical nutrition education, to improve the nutrition knowledge of pregnant women (Zelalem *et al* 2017; FAO 2012). Thus, the gap that this study aimed to bridge is the lack of adequate nutrition education and poor iron supplementation amongst pregnant women.

2.6.2 Nutrition education tools used in sub-Saharan Africa and their success rate

Various nutrition education tools have been developed and used to address IDA in pregnant women in SSA [Food and Health Communications (FHC) 2019]. Nutrition education tools in SSA include social and mass media, and print materials such as brochures, posters and pamphlets [FHC 2019; United States (US) Department of Agriculture and US Department of Human and Health Services (USDA-HHS) 2018; WHO 2017c]. According to the FAO (2013b), mass media such as radios and televisions, have been refined for nutrition education and have been expanded to the internet and cellular phones. However, its limitations lie in dissemination, as well as how to motivate women to take positive action (FAO 2013b).

Other effective tools include the use of popular personalities such as “anaemia champions” on billboards, as well as public health events or campaigns to distribute information on anaemia (WHO 2017c). For instance, in 2016, the WHO sponsored a symposium in Addis Ababa (Ethiopia), where nutrition education was offered to empower women and foster behaviour change (WHO 2017c). The use of village health volunteers to identify and teach women can help to increase awareness. This strategy, if effectively implemented, can reduce the prevalence of IDA in pregnancy by 50% (WHO 2017c). Other ideal tools are visual aids such as charts, posters or fliers. However, these aids are often too small or the colours do not show up well in outdoor settings (FAO 2013b).

Although Tanzania, Ethiopia and Uganda implemented tools for use during nutrition education, the IDA prevalence remains high in SSA (WHO 2017c). This is despite the provision of iron supplements to pregnant women, suggesting that compliance is low and thus justifying the need for nutrition education (WHO 2018). Therefore, there is an urgent need to build national level professional capacity in nutrition education, particularly in SSA (WHO 2018; FAO 2013b).

2.6.3 Factors to be considered when developing nutrition education tools

When developing nutrition education tools, various factors should be considered so as to make the tools useful and effective (FHC 2019; USDA-HHS 2018). According to the USDA-HHS (2018), before developing tools ‘from scratch’, one should establish existing resources that can be used or adapted to meet the needs of the target group. There is a need to clearly define the target group, whether it be a group of adults, children or pregnant women (USDA-HHS 2018). According to the FAO (2012), nutrition education approaches include establishing baseline knowledge of the target group to determine the population’s knowledge, behaviour, attitudes, circumstances, as well as its myths and misconceptions surrounding nutrition. The population’s primary language, education level and reading ability should be established, along with the cultural and religious practices it observes, including dietary restrictions and staple foods (FHC 2019; USDA-HHS 2018; FAO 2012).

Nutrition education tools should be tailored to suit the communication channels used and trusted by the target group. According to the USDA-HHS (2018), the use of plain, simple and easy to understand language is recommended. Short headings, with material organised with the reader in mind and the use of eye-catching, relevant visuals that focus on positive actions, make nutrition education tools more useful (FHC 2019; USDA-HHS 2018; Nyilasy, Lei, Nagpal & Tan 2016). Colour is effective in enhancing the correct interpretation and understanding of

nutritional information and food choices (Khorambadi, Dolatian, Hajian, Zamanian, Taheripanah, Sheikhan, Mahmoodi & Seyedi-Moghadman 2016; Nyilasy *et al* 2016; Carter 2014).

2.6.4 Testing nutrition education tools for suitability to a targeted group

After nutrition education tools have been developed, they should be tested for acceptability and user-friendliness to the target group. Many techniques have been developed for testing nutrition education tools. The Academy of Nutrition and Dietetics Foundation (ANDF) (2016) has identified the Developing and Assessing Nutrition Education Hand-outs (DANEH) checklist, which has been developed to test nutrition hand-outs for inclusion in the Health Food Bank Resource Hub website. The DANEH checklist uses a simple scoring system, where 21 points are used to test the tool. To meet the benchmark for the nutrition education tool to be accepted for use, 16 points out of 21 (76%) should be scored (ANDF 2016). Therefore, the DANEH checklist helps to ensure development of quality nutrition education tools (ANDF 2016).

Despite the many techniques that can be used to test nutrition education tools, basic considerations should focus on content, behaviour, cultural sensitivity, written text organisation, images, as well as the quality of the printed document (ANDF 2016). The content or information should be accurate, current and consistent with WHO guidelines. The WHO (2012) guidelines stipulate that all pregnant adolescents and adult women in all settings, should routinely receive 30-60 mg of elemental iron daily, throughout their pregnancy. Supplementation should begin as early as possible, at least at the beginning of the second trimester until six weeks post-partum (WHO 2012).

The nutrition education tool should spell out its clear purpose and promote relevant health issues for the target group (FHC 2019; USDA-HHS 2018; ANDF 2016). It should clearly highlight specific examples of desired behaviour, at the same time maintaining cultural sensitivity. The nutrition education tool should contain culturally appropriate content and images for the target group, such as images of people or food that are culturally acceptable (ANDF 2016).

Another factor to be considered when testing nutrition education tools is the aspect of written text. The tool should use simple words, positive messages, active voice, conversational tones and repetition of key words or new concepts (FHC 2019; ANDF 2016). The written text should be logically organised starting with the most important messages. Text should be written in an

easy to read font, using at least font size 12 and font types such as Times New Roman or Arial. It is recommended that informative subheadings with short paragraphs with enough space around headings and text, be used. The images in nutrition education tools should be clear and appropriate for the purpose (USDA-HHS 2018; ANDF 2016). Finally, the print version should have quality printing on a durable paper that can be folded without tearing (ANDF 2016).

2.7 WHO recommended intervention measures for addressing IDA amongst pregnant women

The WHO has summarised recommended measures for addressing IDA amongst pregnant women in the various member states, especially those living in developing countries like Zimbabwe. According to the WHO (2017c), health providers, in particular skilled attendents should attend to pregnant women. The health providers should examine and screen all women for anaemia during antenatal and post partum visits (WHO 2016; WHO 2012). There is a need for a functioning referral system that ensures timely referral of pregnant women for monitoring, especially in the case of severe anaemia. Iron and folate supplements should be available at all levels of care (WHO 2019; WHO 2017c; WHO 2012). Another very essential IDA intervention measure is to increase awareness among women and the community on the importance of iron and folate supplementation in pregnancy. This can also be achieved through the development of nutrition education programmes or materials, nutrition counselling, as well as discussions on food taboos that could be nutritionally harmful during pregnancy. It is useful to include family members in discussions related to the diet of the pregnant women (WHO 2017c; Setyobudihono *et al* 2016; Pavord *et al* 2011).

2.8 Conclusions

Iron deficiency anaemia is a severe stage of ID and is a major public health problem, affecting more than two billion people globally. It is the most common form of malnutrition in SSA. Pregnant women are most affected by IDA as a result of increased iron requirements. This chapter has reviewed literature on the supplementation of iron in pregnancy. Areas addressed included the overview, chemistry, sources and functions of iron. Other aspects discussed included the prevalence of IDA, its causes as well as effects on the mother and fetus. Barriers to effective supplementation and strategies for controlling IDA, were also reviewed. Iron deficiency anaemia has negative effects on both mother and fetus. Effects of IDA on the mother include maternal morbidity and mortality, with many dying at childbirth because of anaemia,

increased susceptibility to infections and poor work capacity. IDA may lead to intra-uterine growth retardation, preterm birth and early placenta separation. Low birth weight, undernutrition and low intelligence scores may also result from IDA. Possible barriers to effective iron supplementation include insufficient supply of iron supplements and poor adherence or compliance by pregnant women. Ignorance owing to limited information and lack of adequate counselling, poverty, insufficient dietary iron enhancers, religious and cultural beliefs, are other barriers. Poor infrastructure, difficult access to and poor utilisation of healthcare services can also prevent optimal iron supplementation. Unwillingness by some pregnant women to take supplements and disapproval by male partners may also contribute to poor iron supplementation by women. Strategies for preventing IDA in pregnancy include nutrition education leading to dietary diversification and the use of indigenous foods. Food fortification and biofortification may also help reduce the risks of severe iron deficiency in pregnant women and infants, but may not eliminate the need for targeted strategies for the precarious periods of pregnancy. Development of a nutrition education tool for use by pregnant women could enhance knowledge on the use and importance of iron supplementation, and thus reduce the prevalence of IDA among pregnant women. Because most pregnant women in Zimbabwe are affected by IDA, routine iron supplementation with an accompanying nutrition education tool, remains a critical prevention strategy. The aim of this study was to assess the knowledge and acceptance of iron supplements among pregnant women, attending Mutare City Clinic, Manicaland, Zimbabwe. The study also aimed to identify possible barriers to optimal use of iron supplements by pregnant women. A further aim of the study was to develop and test a nutrition education tool with the aim of creating awareness regarding the importance and use of iron supplements among pregnant women, thus improving acceptance and use of the supplements.

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CHAPTER 3

STUDY DESIGN, BACKGROUND TO THE STUDY SITE AND ETHICAL APPROVALS

This chapter presents the study design, background to the study site and ethical approvals.

3.1 Study design

This cross-sectional study was conducted during the first phase of the study to assess knowledge and acceptance on the importance and use of iron supplements by pregnant women. One hundred and three pregnant women were conveniently sampled, as well as six nurses working with the women. The survey was preferred for data collection since surveys are cost-effective and efficient in gathering data (Sim, Saunders, Waterfield & Kingstone 2018; Creswell 2014, p203). In this study, the convergent parallel mixed-methods approach was adopted to enable collection of both quantitative and qualitative data (Creswell 2014, p269). The survey instruments used were structured interviews and survey questionnaires. Triangulation of instruments was used to overcome bias. Triangulation is a strategy for combining and complementing the strengths of both qualitative and quantitative approaches (Creswell 2014, p251).

The second phase of the study employed a qualitative approach with FGDs. The FGDs aimed to identify the possible barriers to optimal iron supplementation by pregnant women. A homogeneous purposive sample comprising 64 pregnant women, was selected to participate in the FGDs over a period of four weeks. Purposive or subjective sampling is widely used in qualitative research to determine specific traits and information, which cannot be randomly obtained from anyone (Crossman 2018; Palinkas *et al* 2013). Focus group discussions were preferred because they enable data to be drawn from the complex personal experiences, beliefs and perceptions of the pregnant women. Large amounts of qualitative, primary data can also be collected within a short time (Alshenqeeti 2014).

The third phase of the study also employed a qualitative approach in developing a nutrition education tool for pregnant women and testing its user-friendliness and acceptability amongst the women. The FGD interview guide and the developing and assessing nutrition education hand-outs (DANEH) checklist were used to collect data. Sixty-seven pregnant women were purposively sampled to participate in eight FGDs on the development of a nutrition education tool. Another 28 pregnant women participated in three FGDs to test the user-friendliness and

acceptability of the tool to pregnant women. The conceptual framework of the study flow is shown in Figure 3.1.

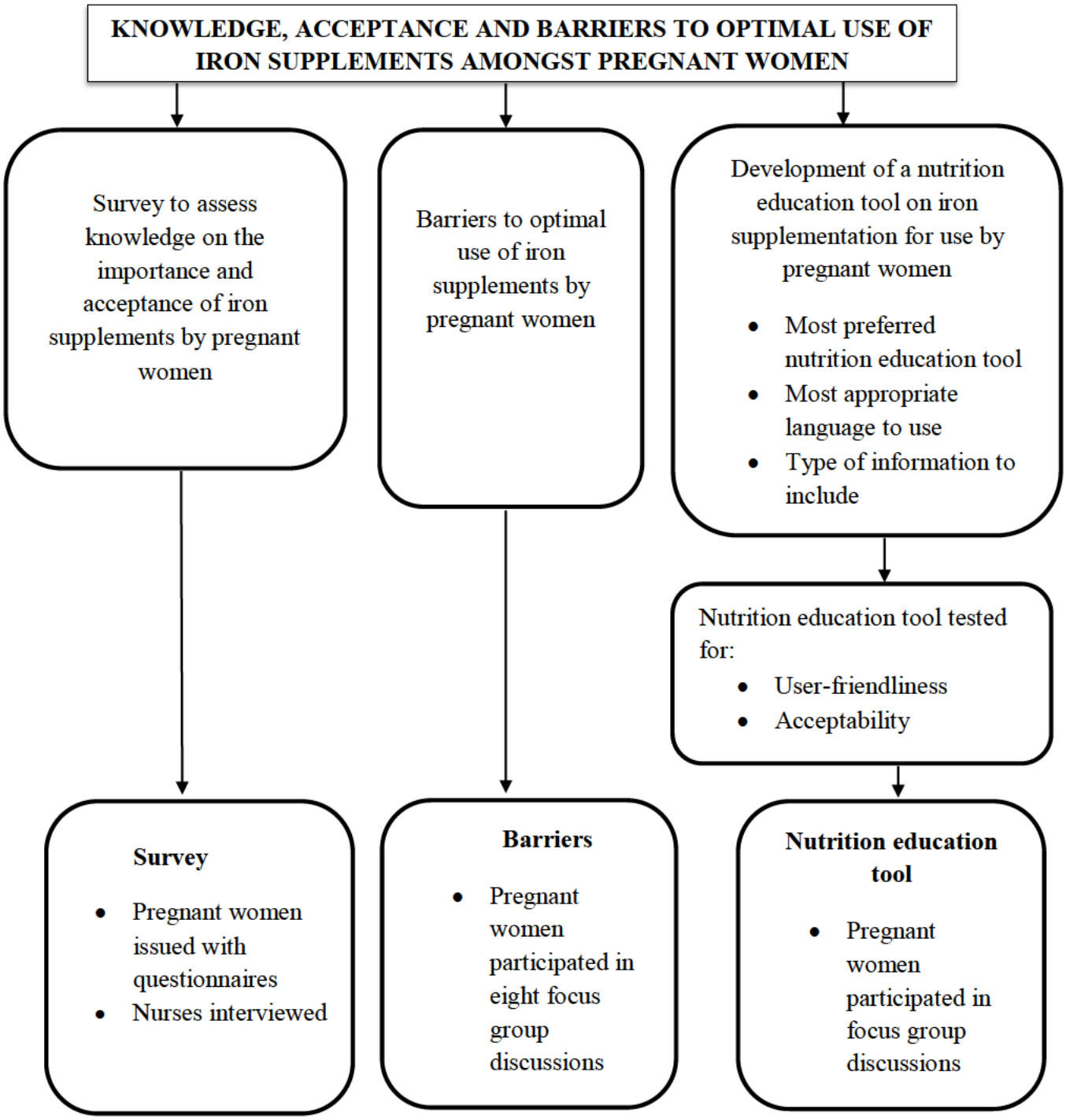

Figure 3.1: Conceptual framework of the study flow

3.2 Setting for the study and participants

The study was carried out in one urban clinic in the city of Mutare, Manicaland province, Zimbabwe. Pregnant women who were either in their second or third trimesters were conveniently selected from Mutare City Clinic during their ANC visits at the clinic. This clinic was chosen because of its central location and accessibility to most residents within the town and surrounding suburbs and also because there is a lack of published data on iron supplement use by pregnant women in this area. Mutare City Clinic is not representative of other rural clinics in Zimbabwe. The city clinic services a mixed hub of Mutare residents, comprising both high and low income earners, as well as the employed and unemployed. However, the low income earners mostly attend Mutare City Clinic for their ANC visits, while most high income earners use private hospitals, where there are better facilities, though costly. The monthly statistics obtained from Mutare City Clinic revealed that the total number of women attending ANC visits monthly between June 2015 and June 2016 ranged from 35 to 55, with a combined total of 579.

3.3 Background to Mutare Municipality

Manicaland is one of the eight provinces in the landlocked Zimbabwe, with Mutare city being the provincial capital (ZimGuide 2019). Mutare is the fourth largest city in Zimbabwe and is the eastern gateway city to the Indian Ocean, lying approximately 8 km from the border between Zimbabwe and Mozambique [ZimGuide 2019; Portlandmutare 2016; Zimbabwe National Statistics Agency (Zimstat) 2013]. Mutare is well known for its location high in the Eastern Highlands and it lies between the Tsambe and Mutare rivers (Figure 3.2).

Figure 3.2: The map of Zimbabwe showing the city of Mutare in Manicaland (United Nations 2010)

The city of Mutare is surrounded by ever misty mountains in the beautiful Eastern Highlands. The numerous mountainous ranges that are characteristic of the Eastern Highlands have earned Mutare the name 'kumakomoyo', which denotes a place of many mountains (ZimGuide 2019; Portlandmutare 2016). According to Zimstat (2013), the word 'mutare' originates from the word 'Utare' which means 'iron', or simply metal. This was after gold was discovered in the Penhalonga valley through which the Mutare river runs (Zimstat 2013). The town lies north of the Bvumba mountains and south of the Imbeza valley and has a mountain pass leading into the city from the west (ZimGuide 2019; Portlandmutare 2016; Zimbabwe Atlas 2012). Mutare is also closely linked to Rusape, Nyanga, Vumba, Chimanimani mountains and Honde Valley (ZimGuide 2019).

Economically, Mutare is mainly agrarian with vegetable and citrus farming being dominant, followed by mining of diamonds and gold in Marange and Penhalonga, respectively (ZimGuide 2019). Agriculture and cattle ranching, forestry, as well as trading in second hand clothes from neighbouring Mozambique, are among other economic activities. According to the United

Nations (2010), the country analysis report for Zimbabwe confirms that agriculture plays a pivotal role in Zimbabwe's economy and is a key component of the efforts to reduce poverty. Mutare also generates revenue from tourist attraction centres such as the Nyanga and Bvumba mountains, various botanical gardens and the hot-springs (Portlandmutare 2016; Mutasa 2015).

Urban Mutare occupies an area of approximately 16 700 hectares. The population census of 2012 revealed an urban population of 187 621 inhabitants, comprising 88 630 males and 98 991 females (Zimstat 2013; Zimbabwe Atlas 2012). The population in Mutare is predominantly black African Shona, the majority being of the Manyika dialect. In Manicaland, the distribution of the urban population in terms of race is black African (99.2%), White (0.2%), Indian/Asian (0.2%) and mixed race (0.2%), with another 0.2% not having stated. The literacy level in Mutare district is very high at 99% (Zimstat 2013). In spite of the high literacy levels, the unemployment rate has remained very high. According to Bhoroma (2019), Zimbabwe is currently experiencing all features of economic decline, a high unemployment rate, declining corporate earnings and rising inflation. Zimbabwean statistics indicate that in June 2019 inflation had quickened to 175.66%, the second highest in the world after Venezuela (Bhoroma 2019). Zimbabwe's failure to curb the escalating unemployment crisis is despite government intervention to stop employers retrenching staff (Mutasa 2015). Economists have warned that unemployment will continue to rise as the economy worsens, with companies continuing to collapse and also worsening environmental conditions such as recurrent droughts [Bhoroma 2019; The Economist Intelligence Unit Limited (EIUL) 2016; Mutasa 2015; United Nations 2010]. The income of the majority of citizens is almost zero, with many households going for months without income (Mutasa 2015). The Zimbabwean economy has suffered a cumulative economic decline, which has worsened the poverty and unemployment situation (United Nations 2010). This has made the standard of living very difficult and unbearable for many households, with the frequency and quality of meals diminishing each day (Mutasa 2015).

3.4 Background to Mutare City Clinic

Mutare City Clinic, the study site, is run by the Mutare Municipality's Health Department at the Civic Centre (Figure 3.3), but falls under the Ministry of Health and Childcare (MOHCC). Most of the black African majority in the surrounding suburbs come to this clinic for ANC visits during pregnancy. Suburbs serviced by the city clinic include Murambi, Fairbridge, Morningside, Tigers Kloof, Greenside, Bordervale, Palmerstone, Darlington, Hospital Hill, Yoevil, Westlea, Utopia, Florida, as well as the Avenues in town.

Figure 3.3: Mutare Municipality Civic Centre

Mutare City Clinic (Figure 3.4) is the only public health centre in the central business district where pregnant women can go for ANC (ZimGuide 2019; Zimstat 2013). According to ZimGuide (2019), Mutare Provincial Hospital, which is another health centre located a few kilometres from the Central Business District (CBD), is a referral centre for the whole province of Manicaland and focuses on emergencies and complicated cases only.

Figure 3.4: Mutare City Clinic (Study site)

Although various private health institutions are scattered around the city, because of the poor financial situation, the majority of pregnant women use Mutare City Clinic, where they pay $2 500 Zimbabwean dollars (R500) for ANC. Many pregnant women cannot afford to pay the thousands of Zimbabean dollars usually charged in many private practices.

Mutare City Clinic is manned by nine staff members, six of whom are registered general nurses (RGN), while three others are general workers. Among the six nurses, there is the Sister in charge (SIC), who heads the healthcare centre. There are two full-time nurses in the ANC section and two full-time nurses in the well-baby clinic. The other two work in the outpatients department (OPD) and dispensary. Out of the six nurses, five are female, with only one male. Mutare City Clinic is located in the eastern direction, approximately 300m from the CBD (Figure 3.5).

Figure 3.5: Aerial view of Mutare Central Business District including the City Clinic (Corner C Avenue and 5th Street) (Street-view Maps 2019)

3.5 Approvals to conduct study

Ethical approval to conduct this study was obtained from the University of KwaZulu-Natal Humanities and Social Sciences Research Ethics Committee (Reference number: HSS/0369/016D) (Appendix A). Approval to use the Mutare City Clinic was also obtained

from Mutare Municipality's Health Department, Director of Health Services (Appendix B). Written consent was also obtained from individual participants, including both pregnant women and nurses before they could participate in the research.

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CHAPTER 4

PERCEPTIONS OF NURSES AND PREGNANT WOMEN ON KNOWLEDGE AND USE OF IRON SUPPLEMENTS DURING PREGNANCY

Abstract

Iron supplementation is recommended for every woman during pregnancy. This is necessary to increase blood haemoglobin (Hb) levels and prevent iron deficiency anaemia (IDA), which usually occurs due to the increased demands of pregnancy. As the pregnancy progresses, the iron requirements also increase, and since diet alone cannot suffice, there is a need for iron supplements. In developing countries, foods that are rich in haem-iron are usually expensive and inaccessible, leading to a high prevalence of IDA. In Zimbabwe, a developing country, IDA affects women of reproductive age, especially during pregnancy. Therefore, optimal use of iron supplements by pregnant women can be an effective intervention strategy for the alleviation of IDA. Iron supplementation may help to reduce the maternal mortality rate and thus improve the health of women. The aim of this study was to assess knowledge on the importance of iron supplements during pregnancy amongst pregnant women attending Mutare City Clinic, Manicaland, Zimbabwe. The study also aimed to assess the use of iron supplements by pregnant women, as perceived by nurses and pregnant women attending Mutare City Clinic for ante-natal care (ANC). Therefore, six nurses working at Mutare City Clinic were interviewed. Mutare was chosen as the site for the study, since there is no published data on iron supplementation during pregnancy in the city. The study sample comprised 103 pregnant women who were conveniently sampled and were attending Mutare City Clinic for their ANC. The study aimed to establish the level of understanding and awareness of iron supplements by pregnant women, and how well they accepted and used the iron supplements. Their ages, religious affiliations, highest educational qualifications, marital and employment status were also established. It was found that women generally had limited knowledge on the importance of iron supplements during pregnancy. Interviews with the nurses confirmed that despite high literacy levels, discussions and nutrition education from nurses, iron supplementation during pregnancy was still inadequate. Many women seemed to appreciate the role of iron supplements in pregnancy, but the onset, compliance and the duration over which the supplements needed to be taken, were not fully understood. The majority indicated that they would stop taking supplements when they delivered their baby. This was, however, contrary to the recommendations by the World Health Organization (WHO), which stipulate that daily

supplementation should continue up to six weeks post-partum, or even three months post-partum, in severe cases. Early bookings at the healthcare centres would likely enhance use of iron supplements by pregnant women, because iron supplements are offered to pregnant women during their first contact with the nurses. Establishing haemoglobin levels before or at the onset of pregnancy helps to detect and address low Hb levels and the complications that may arise. Nutrition education on iron supplementation given during ANC visits, may help to improve compliance amongst pregnant women, thus contributing towards positive maternal outcomes.

4.1 Introduction

Iron supplements are essential during pregnancy. The WHO (2012) has recommended that all pregnant women should routinely receive iron and folate supplements, with appropriate dietary advice to ensure enhanced absorption of iron. Most healthcare centres recommend routine iron supplementation in pregnancy, using once daily oral dosages (WHO 2015a; Ugwu, Olibe, Obi & Ugwu 2014). A standard dose of 60 mg iron and 400 µg folic acid daily for six months is recommended in pregnancy, and can be continued until three months post-partum (WHO 2015a; Ibrahim 2008). Iron supplements are essential in preventing IDA and increasing haemoglobin (Hb) concentrations. Iron supplementation for women during pregnancy benefits the developing fetus, since it solely depends on maternal iron stores (Cox 2016; Rashash & Abbas 2015; Stoltzfus 2011).

According to the WHO (2015b), anaemia is a public health problem affecting low, middle and high-income countries. However, it is highly prevalent in low income countries. Cox (2016) shares the same sentiments and highlights that developing countries are particularly at high risk of IDA. This increased risk of IDA results from poor availability of iron-rich foods and iron supplements. Anaemia in pregnancy is characterised by a Hb level of <11 g/dl or haematocrit <33% (WHO 2015b; Cox 2016). Jönsson & Guha Sapir (2009), note that in Zimbabwe the prevalence of anaemia increased from 31% in 1999, to 37.3% in 2006, and is therefore a priority. This reinforces that there is a need for pregnant women to have adequate knowledge on iron supplements to ensure acceptance and compliance with the supplements (Cox 2016; Jönsson & Guha Sapir 2009).

Iron supplements are useful in ensuring the formation of Hb, which gives blood its red colour. Haemoglobin, which transports oxygen around the body cells (Williams 2011, p15; WHO

2010), is increased in order to meet the recommended dietary allowance (RDA) for iron during pregnancy. Although it is found in every cell, iron is widely distributed in the red blood cells [Linus Pauling Institute (LPI) 2016]. Iron, which has important metabolic functions in living organisms, [Australian Government Geoscience (AGG) 2016], is the main constituent of cytochromes, which are actively involved in the mitochondrial electron transport chain during the metabolism of energy-yielding nutrients (AGG 2016). It also helps in the formation of enzymes, co-enzymes and has anti-oxidant functions. Iron is also important for the storage of oxygen, since it is a component of the protein myoglobin, which helps the body to store oxygen in the muscles (Culvert & Brody 2016).

Optimal absorption of iron from supplements helps to ensure normal regulation of fetal growth, immune system functioning, cognition, as well as proper cell differentiation (Rajendram, Preedy & Patel 2017; Stewart 2016). The need for iron supplements during pregnancy varies according to trimesters. The iron requirement gradually increases from the first trimester throughout the remainder of pregnancy, until pregnancy is at full term. In the first trimester, because menstruation stops, there is a median saving of about 0.56 mg of iron, with most of the iron accumulating during the third trimester (Rajendram *et al* 2017; Stewart 2016; Brown 2013, p113; Osungbade & Oladunjoye 2012). In the third trimester, iron requirements for fetal growth rise steadily in proportion to the weight of the fetus (Rajendram *et al* 2017; Brown 2013, p113). To supply fetal needs, the mother's blood volume expands to approximately 150% of normal and the number of red blood cells increases by about 20%-30% (Rajendram *et al* 2017). Therefore, if iron stores and dietary iron intake are not sufficient to meet iron requirements during pregnancy, IDA results. Thus, there is a need for optimal use of iron supplements to guard against deficiencies (Rajendram *et al* 2017).

There are many types of iron supplements. The most common oral iron salts are ferrous fumarate, ferrous sulphate and ferrous gluconate (WHO 2012; Ibrahim 2008). However, ferrous sulphate ($FeSO_4$) is the standard preparation used in the oral management of IDA. It is the most favourable and most common supplement among other salts. It is very soluble, fast working and has good bioavailability. It is also a cost-effective supplement [Stewart 2016; National Rural Health Mission (NRHM) 2014; WHO 2012; Ibrahim 2008].

Inadequate use of iron supplements may have negative effects on the health of both the pregnant woman and fetus. Some of the major effects on the woman include high maternal morbidity and mortality as well as cardiovascular consequences (NRHM 2014; Pavord, Myers,

Robinson, Allard, Strong & Oppenheimer 2011, p6; Stoltzfus 2011). Increased susceptibility to infections, poor work capacity and disturbance of post-partum cognition and emotions are other side-effects (NRHM 2014; Stoltzfus 2011). On the other hand, IDA can reduce oxygen supply to the fetus causing intra-uterine growth retardation and the fetal brain may be at risk of failing to develop optimally. There is some evidence of the association between maternal ID and increased preterm delivery, low birth weight, possible placental abruption and increased peri-partum blood loss (Pavord *et al* 2011, p6). Lower scores in intelligence, language and gross-motor and attention tests may be evident in affected children at the age of five years (Talaulikar 2012). Therefore, if IDA is reduced in pregnant women, fetal outcomes may be positive. Five strategies for combating IDA include nutrition education, dietary diversification, food fortification, food biofortification and iron supplementation (WHO 2017; WHO 2015b). Out of these five strategies, iron supplementation is the most important and affordable strategy, especially when dealing with vulnerable groups such as pregnant women (WHO 2017; WHO 2015b).

Although iron supplements are essential during pregnancy, the main challenge affecting pregnant women is poor use of iron supplements (Nisar, Alam, Aurangzeb & Dibley 2014). Poor use of iron supplements has been noted to be mainly as a result of inadequate supplies at the healthcare centres, poor adherence by women, religious reasons, as well as the lack of correct information (WHO 2015b; Nisar *et al* 2014). This has resulted in various complications, negatively affecting pregnancy outcomes (Talaulikar 2012; Pavord *et al* 2011, p6). Thus, this study aimed to assess knowledge on the importance of iron supplements during pregnancy amongst pregnant women attending Mutare City Clinic, Manicaland, Zimbabwe for ANC. The study also aimed to assess the use of iron supplements by pregnant women, as perceived by nurses and pregnant attending Mutare City Clinic for ANC. Figure 4.1 illustrates the flow diagram of the study design.

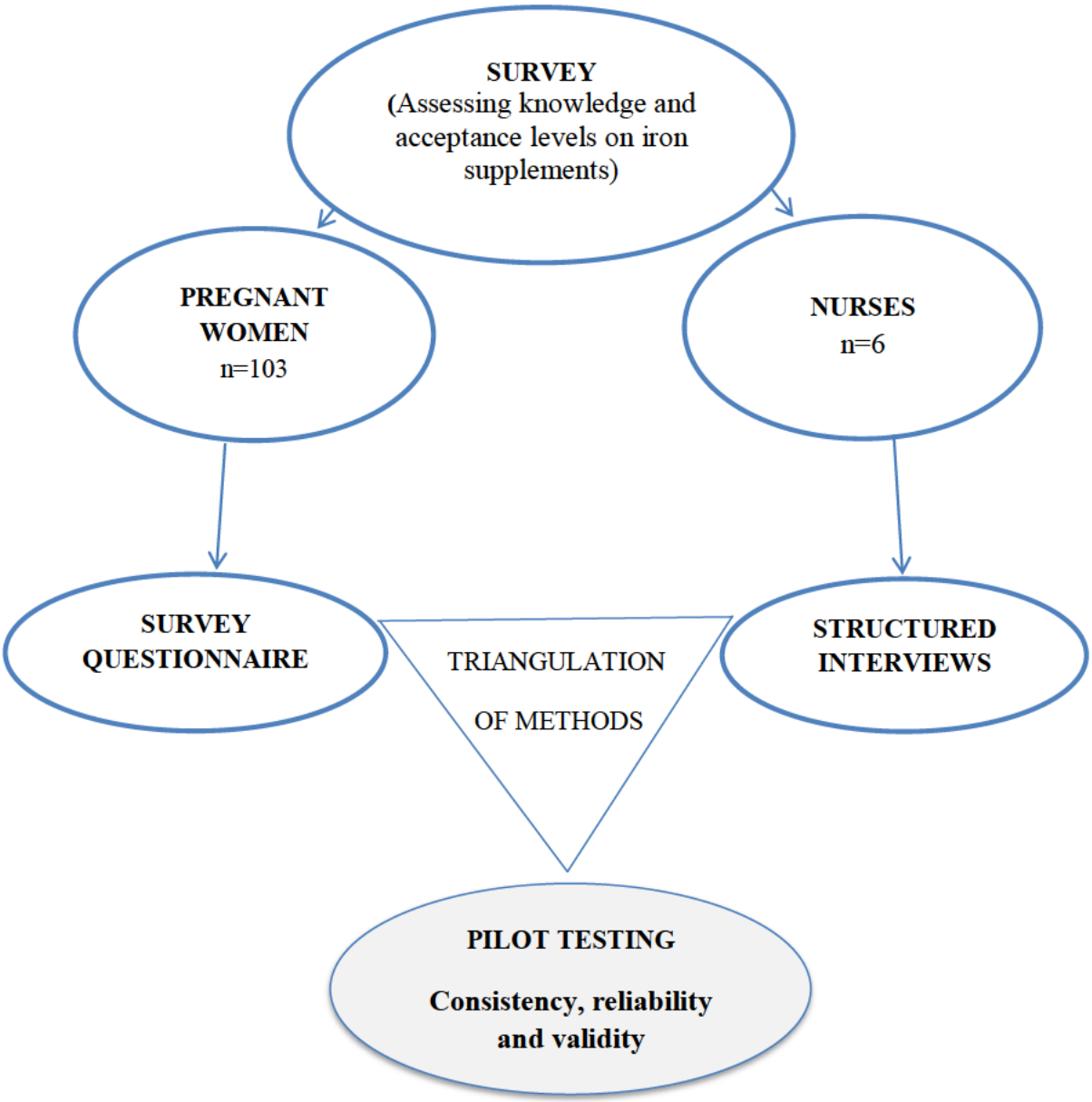

Figure 4.1: Flow diagram of the study design

4.2 Materials and methods

A cross-sectional approach was used to collect data. The mixed-methods approach was adopted, with the convergent parallel mixed-methods being specifically used. The convergent parallel mixed-methods is an approach in which the researcher collects both quantitative and qualitative data during the same phase of the research process, analyses them separately and then compares the results to see if the findings from each are similar (Creswell 2014, p269). In this study, the researcher merged quantitative data obtained from pregnant women with qualitative data obtained from nurses to answer the study objectives. The study made use of two instruments,

the survey questionnaire, to collect data from pregnant women and structured interviews to collect data from nurses. Thus, it employed both the qualitative and quantitative data collection methods.

4.2.1 Study design

In this study, a survey was conducted to establish the knowledge and use of iron supplements among pregnant women, as well as the pregnancy history and type of complications faced by these pregnant women. A survey is a process of gathering data that could involve a wide variety of data collection methods, including questionnaires and interviews (Sim, Saunders, Waterfield & Kingstone 2018; Omona 2013). A survey is a commonly used method of collecting information about a population of interest (Guest, Namey & McKenna 2017; Sharma 2017; Omona 2013). This cross-sectional survey included pregnant women receiving ANC at Mutare City Clinic, as well as the nurses providing ANC services to the women. Surveys are advantageous in that they are cost-effective and efficient in gathering information about a population (Alshenqeeti 2014; Palinkas, Horwitz, Wisdom, Green, Duan & Hoagwood 2013). They are particularly useful when the population of interest is very large or dispersed across a large geographical area (Martínez-Messa, González-Chica, Duquia, Bonamigo & Bastos 2016; Alshenqeeti 2014).

4.2.2 Population and sample selection

4.2.2.1 Study population

In this study, all pregnant women attending the Mutare City Clinic for ANC services were the target population. The total population at the time of the study was 147 pregnant women. The sample to be studied was extracted from the study population.

4.2.2.2 Sampling of pregnant women

One hundred and three women in their second and third trimester of pregnancy, attending Mutare City Clinic for their ANC visits, were selected to participate in the survey. These pregnant women were conveniently sampled by the nurses, based on their availability, as well as statistics obtained from the senior nursing Sister in the ANC unit. Pregnant women in the second and third trimester were specifically chosen because iron requirements increase as the pregnancy progresses. As such, iron deficiency usually becomes evident as the pregnancy advances (Brannon & Taylor 2017; Gautam, Saha, Sekhri & Saha 2008).

4.2.2.3 Sampling of nurses

Six nurses, including the Sister in charge (SIC), staff Mutare City Clinic. All six nurses (five female and one male), were included in the study due to the small number of nurses employed at the clinic. All nurses met the inclusion criteria, and thus were recruited to participate in six individual, structured interviews. The interviews aimed to establish knowledge and acceptance levels of pregnant women on the use of iron supplements, as perceived by nurses. The nurses work very closely with the pregnant women during their ANC visits. Therefore, they are most likely to advise and guide pregnant women on the use of iron supplements.

4.2.3 Instruments for data collection

Instruments refer to fact-finding strategies or tools developed to aid the acquisition of data in varying and distinctive ways (Annum 2017; Dudovskiy 2017; Guetterman 2015). Various types of instruments are employed for data collection to suit specific research approaches, which could either be qualitative, quantitative or the mixed-methods. For the purposes of this study, a survey questionnaire and structured interview guide were the instruments used for data collection. The survey questionnaire and structured interviews were specifically designed to meet the study objectives.

4.2.3.1 Survey questionnaire

Questionnaires are mostly used in surveys and consist of a predefined series of questions used to collect statistically useful information from individuals (Dudovskiy 2017). A questionnaire is an instrument for collecting data and always involves asking a given subject to respond to a set of systematically compiled oral or written questions (Annum 2017; Sharma 2017; Omona 2013). A survey questionnaire was used to collect data from pregnant women in their second and third trimester, attending Mutare City Clinic for ANC. Advantages of questionnaires include increased speed of data collection, cost efficiency, practicality and higher objectivity, compared to many alternative methods of primary data collection (Dudovskiy 2017; Guest *et al* 2017; Martínez-Messa *et al* 2016). Therefore, for the purposes of this study, a survey questionnaire was used because of its ability to collect varied data from a diverse population within a short space of time. The questionnaire was developed in both English (Appendix C) and Shona (Appendix D), so that participants could answer in the language most preferred or best understood. The questionnaire contained both close-ended and open-ended questions. It was designed and developed by the researcher to meet the specific study requirements. The survey questionnaire was divided into three sub-sections. The first sub-section (Section A)

addressed the demographic characteristics of the participants, comprising mainly close-ended questions. The second sub-section (Section B) sought to establish the pregnancy history of the pregnant women and comprised both closed- and open- ended questions. Section C focused on the knowledge of pregnant women on the use of iron supplements, addressing issues of frequency, consistency, availability as well as duration of supplementation.

However, since questionnaires are written forms completed by participants, there is a possibility that some participants may give biased information (Dudovskiy 2017). Therefore, triangulation of instruments helps to ensure validity and reliability of findings. According to Yeasmin & Rahman (2012), survey instruments must be valid and reliable. For instance, non-verbal cues can be observed during interviews, which is not possible when using questionnaires (Annum 2017; Yeasmin & Rahman 2012).

4.2.3.2 Structured interviews with the nurses

Interviewing is a data collection method which is used when there is need to meet face-to-face with individuals to interact and generate ideas based on mutual interest (Annum 2017; Alshenqeeti 2014). According to Jamshed (2014), it is the most common form of data collection in qualitative research. Interviews offer many advantages in qualitative research, such as a high return rate and fewer incomplete answers. Interviews offer a controlled answering order, which is relatively flexible. According to Yeasmin & Rahman (2012), interviews help the interviewer to capture verbal and non-verbal cues. Thus, it is ideal in that it ensures that one keeps focus, at the same time capturing emotions and behaviours. Qualitative interviews help the interviewee to provide a first hand, first person account (Guest *et al* 2017). Questions are usually open-ended and the discussion is conversational in nature. The interviewer is able to gather in-depth data that is not easily obtained through questionnaires (Annum 2017; Guetterman 2015; Alshenqeeti 2014).

4.2.3 (a) Triangulation of data instruments and participants

Triangulation is a strategy for combining and complementing the strengths of both qualitative and quantitative approaches (Creswell 2014, p251; Yeasmin & Rahman 2012). According to Creswell (2014, p251), triangulation of data sources is a means for seeking convergence across qualitative and quantitative methods. It refers to the use of multiple methods of data collection in order to develop a comprehensive understanding of phenomena. In qualitative research, triangulation is a strategy to test validity or accuracy of a database (Carter, Bryant-Lukosius,

DiCenso, Blythe & Neville 2014; Creswell 2014, p251). According to Yeasmin & Rahman (2012), each data collection tool has its own weakness or intrinsic bias. As such, it is beneficial to combine qualitative and quantitative data, as this neutralises weaknesses from each.

Triangulation of data and participants was conducted by way of survey questionnaires for pregnant women and interviews conducted with six nurses from the Mutare City Clinic. The questionnaire, which is a quantitative instrument, was used in combination with an interview, which is qualitative in nature. Combining the advantages of survey questionnaires and interviews helped to counter bias, at the same time minimising shortcomings of both methods. In this study, the use of different categories of participants, who were the nurses and the pregnant women, helped to ensure validity and reliability of the data. This also helped to clarify nurses' and pregnant women's perceptions of the importance and use of iron supplements during pregnancy.

4.2.4 Pilot study

4.2.4.1 Pregnant women

The pilot study was conducted on the 20th and 24th of June 2016, prior to the main study, which was conducted between August and mid-September 2016. The purpose of the pilot study was to determine the feasibility of the study and to validate and check the reliability of the instrument (survey questionnaire). It also aimed to identify and correct possible typographic errors or ambiguous questions in the survey questionnaire. Ten pregnant women in their last trimester of pregnancy and specifically at 28 weeks gestation and above participated in the pilot study. The nurses purposively selected these women during their ANC visits at Mutare City Clinic. The pilot study participants were not allowed to participate in the main study. To ensure non-involvement of these participants in the main study, the main survey was conducted from the end of August. The end of August was ideal as all the pilot study participants would have delivered by then. Before participating in the pilot study, participants signed consent documents, indicating their willingness to participate, to be audio-recorded, to be photographed and to have their photographs reproduced. Consent documents were prepared in both English (Appendix E) and Shona (Appendix F). After the pilot study, ambiguous statements in the English versions and typographical errors in the Shona versions of the survey questionnaire were identified and corrected. On the English version, question 9(a) was edited to: 'Have you experienced any complications in previous pregnancies?' Question 14(a) of the Shona version was edited to: 'muri kuashandisa' instead of 'murikuashandisa.' Most participants made use of the English version of the survey questionnaire (Appendix C), while a few others preferred the

Shona version (Appendix D), for clarity of explanations and ease of understanding. The pilot study found that it took the pregnant women about 25 minutes to complete the survey questionnaire.

4.2.4.2 Nurses

Two registered general nurses (RGNs) participated as interviewees in the pilot study, which was conducted prior to the main study. They both worked in the ANC unit of a clinic in the neighbouring township of Chikanga, in the city of Mutare. These nurses were invited to participate in the pilot study based on their experience in the ANC unit and their similar qualifications to those of the main study, who were also registered general nurses. Due to the small number of nurses at the Mutare City Clinic, all the nurses were invited to participate in the main study. Therefore, the researcher had to conduct the pilot study with nurses from another clinic, who would not participate in the main study. Before participating in the pilot study, the two participants signed consent documents, indicating their willingness to participate, to be audio-recorded, to be photographed and to have their photographs reproduced. Informed consent documents were prepared in English (Appendix H). The pilot study was conducted about two weeks before the main study began. This was done to allow time for corrections and adjustments to be made to the questionnaire, should they be needed. Changes were made to some ambiguous words and some technical terms, which were then replaced with clearer alternatives. The interviews conducted with nurses during the pilot study took about 20 minutes per session. The interview guide (Appendix G) was developed and conducted in English, since all nurses were generally very proficient in English.

4.2.5 Procedure for data collection

Two instruments were used to collect data, which was the survey questionnaire and structured interviews. The questionnaires were administered to pregnant women over a period of 6 weeks, from the beginning of August to mid-September 2016, during their ANC visits at the clinic. Structured interviews were conducted face-to-face with all nurses at the city clinic, over a period of four weeks and was facilitated by the researcher.

4.2.5.1 Pregnant women

The survey questionnaires were administered over a period of six weeks, on Mondays and Fridays, when pregnant women came for their routine ANC visits at the clinic. The researcher first explained the purpose of the study to the pregnant women. It was also made clear to them

that they were free to stop participating in the study at any point, should they so wish, without any negative consequences. Participants were assured that no names would be used and confidentiality would be maintained. Before they participated in the survey, participants gave consent to participate, to be photographed and to have their photographs reproduced. Consent documents were prepared both in English (Appendix E) and Shona (Appendix F). To control bias, the researcher and research assistants ensured that participants did not discuss their responses with each other as they completed the questionnaires. The survey questionnaires were developed in both English (Appendix C) and Shona (Appendix D), with accompanying consent forms in English (Appendix E) and in Shona (Appendix F). It took about 25 minutes for most women to complete the questionnaires. A research assistant checked that all questions in the questionnaire were answered before collecting the questionnaires from the women.

4.2.5.2 Nurses

In the survey, six interview sessions were conducted with nurses over a four week period using an interview guide in English (Appendix G). The interview sessions were scheduled depending on availability of the nurses, during each particular week. The interviews aimed to gather information from nurses about their perceptions on the use of iron supplements by pregnant women. The researcher first explained the purpose of the study to each interviewee before the interview commenced. The nurses were each given an interview consent form (Appendix H) to read. After reading it, they then gave consent to participate, to be photographed and to be audio recorded during interview sessions. The researcher, with the aid of two research assistants, conducted the interviews. One research assistant set up the voice recorder and recorded all the interview sessions, while the other focused on photography, taking notes, as well as noting non-verbal cues from the participants. Figure 4.2 illustrates pregnant women completing questionnaires for the survey. Figure 4.3 shows an interview session in progress with one of the nurses at Mutare City Clinic.

Figure 4.2: Participants completing questionnaires

Figure 4.3: Interview session with one of the nurses at Mutare City Clinic

4.3 Consent

Ethical approval to use Chikanga Clinic, from where pilot study participants were recruited, had not been applied for, since it was initially assumed that the pilot study would be done at Mutare City Clinic. However, due to the small number of nurses working at Mutare City Clinic, it was decided that all the nurses would be invited to participate in the study. The SIC at Chikanga Clinic gave permission for nurses to participate in the pilot study. The SIC at Mutare

City Clinic, on behalf of the researcher, invited two nurses from Chikanga clinic ANC section to participate in the pilot study based on their experience with ANC.

4.4 Data analysis

A research assistant translated the Shona versions of the questionnaire into English. The translations in English were then translated back to Shona to check for accuracy in translation. The interview audio recordings were transcribed with the assistance of the two research assistants, one of whom was responsible for checking the accuracy of the transcriptions. The transcribed interview data were organised and coded according to major ideas that emerged from the findings. The interview findings from nurses were merged with corresponding findings from pregnant women. The descriptive analyses of data were then conducted using the Statistical Package for Social Sciences (SPSS) version 20.0 and exported to Gretl software to enhance descriptive analysis of data. The contributions of several variables were assessed. These included the availability of supplements at the clinic, cultural and religious background, marital status, support from spouses, number of previous pregnancies experienced and the form in which nutritional information was given to the women. The variables were analysed using detailed descriptions and narrative text.

4.5 Results

4.5.1 Pregnant women

4.5.1.1 Socio-demographic characteristics of pregnant women

Results on the socio-demographic characteristics of the participants are presented in Table 4.1. The pregnant women ranged in age from 16 years up to ≥ 35 years. Most women were between 26-30 years of age (37.9%; n=39), followed by 21-25 years (27.2%; n=28). The least represented age group was 16-17 years (1.9%; n=2), followed by >35 years (6.8%; n=7) and 18-20 years (9.7%; n=10). The majority of the women in this study (98.1%; n=101) indicated that they were married, while 1.9% (n=2) were single. All the pregnant women (100%) belonged to the Christian religion. Most pregnant women (62.1%; n=64) had attained Ordinary Level education, two equal groups of 11.7% (n=12) each, had obtained Advanced and Diploma levels, respectively. Another two equal groups of 1.0% (n=1) each, held Masters degrees and Grade 7, respectively.

Almost half (52.4%; n=54) of the women indicated that they were not employed, either formally or informally (Table 4.1). Of the 47.6% (n=49) who were employed, only 31.1% (n=32) had formal jobs, while 16.5% (n=17) were informally employed, mainly as cross-border

traders. Cross-border traders import goods from other countries to sell in their own country. Table 4.1 summarises the socio-demographic characteristics of pregnant women.

Table 4.1: Socio-demographic characteristics of pregnant women (n=103)

Variable	n	%*
Age (years)		
16-17	2	1.9
18-20	10	9.7
21-25	28	27.2
26-30	39	37.9
31-35	17	16.5
> 35	7	6.8
Marital status		
Married	101	98.1
Single	2	1.9
Divorced	0	0
Religion		
Christian	103	100
Highest education level		
Grade 7	1	1.0
Form 1-2	8	7.8
Ordinary Level	64	62.1
Advanced Level	12	11.7
Diploma	12	11.7
Bachelor's degree	5	4.9
Master's Degree	1	1.0
Employment status		
Unemployed	54	52.4
Formally employed	32	31.1
Informally employed/self-employed	17	16.5

* Percentage of sample (n=103)

4.5.1.2 Pregnancy history of participants

Results on the pregnancy history of participants are presented in Table 4.2. Approximately half of the sample (51.5%; n=53) indicated that they were between 25-32 weeks along in their pregnancies, followed by 17.5% (n=18) between 33-36 weeks and 10.7% (n=11) between 16-20 weeks (Table 4.2). Only six women (5.8%) were between 12-15 weeks pregnant and these were presumed to have booked for ANC on time.

Out of the 103 participants, 65% (n=67) had been previously pregnant at least once, with just over one third (35%; n=36) being pregnant for the first time. Out of the 65% (n=67) who were previously pregnant, 26.2% (n=27) were pregnant for the second time and 24.3% (n=25) for

the third time. Some 10.7% (n=11) had been pregnant three times before, while 3.9% (n=4) had been pregnant four or more times before. Of the 67 women who had previous pregnancies, 47.8% (n=32) had one successful pregnancy and 37.3% (n=25) had two successful pregnancies. Some 7.5% (n=5) had three, while 1.5% (n=1) had four or more successful previous pregnancies. On the other hand, 6% (n=4) had not experienced a successful pregnancy due to various complications (Table 4.2).

Table 4.2: Pregnancy history of women (n=103)

Variable	n	%
Stage of pregnancy (n=103)		
12-15 weeks	6	5.8
16-20 weeks	11	10.7
21-24 weeks	8	7.8
25-28 weeks	27	26.2
29-32 weeks	26	25.2
33-36 weeks	18	17.5
37-40 weeks	7	6.8
Number of previous pregnancies (n=103)		
None	36	35.0
One	27	26.2
Two	25	24.3
Three	11	10.7
≥ Four	4	3.9
Number of successful previous pregnancies (n=67)		
None	4	6.0
One	32	47.8
Two	25	37.3
Three	5	7.5
≥ Four	1	1.5

4.5.1.3 Complications with previous pregnancies

Results of findings on complications experienced during previous pregnancies are summarised in Table 4.3. Of the 67 women who were previously pregnant, 94% (n=63) had successful outcomes in all or some of their pregnancies, while 6% (n=4) women experienced no success with their previous pregnancies. However, of the 63 women with successful outcomes, 33.3% (n=21) had some complications during pregnancy. Thus, the total number of women who experienced complications was 25 (37.3%), inclusive of the four women (6%) whose infants failed to thrive. Miscarriages (32%; n=8) were the most common complication. Due to other complications at the time of delivery, some women delivered through caesarean section (20%;

n=5), while others had episiotomies (16%; n=4) and pregnancy induced hypertension (PIH) (12%; n=3).

Just over 43% (n=45) indicated that they had normal iron levels prior to registration at the clinic, 10.7% (n=11) had low iron levels, while 1% (n=1) had higher than normal levels. On the other hand, 44.7% (n=46) did not know their iron levels. Of the 57 (55.3%) women who had prior knowledge of their Hb levels, 52.6% (n=30) had been informed by nurses, while the remaining 47.4% (n=27) were informed by medical doctors.

Table 4.3: Iron levels and complications with previous pregnancies (n=67)

Variable	**n**	**%**
Complications experienced in previous pregnancies (n=67)		
Yes	25	37.3
No	42	62.7
Type of complications experienced (n=25)		
Miscarriages	8	32.0
Excessive bleeding during delivery	1	4.0
Pregnancy induced hypertension (PIH)	3	12.0
Failure of fetus to thrive	2	8.0
Caesarian section	5	20.0
Ectopic pregnancy and miscarriage	1	4.0
Episiotomy	4	16.0
PIH and history of big babies (>4.5kg)	1	4.0
Number of infants delivered (n=103)		
None	40	38.8
One	31	30.1
Two	25	24.3
Three	5	4.9
Four	1	1.0
Five and above	1	1.0
Iron level before pregnancy (n=103)		
High	1	1.0
Low	11	10.7
Normal	45	43.7
No idea	46	44.7
Person who informed of iron level (n=57)[a]		
Medical doctor	27	47.4
Nurse	30	52.6

[a] Some participants did not answer.

4.5.1.4 Use of iron supplements by pregnant women

The use of iron supplements by pregnant women is summarised in Table 4.4. The majority of participants (95.1%, n=98) visited the clinic for routine ANC visits at least once a month (Table 4.4). They would also get their supplies of iron supplements at the same time, if they were available at the clinic. Almost all pregnant women (98.1%, n=101) were aware of the need to take iron supplements, while very few women (1.9%, n=2) were unaware. Despite almost every pregnant woman (98.1%, n=101) being aware of the need to take iron supplements, only 76.7% (n=79) were taking iron supplements consistently, while 7.8% (n=8) sometimes took the supplements (Table 4.4). A total of 15.5% (n=16) were not taking iron supplements at all. Out of the 87 women who took iron supplements, 90.8% (n=79) took them on a daily basis, while 4.6% (n=4) took the iron supplements once a week. Two equal groups of 2.3% (n=2) each, took the supplements twice and thrice a week, respectively (Table 4.4). One woman indicated that her religious affiliation did not permit use of supplements.

The onset of taking iron supplements was shown to be predominantly at three months into the pregnancy (29.9%; n=26); followed by four months (23.0%; n=20) and five months (19.5%; n=17). It was also noted that 6.9% (n=6) of the participants started taking their iron supplements even before three months into their pregnancies. However, another 6.9% (n=6) started taking iron supplements after six months (Table 4.4).

Just over 88% (n=77) of the pregnant women who were taking supplements indicated that they obtained these from the local clinic, while 9.2% (n=8) bought their supplies from private pharmacies, and the remaining 2.3% (n=2) either bought from the pharmacy or sometimes collected from the clinics. Seventy-three out of the 79 women (92.4%) who collected their supplies from the clinic, indicated receipt of iron supplements at least once a month from the local clinic (Table 4.4). Most of the pregnant women (90.8%; n=79) took their supplements on a daily basis, which is in line with recommendations given by WHO (2012).

Table 4.4: Use of iron supplements by pregnant women (n=103)

Variable	n	%
Frequency of check-up visits at clinic (n=103)		
Once every week	2	1.9
Once every two weeks	3	2.9
Once a month	98	95.1
Awareness of the need to take iron supplements (n=103)		
Yes	101	98.1
No	2	1.9
Iron supplements being taken (n=103)		
Yes	79	76.7
No	16	15.5
Sometimes	8	7.8
If yes, when were iron supplements started?(n=87)		
Before three months	6	6.9
At three months	26	29.9
At four months	20	23.0
At five months	17	19.5
At six months	12	13.8
After six months	6	6.9
Reasons for not taking iron supplements (n=16)		
I just don't like them	3	18.8
My church does not allow use of tablets	1	6.3
They are expensive	0	0
They cause discomfort like constipation and heartburn	2	12.5
We have not yet been given	5	31.3
Lack of knowledge	5	31.3
Reasons for taking iron supplements (n=87)		
They increase my blood volume	82	94.3
Nurses at clinic encourage us to take the supplements	5	5.7
Source of iron supplements (n=87)		
Given at the clinic	77	88.5
Bought from pharmacy	8	9.2
Bought from pharmacy and sometimes collected from clinic	2	2.3
How often are you offered iron supplements? (n=79)		
Once a month	73	92.4
Once in two months	6	7.6
Frequency of taking supplements (n=87)		
Daily	79	90.8
Once a week	4	4.6
Twice a week	2	2.3
Thrice a week	2	2.3

4.5.1.5 Knowledge of iron supplements by pregnant women

Findings on the knowledge of iron supplements by pregnant women is presented in Table 4.5. The majority of the pregnant women (72.4%; n=63) indicated that they were going to take iron

supplements up to when they delivered. Another 25.3% (n=22) would take them up to three months after delivery; 1.2% (n=1) indicated they would take supplements until their blood iron levels normalised. Yet another 1.2% (n=1) would continue with supplements for up to six weeks after delivery (Table 4.5). Only 25.2% (n=22) indicated that they would use iron supplements until at least three months after delivery.

Out of 103 pregnant women, the majority (96.1%; n=99) acknowledged receiving information regarding the importance of iron supplements. Two women (1.9%) indicated that they received the information, though less frequently. Yet another two women (1.9%) said they did not receive any nutrition information. Of the 101 pregnant women who received nutrition information, most participants (98%; n=99) confirmed that the information was mainly disseminated through talks/discussions held at the clinic.

All the participants inclusive of those who were not taking supplements, confirmed that iron supplements were necessary for pregnant women. However, there were diverse opinions on justifications regarding the need for iron supplements. Most (75.7%; n=78) believed that the iron supplements were really necessary for increasing blood volume for both the mother and fetus. Another 13.6% (n=14) cited the importance of supplements in boosting the mother's immune system and prevented anaemia, while 14.6% (n=15) highlighted that supplements reduced complications and death of both mother and fetus during and after delivery. Only one person (0.9 %) incorrectly thought that iron supplements were used to prevent malaria.

Table 4.5: Knowledge of iron supplements by pregnant women (n=103)

Variable	n	%
Duration of iron supplementation (n=87)		
Up to when I deliver	63	72.4
Up to three months after delivery	22	25.3
When my blood Hb level becomes normal	1	1.2
Up to six weeks after delivery	1	1.2
Was information given on importance of iron tablets? (n=103)		
Yes	99	96.1
No	2	1.9
Sometimes	2	1.9
If yes, in what form was the information given (n=101)		
Pamphlets	2	2.0
Talks/discussions	99	98.0
Are iron supplements necessary? (n=103)		
Yes	103	100
No	0	0
If yes, why? (n=113)*		
Increase blood volume of both mother and fetus. During delivery, mother will be having enough.	78	75.7
To boost the mother's immune system and prevent anaemia.	14	13.6
Increases strength of fetus.	2	1.9
To prevent death of mother and child.	1	0.9
Reduces complications and death of mother and child during and after delivery. Therefore, it helps avoid occurrence of adverse effects on the mother and child.	15	14.6
Good for the fetus as blood carries oxygen to it.	2	1.9
To prevent malaria.	1	0.9

* Of the 103 participants, some pregnant women gave more than one response in justifying the need for iron supplements

4.5.2 Nurses

Of the six nurses interviewed, five were female and one was male. The findings revealed experiences of nurses with pregnant women during ANC. Out of the six nurses working at the clinic, two nurses worked full-time in the ANC section. The other four nurses came in occasionally to relieve those in the ANC unit. This explains the differences in responses given by the nurses during the interviews. Table 4.6 presents a summary of findings from interviews conducted with the nurses' on their experiences with pregnant women.

The findings revealed that two nurses (33.3%) had worked at the clinic for a period of between 0-17 months (Table 4.6). Another two (33.3%) spent between 4-6 years, while yet another nurse worked for a period between one and a half to three years. The longest serving nurse had worked for at least 10 years at the clinic. The nurses stated that the numbers of ANC visits they

had per day varied or fluctuated. Three nurses (50%) indicated that 10-15 pregnant women visited per day, while two nurses (33.3%) indicated a range of 7-15 women. The sixth nurse said approximately 20-25 women came for ANC visits per day. It was therefore observed that, an average range of 7 to 10 women came for ANC visits per day. Three nurses (50%) stated that most women came to register their pregnancies in the second trimester. Two other nurses (33.3%) said women preferred registering in the first trimester. However, one nurse (16.7%) stressed that most women were in the habit of registering late, when they were already in the third trimester, especially the multi-gravida. All nurses (n=6; 100%) confirmed offering iron supplements to pregnant women free of charge, as long as they were available at the clinic. Iron supplements were offered at first booking, depending on when the women came, regardless of trimester. Three nurses (50%) said pregnant women were generally positive about taking iron supplements, while three other nurses (50%) indicated that perceptions of women were uncertain and difficult to predict (Table 4.6).

The following excerpts were given by the nurses during the interview sessions conducted with them. The excerpts have varying codes at the end to indicate the separate individual nurses. They are in response to the stage at which women came to register their pregnancies:

'*20-24 years come earlier, (especially first time mothers) at about 10-24 weeks. Multiple pregnancies normally book at 25 weeks and above. All women are encouraged to register early but the multiple pregnancies have a tendency to delay, as they say they know it all, and assume they have the experience and there is nothing new*' [Int-2].

'*Very few come before 16 weeks, but quite a good number come after 20 weeks. Government is encouraging health personnel to educate the women to book at 12 weeks, but very few come at that time, especially multiple pregnancies*' [Int-6].

'*They vary in times they come and register, very few register before the second trimester. Some may face financial constraints so delay as they will be looking for money. Registration fees have gone up so it's a challenge; some few will delay coming to register*' [Int-4-M].

'*Mostly they come in the second trimester, in the 1st trimester they are very few. The ministry of health recommends that they come at 8 weeks, once they miss a period*' [Int-5-SIC].

'*Some come between 9-24 weeks for new bookings. Some 18 weeks i.e. para-1/ first time mothers. Multiple pregnancies usually come after 24 weeks, some may come at 34 weeks to register for the first time*' [Int-3].

The following excerpts are on when nurses start offering iron supplements to women:

'*We recommend that they start in first trimester, but because they may not come in first semester, we give as soon as they come for their first booking*' [Int-4-M].

'*At their first booking, they are usually seen with their packets or envelopes of supplements. Everyone is given regardless of trimester, at first contact depending with the time they come and register. So it differs from woman to woman*' [Int-1].

One nurse indicated that supplies were generally in short supply. '*Yes, we have some supplies at times, but at times we don't. So in some cases we offer supplements, but sometimes they buy from the pharmacies. Its 50:50 that is clinic: pharmacy*' [Int-4-M]. One of the nurses stated that, '*we have challenges especially in the last two weeks or sometimes in the last week when the monthly supplies usually get depleted. So the women coming towards the end of the month usually have to buy from pharmacies since our supplies will be used up already. Even those coming for their initial registration would sometimes fail to get any supply*' [Int-5-SIC].

On the recommended iron supplement dose and the frequency for taking, four nurses suggested once a day, while one other nurse opted for twice a day. One nurse preferred once a week, however advising that, '*It depends with the type of supplements and manufacturer. Some may take once a week; three times a day or once a day. It depends with the strength of the supplements and manufacturer. The type which we have here is one tablet/day*' [Int-4-M].

Three nurses said women were generally positive about the iron supplements offered to them. One nurse stated that, '*others, as early as nine weeks, or once they detect some fetal movements, will actually come and ask for supplements. This means they are positive. The majority is willing to take but some will give reasons like nausea and they won't accept*' [Int-3].

'*Yes, they are positive especially if health education is given first on the importance and use of iron supplements*' [Int-2].

Another three nurses indicated that pregnant women had less positive perceptions towards iron supplements. One nurse had this to say*:* '*perceptions of pregnant women towards supplements are very difficult and unpredictable. The challenge is to educate them. Usually they are given supplements, but some do not take them. They have haemorrhage during and after delivery, because blood will be at its low levels, we really have a challenge to educate them, but some are responding very well*' [Int-5-SIC].

'*Uncertain, some just collect, take them home and keep them there. They don't use them. Some like them so much that they don't want to miss a dose. Some say they cause nausea, but generally, they are taking them*' [Int-6].

Table 4.6: Nurses' experiences with pregnant women at Mutare City Clinic (n=6)

Variable	n	%*
Length of time working at Mutare City Clinic		
0-17 months	2	33.3
1.5-3 years	1	16.7
4-6 years	2	33.3
7-9 years	0	0
10 years and above	1	16.7
Approximate number of ante-natal patients seen per day		
7-15	2	33.3
10-15	3	50
16-19	0	0
20-25	1	16.7
Stage of pregnancy at which most women register for ante-natal care		
First trimester	2	33.3
Second trimester	3	50
Third trimester	1	16.7
Are iron supplements offered to pregnant women?		
Yes	6	100
No	0	0
Stage at which iron supplements are offered		
At first booking/contact	6	100
At four months and above	0	0
Perceptions of pregnant women towards iron supplements		
Positive	3	50
Negative	0	0
Uncertain	3	50

*Percentage of sample (n = 6)

Interview findings presented in Table 4.7 revealed that most nurses (n=4; 66.7%) advised pregnant women to take iron supplements once daily, one nurse (16.7%) suggested twice a day, while yet another nurse advised on twice a week. All the nurses (n=6; 100%) confirmed discussing with women the importance of iron supplements and when to eventually stop taking the supplements. Four nurses (66.7%) said women should stop taking iron supplements at six weeks post-delivery, one nurse (16.7%) was not sure of exact time, while yet another nurse advised that women should only stop after delivery and Hb tests. Four nurses (66.7%) stated that iron supplements ensured that maternal iron stores were not depleted by the infant. Three nurses (50%) said iron supplements enhanced normal growth of the fetus. Half of the nurses

(n=3) confirmed receiving reports on challenges faced during iron supplementantion, while three other nurses received no reports. Nausea was the most common challenge noted by most of the nurses (n=5; 83.3%). The majority of nurses (n=5; 83.3%) identified counselling as an effective strategy for addressing challenges associated with iron supplementation. One nurse (16.7%) also advised that supplements could be taken together with food to minimise side effects, while yet another nurse suggested interviewing the pregnant women to establish other undelying factors (Table 4.7).

The following excerpts are on importance of iron supplements as perceived by nurses:
All six nurses concurred that they also held health education talks and discussions with the women on the importance of iron supplements in pregnancy. They stated that, '*the pregnant women are given lectures in ANC before they are given anything*' [Int-1]. '*We give them education before giving them supplements*' [Int-2 & 3].

'*Health education talks are given at every visit where iron supplements are also talked about*' [Int-5]. '*On first booking on Thursday, they are given long education talks/lectures on importance of tablets. In subsequent visits, there is reinforcement of health education and drug compliance as they come to collect tablets. Some may also remind us in case we forget giving them tablets. Others are very quiet that you wonder whether they are taking the supplement or not. They don't even ask for the next supply*' [Int-6].

The last respondent had this to say, '*on the first day, everything is explained to them, e.g. functions of iron supplements are discussed. Health education is given and requirements and expectations are spelt out*' [Int4-M].

Yet another nurse stressed that, '*They only stop after delivery or after Hb tests to determine the iron levels. If the levels are normal, they will stop, but not before they have delivered. However, Hb tests are rarely performed because of financial constraints. Therefore, all women are encouraged and expected to take supplements until they deliver*' [Int-4-M].

In justifying the need for iron supplements, one nurses stressed that '*Depleted iron stores are very dangerous, because the placenta has no mercy with the mother, so it ensures that baby has enough supplies, which are extracted from the mother's reserves*' [Int-6].

Table 4.7 summarises findings on importance of iron supplements as perceived by nurses.

Table 4.7: Importance of iron supplements as perceived by nurses (n=6)

Variable	n	%
Advice on frequency of iron supplementation		
Once a day	4	66.7
Twice a day	1	16.7
Once a week	1	16.7
Discussions on the importance of iron supplements		
Yes	6	100
No	0	0
Women encouraged to eventually stop supplementing		
Yes	6	100
No	0	0
Stage at which most women stop iron supplementation		
At six weeks post natal or until six weeks post-delivery in normal circumstances.	4	66.7
Not sure when they stop.	1	16.7
They only stop when they have delivered or after Hb tests to determine the iron levels.	1	16.7
Reasons for taking iron supplements in pregnancy		
To boost or enhance their iron/haemoglobin levels in pregnancy.	2	33.3
To enhance normal growth of fetus.	3	50
To ensure maternal iron stores are not depleted by infant.	4	66.7
To prevent iron deficiency anaemia related to pregnancy.	2	33.3
For the well-being of both mother and fetus.	1	16.7
Reports on challenges faced during iron supplementation		
Yes	3	50
No	3	50
Specific challenges experienced due to iron supplementation		
Constipation and discolouration of stools	1	16.7
Nausea	5	83.3
Abdominal upsets/ flatulence	1	16.7
Vomiting	1	16.7
Dizziness	1	16.7
Strategies for addressing challenges in iron supplementation		
Counseling pregnant women.	5	83.3
Taking supplements together with food.	1	16.7
Interviewing women to establish other underlying factors.	1	16.7
Additional comments from nurses about the study		
'Iron supplements are being given freely at the clinic.'	1	16.7
'In the ANC room, there are plenty of charts available and displayed. Women are free to come and read.'	1	16.7
'Nutrition education is being given time and again.'	1	16.7

4.6 Discussion

The age range of 26-30 years is the optimal period for pregnancy as iron stores will generally be adequate in healthy women at this age. Women are mentally mature and most fertile during their twenties. They are also physically ready for the rigors of pregnancy and childbirth (Matthiessen 2017). According to Matthiessen (2017), pregnancy is often physically easier for women in their twenties because there is a lower risk of health complications like high blood pressure and diabetes. Gynaecological problems like uterine fibroids are less likely as these often develop with advancing age (Matthiessen 2017; Watson, Luke & Inall 2017).

On the other hand, teenage pregnancies in the 16-17 year age group pose a serious threat to the health of both mother and fetus because of inadequate iron stores in the mother [American Pregnancy Association (APA) 2019]. According to Ramulumo & Pitsoe (2013), teenage pregnancy is a global social problem affecting both developing and developed countries. However, in this study, the prevalence of teenage pregnancies was still low. This could have been due to the fact that many communities prohibited such pregnancies, or worse still that teenagers hid their pregnancies and avoided ANC offered at the clinics, until late in the pregnancy. Despite the low prevalence of teenage pregnancies recorded, it has been noted that in the majority of teenage pregnancies, the risks are usually great. These risks include teenagers giving birth to underweight babies, who may also fail to thrive due to depleted nutrient reserves in the teenage mother. The teenage mother may also develop complications or even die during the process of delivery (APA 2019; Matthiessen 2017; Ramulumo & Pitsoe 2013). Causes of teenage pregnancies include socioeconomic background, peer pressure, lack of sex education, early marriages, as well as traditional gender roles (Moyo 2014; Ogori, Shitu & Yunusa 2013; Ramulumo & Pitsoe 2013). In adolescent pregnancies, because of undeveloped iron stores, there is greater need for iron and folic acid (IFA) supplements, as compared to other pregnancies, to prevent anaemia. Inadequate iron stores in adolescents may result in the fetus failing to thrive or having low birth weight [Watson *et al* 2017; WHO 2017; United States Agency International Development (USAID) 2015; Food and Agriculture Organization of the United Nations (FAO) 2013].

As much as teenage pregnancies are not encouraged, pregnancies at a later age are also not advised, especially at 35 years and beyond. This is meant to guard against complications at childbirth and deformities or abnormalities in children, associated with advanced age in the pregnant woman (Matthiessen 2017; Ramulumo & Pitsoe 2013). According to Matthiessen

(2017), as women get older, their ovaries age along with the rest of the body and the quality of the eggs gradually deteriorate. This increases the likelihood of genetic abnormalities that cause Down syndrome and other birth defects (Matthiessen 2017).

Regarding marital status, while being married does not always guarantee good spousal support, the probability of men supporting their wives in the current study was very high, since the majority of pregnant women were married. According to Nisar *et al* (2014), good spousal support is critical in ensuring compliance with iron supplements. Spouses can help remind their pregnant partners to take their supplements consistently and may also assist by buying them from private pharmacies, if the clinic supplies are in short supply.

All the pregnant women (100%; n=103) were affiliated to the Christian religion. However, their specific denominations could not be established to assess the diversity of doctrines within various Christian denominations. The issue of religion and culture is very critical in establishing reasons why some women may not consume certain foodstuffs, medications, as well as supplements. They are the main limiting factors leading to many food restrictions, thus causing IDA in pregnant women (Onyeneho, I'Aronu, Chukwu, Agbawodikeizu, Chalupowski & Subramanian 2016; Setyobudihono, Istiqomah & Adiningsih 2016; Dwumfour-Asare & Kwapong 2013). Setyobudihono *et al* (2016), revealed that in some religions, women were expected to submit to the authority of their husbands. Some husbands, out of ignorance discouraged their wives from taking iron supplements and would advise on incorrect replacements, such as anthill soil or concoctions prepared by elderly women. These elderly women, especially the mothers-in-law, prepared these concoctions based on their indigenous knowledge systems (IKS). Women were still expected to play the subservient role and obey their husbands, even if this cost them their health (Setyobudihono *et al* 2016).

Some Christian denominations discourage the use of iron supplements. Sey-Sawo & Tunkara-Bah (2016) attribute the low use of supplements in some households to religious and cultural norms, including food taboos and restrictions. For instance, in some cultures, pregnant women are prohibited from eating eggs fearing that the child will be mute or stutter (Sey-Sawo & Tunkara-Bah 2016). However, eggs are a good source of nutrients required during pregnancy (Marini 2017; My Food Diary 2016). In most cases, women serve the best part of a meal to their husbands, depriving themselves of nutrients required during pregnancy (Sey-Sawo & Tunkara-Bah 2016).

The fact that most of the participants had achieved at least Ordinary Level education indicates high literacy levels. However, despite the high literacy rate, it is a concern that more than half of the participants were neither employed in the formal nor informal sectors. Thus, with nutrition education and guidance from nurses, most of these women would be able to understand the importance of iron supplements during pregnancy. It is also likely that they would read widely and have an appreciation of iron absorption enhancers, such as foods and drinks containing vitamin C, as well as inhibitors such as phytates, oxalates and tannins (Pamplona-Roger 2013, p401; Williams 2011, p15). According to the International Monetary Fund (IMF) (2017), Zimbabwe's economy is facing difficulties. The unemployment rate was between 85%-90% in 2017 (IMF 2017). Unemployment is a threat to the consumption of balanced diets by pregnant women, who struggle to get balanced meals, let alone iron-rich foods (Sey-Sawo & Tunkara-Bah 2016; USAID 2015). This also increases their financial dependency on their spouses for nutritional support (Sey-Sawo & Tunkara-Bah 2016; USAID 2015).

Although some women may afford some cheap non-haem iron-containing foods, the challenge lies in the bioavailability and absorption of these foods (Stoltzfus 2011; Williams 2011, p15). According to Pamplona-Roger (2013, p401), the absorption of iron from vegetables is 10%, 15% from fish and 20% from soybean and its derivatives. It is greatest in meat, where the percentage absorption is at least 30%, yet most women may not be able to buy meat frequently due to its high cost. A similar finding was revealed by Sey-Sawo & Tunkara-Bah (2016), who confirmed that in The Gambia and other less developed countries, the low socio-economic conditions prevailing increased the prevalence of IDA due to poverty, food deficit, poor dietary habits and low social status of women.

Low socioeconomic conditions also make it difficult for some pregnant women to buy iron supplements from private pharmacies, since the clinic supplies are usually very limited. This implies that pregnant women have no option but to wait for supplements to become available at the clinic, however, this takes a long time. Therefore, availability of supplements at the clinic increases the use of iron supplements by the pregnant women. Thus, if the current challenge of inadequate iron supplement supply persists at the clinic, many of the unemployed women would fail to receive and use iron supplements. They may have to depend on their husbands if they are employed. There is a need for the Health Ministry of Zimbabwe, through the healthcare

centres, to address maternal nutrition in order to improve birth outcomes and reduce maternal deaths associated with IDA (Sey-Sawo & Tunkara-Bah 2016; MOHCC 2012).

Table 4.2 revealed that the majority of pregnant women attended ANC services when they were between 25 and 35 weeks gestation, which is rather late. Delays in booking could indicate a lack of awareness on the importance of iron supplements or due to unavailability of registration fees, set at $2 500 Zimbabean dollars (R500). Since the majority of the participants obtained their iron supplements from the clinic, this meant that they would only start taking the iron supplements after registration. Therefore, the majority of the women would only take iron supplements in the last trimester, and would fail to meet the increased iron needs of pregnancy, especially in the third trimester. Cox (2016), confirms that a study on pregnant women from China, Zimbabwe, India and Mexico revealed that ID and IDA were higher in the third trimester of pregnancy, as measured by the ferritin levels. This implies that women should have started supplementation well in advance to boost their iron stores in preparation for the third trimester requirements. According to the WHO (2012), supplementation should commence at the beginning of the second trimester.

Complications of pregnancy are health problems that occur during pregnancy [Centers for Disease Control and Prevention (CDC) 2016]. The various forms of complications experienced by the women threatened the outcomes of their pregnancies. It has also been established that complications themselves could possibly trigger anaemia in a previously non-anaemic woman (APA 2019). These could involve the health of the pregnant woman, the infant or both. Some women have complications arising during pregnancy, while some are noticed before pregnancy (APA 2019; CDC 2016). Certain complications may also be triggered by lack of timely and consistent use of iron supplements. It is therefore very important for women to receive appropriate health care before and during pregnancy, to lessen the risk of pregnancy complications (CDC 2016).

If a pregnant woman is unaware of her iron status, she may enter pregnancy with already depleted iron stores, thus threatening her health. It is therefore recommended that women enter pregnancy with blood Hb levels of at least 11 g/dl and that they start supplementing with iron at the beginning of the second trimester, until six weeks post-partum (WHO 2017; WHO 2012). Williams (2011, p15) warns that pregnant women are at a high risk of anaemia, thus implying that dietary intake and iron supplementation are needed to boost the existing iron stores. Those with normal iron stores may fail to take iron supplements because they may be unaware of the

increased iron requirements during pregnancy. This, coupled with delays in registering for ANC, can increase the risk of complications. It can also delay the detection of complications arising from insufficient iron levels during pregnancy. This could be a challenge especially for women or teenagers pregnant for the first time, who may lack knowledge on the importance of taking iron supplements. Watson *et al* (2017) explains that people often do not know that they have anaemia until they have signs or symptoms, such as pallor, fatigue or difficulty exercising. Shortness of breath, a fast heart-beat, cold hands and feet and craving strange substances such as dirt or clay, are other symptoms. Therefore, it is advisable that women enter pregnancy already aware of their iron status (Watson *et al* 2017; WHO 2017). However, starting supplementation with iron at the beginning of the second trimester for every pregnant woman applies mostly to women in developing countries. This is despite the strong recommendation from the WHO, which stipulates that all pregnant women should be given 60 mg of elemental iron daily from the beginning of the second trimester up to six weeks post-partum. Findings from a study in four German states revealed that iron supplements were only recommended for pregnant women diagnosed with iron deficiency or anaemia (Demuth, Martin & Weissenborn 2018).

Women should have regular Hb tests during pregnancy to guard against complications. This further emphasises the importance of early registration for ANC, as recommended by the Ministry of Health and Childcare (MOHCC) (2012). The facilities at Mutare City Clinic were very limited and no Hb tests could be conducted for pregnant women during ANC. Nurses could only make clinical observations of the tongue, eyes, hands and skin for their assessments. Therefore, for pregnant women to be tested, they would have to go to the private hospitals or doctors' surgeries for a full blood count (FBC). Only in extreme cases of IDA, would pregnant women be seen at the provincial hospital, after being referred from the city clinic. As such, it is very difficult to assess the exact Hb levels of women using clinical assessment alone. The majority of cases would go for months with undetected anaemia, which would only be established when it was too late, or at childbirth (Watson *et al* 2017). According to the WHO (2015b), developing countries are always slow in implementing strategies to address health challenges, yet they have the highest prevalence of deficiency diseases. Even though literacy levels are high in Zimbabwe, there is still evidence of a lack of research on pregnancy-related issues [United Nations Children's Fund (UNICEF) 2018].

Most women indicated that they visited the local clinic at least once a month, which was commendable. Routine ANC visits at least once a month are recommended by the MOHCC (2012). Defaulting, on the other hand, might have been triggered by various factors, such as general dislike of supplements and religious restrictions. Five out of the 16 women who were not taking iron supplements, cited a lack of knowledge on iron supplements as the reason for not taking them. This implies that some women may have lacked the understanding or motivation to take iron supplements daily, especially in the face of common side-effects (Tolkien, Stecher, Mander, Pereira & Powell 2015). Some women indicated that they were still to receive iron supplements from the Mutare City Clinic. Thus, a shortage of supplies at the clinic was a serious challenge. Since a significant number of the participants in this study were unemployed, the continued availability of this free supply facility at the clinic influenced their acceptance and use of iron supplements. Similarly, according to findings from a study undertaken in rural and urban Pakistan by Nisar *et al* (2014), erratic iron supplement supplies was a major barrier to optimal iron supplementation. Since most of the pregnant women were unemployed, they could not afford to buy from pharmacies, thus resulting in poor adherence to iron supplementation. This is the reason why IDA in pregnancy is mainly due to failure to take iron supplements, with 58% of pregnant women in developing countries being anaemic (Sambili, Kimambo, Peng, Ishunga, Matasha, Matumu, Noronha & Ngilangwa 2016; Raut, Jha, Shrestha, Sah, Sapkota, Byanju & Malla 2014; WHO 2012; Stoltzfus 2011). Some pregnant women did not take supplements as they wanted to avoid discomforts such as nausea, constipation and heartburn. Some women who had previous successful pregnancies, may have felt that they were now more experienced, resulting in them defaulting (Nisar *et al* 2014). According to a study on adherence to iron supplementation in 22 sub-Saharan African countries, overall adherence was 28.7%, ranging from 1.4% in Burundi, to 73.0% in Senegal (Ba, Ssentongo, Kjerulff, Na, Liu, Gao & Du 2019).

Watson *et al* (2017) concurring with Tolkien *et al* (2015), acknowledged that iron supplements cause side-effects, including constipation. Ba *et al* (2019) also confirmed that many women in SSA do not adhere to iron supplementation during pregnancy due to complaints about side-effects. Pregnant women are especially susceptible to constipation, which could be alleviated through the addition of extra fibre and water or the use of a stool softener. Starting with a low dose of iron and then gradually increasing the dose to the daily recommended amounts may help minimise the side-effects (Watson *et al* 2017). The form of iron supplements being used can also be changed to one that is better tolerated (Watson *et al* 2017; WHO 2012). The iron

supplements can also be taken with food to minimise the severity of side-effects (Watson *et al* 2017). However, it is important for pregnant women to realise that the benefits of iron supplements outweigh the side-effects associated with their use (Watson *et al* 2017; Tolkien *et al* 2015; WHO 2012).

The responses given by the study participants towards iron supplementation are almost similar to a Gambian study by Sey-Sawo & Tunkara-Bah (2016). The current study revealed that many participants were willing to take iron supplements to prevent anaemia, however, only a small portion took the supplements for the recommended six months during pregnancy, as recommended by the WHO (2016). The same applies to the Gambian study which revealed that all pregnant women were given iron supplements upon registration at the clinics, yet 68% of pregnant women remained anaemic (Sey-Sawo & Tunkara-Bah 2016). The unavailability of the supplements, side-effects and late registration at clinics were some of the reasons given by participants for not taking iron supplements. However, as emphasised by Sey-Sawo & Tunkara-Bah (2016), anaemia is associated with grave consequences for both mother and fetus. There is increased risk of maternal deaths since anaemic women do not tolerate blood loss to the same degree as healthy women. During delivery, a healthy woman can tolerate a blood loss of up to 1 L, but in an anaemic woman, a blood loss of 150 ml can be fatal. Anaemic women also have anaesthetic and operative risks because anaemia lowers resistance to infection and wounds may either fail to heal promptly after surgery, or may break down altogether (Sey-Sawo & Tunkara-Bah 2016). Low birth weight in the infant is associated with perinatal morbidity and increased risk of long-term disability (Sey-Sawo & Tunkara-Bah 2016; WHO 2012; WHO 2010). Since some of the participants indicated that they had complications and others had unsuccessful previous pregnancies, these could have been worsened by depleted iron stores.

The ideal time to start taking iron supplements is probably as soon as the pregnancy is confirmed, especially if there is a history of anaemia. Late supplementation (after six months), as indicated by some participants, is not encouraged (Demuth *et al* 2018; Peña-Rosas, De-Regil, Garcia-Casal & Dowswell 2015). With late iron supplementation, it may be too late to develop sufficient iron stores to meet the needs of the pregnant woman and the fetus. The number of previous successful pregnancies can influence the onset of taking iron supplements, as it also affects timely registration at healthcare centres (Demuth *et al* 2018). The latest time to begin taking iron supplements is at the end of the first trimester. According to the WHO (2016), all

pregnant women should be given a standard dose of 60 mg iron and 400 µg folic acid for six months to meet their iron and folic acid requirements. If the iron levels are not yet corrected at the end of six months, iron supplementation can be continued during the post-partum period or the iron dose may be increased to 120 mg during pregnancy (WHO 2017; MOHCC 2012; WHO 2010).

However, in the current study, a shortage of supplies hindered iron supplement use by most women and this may have seriously influenced the increased levels of IDA in pregnant women. The majority of the women solely depended on the clinic supplies for iron supplements, which partially failed to meet demand. Stoltzfus (2011) stresses that erratic or insufficient supplement supplies is another challenge to optimal iron supplementation. Since the majority of the women in this study were unemployed, this implied that only a few of them could afford to buy the iron supplements from private pharmacies. However, the challenge with buying from pharmacies could be the bioavailability of certain brands of supplements (Bookari, Yeatman & Williamson 2016). Ferrous sulphate is the most bioavailable and cost-effective iron supplement, as compared to ferrous gluconate and ferrous fumarate (Bookari *et al* 2016; Ibrahim 2008).

Despite the fact that most women (Table 4.4) reported taking iron supplements daily, the response by some of the participants that they would take iron supplements until they delivered (Table 4.5), was highly indicative of a lack of awareness on the onset and duration of taking iron supplements. The quarter of the women (Table 4.5), who responded correctly about compliance with the duration of iron supplement use, could be deemed too small. Participants understood that they had to take iron supplements, but they lacked the correct knowledge on the required duration, as recommended by the WHO. The duration of taking iron supplements was greatly influenced by the number of previous pregnancies experienced, the number of successful pregnancies and the form in which nutritional information on iron supplementation was given to the women. The WHO recommends that all pregnant women should take iron supplements from the beginning of the second trimester up to six weeks post-partum (WHO 2015a). Where the prevalence of IDA is high, supplementation should continue for three months post-partum to prevent IDA in women (WHO 2015b). Sey-Sawo & Tunkara-Bah (2016) highlight that even when food intake is adequate, it may take up to two years to replenish body iron stores after a pregnancy. In developing countries, every second pregnant woman is estimated to be anaemic, justifying the serious need for iron supplementation during pregnancy [Food and Agriculture Organization of the United Nations (FAO), International Fund for

Agricultural Development (IFAD) & World Food Program (WFP) 2012; United Nations (UN) 2011].

The manner and nature in which the nutrition information on iron supplements was given to pregnant women, could also contribute to the way other potential pregnant women would frequent Mutare City Clinic. Thus, the lack of awareness on the importance of iron supplements by pregnant women could also be attributed to shortcomings in the content of the nutrition information shared at the clinic (Nisar *et al* 2014). According to Pavord *et al* (2011), nutrition discussions on iron supplement use may not suffice, since there is considerable probability that some pregnant women may not like participating in discussions. There may be a need for consistent home follow-up visits before the next ANC visit at the clinic, and additional nutrition education material to take home to improve compliance with iron supplements during pregnancy (WHO 2017; Pavord *et al* 2011).

The fact that one participant indicated that iron supplements were meant to prevent and treat malaria, could have been a misinterpretation of prior information from the WHO (2012). The WHO (2012) stipulated that, in malaria-endemic areas, provision of iron and folic acid supplements should be implemented in conjunction with measures to prevent, diagnose and treat malaria (WHO 2012). This implies that there is lack of awareness among some women on the reason for taking iron supplements during pregnancy.

Most of the nurses who were interviewed indicated that the majority of pregnant women were in the habit of registering their pregnancies in the second trimester, or even in the third trimester of their pregnancies. Only a few preferred to register their pregnancies early in the first trimester. According to Sey-Sawo & Tunkara-Bah (2016), it is during the registration period that women at risk for IDA are identified and the appropriate action taken to minimise mortality and morbidity associated with IDA. Conversely, late ante-natal booking is a common phenomenon among pregnant women. Late ante-natal booking is associated with complications such as anaemia, hypertension and intrauterine fetal death (Noronha, Khasawneh, Sheshan, Ramasubramaniam & Raman 2012; WHO 2010). Early registration helps address poor maternal nutrition to improve birth outcomes and reduces maternal deaths associated with anaemia (Sey-Sawo & Tunkara-Bah 2016). Since the majority of the women had a tendency of registering late and not maximising ANC services, the MOHCC developed a strategy to reduce the number of ANC visits that pregnant women were required to make. According to one of the nurses, the MOHCC introduced focused ANC.

'*Now we are doing focused ANC such that if a woman is seen at first visit/ booking, they will be seen again at the second visit which will be after 28 weeks. At least four visits will be made per pregnancy. This lessens the burden for women to keep coming. Therefore throughout the pregnancy, women will visit the clinic at least four times*' [Int 6].

However, as much as the burden of women coming to the clinic could be lessened, this could actually pose serious adverse effects. If a woman developed some latent complications in between visits, these could go undetected for a long time because of the reduced visits. In the case of iron supplementation, it would then be difficult for the nurses to assess compliance. In the event that some women developed side-effects due to iron supplements, they would not receive counseling or nutritional advice on time and would have to wait for the next visit at the clinic. Focused ANC reduces the workload of the nurses, but this is a disadvantage to pregnant women who need continuous support.

Most of the nurses suggested that iron supplements offered to or bought by pregnant women from private pharmacies should be taken once a day. This was based on the WHO (2017) and WHO (2012) recommendations that daily oral iron and folic acid supplementation, should form an integrated part of ante-natal and neonatal care. However, supplements were not readily available at the clinic in most instances, forcing women to buy from private pharmacies, where they were very expensive. As much as women may have accepted the iron supplements, the challenge of unavailability of iron supplements was a critical factor in preventing optimal use of the iron supplements by pregnant women. Thus, it becomes more difficult to alleviate IDA. Women are supposed to be examined and screened for anaemia during and after pregnancy, with prompt detection using a multiple site clinical assessment. In this regard, nurses could clinically assess extreme pallor or very low Hb levels with reasonable sensitivity and high specificity (WHO 2010). Severe cases of anaemia need to be referred to higher levels of care, to reduce neonatal and maternal deaths and infections during pregnancy (WHO 2012).

In justifying the need for iron supplements, most nurses stated that supplements helped to ensure that iron stores were not depleted by the growing fetus, thus preventing IDA related to pregnancy. Other nurses highlighted the importance of supplements in enhancing normal fetal growth. Since the fetus is growing, there is a need to produce more blood. Pregnant women also need to have adequate Hb levels or blood volume to prepare for delivery (Noronha *et al* 2012; WHO 2010). If pregnant women lack iron, they are going to suffer the effects of post-partum haemorrhage (WHO 2015a; Noronha *et al* 2012). Therefore, the mother will need more

blood to supplement what will be lost during delivery. Problems of women haemorrhaging, fainting, and being unwell are increasing because of low Hb levels (WHO 2015b; Pavord *et al* 2011). The MOHCC (2012), in accordance with the WHO (2012), recommends iron supplements to avoid these complications.

Most nurses confirmed receiving reports on challenges or minor discomforts faced by pregnant women due to iron supplementation. The challenges or side-effects affecting pregnant women range from dizziness, constipation and discolouration of stools, to nausea, vomiting, flatulence and diarrhoea (Nisar *et al* 2014; Pavord *et al* 2011). However, the frequency and severity of these depends on the amount of elemental iron released in the stomach. Gastrointestinal discomfort was also common in women consuming large amounts of supplemental iron, particularly on an empty stomach (Pavord *et al* 2011).

Regardless of these side-effects, the WHO (2012) strongly recommends iron and folate supplementation. This is because the desirable effects of iron supplementation far outweigh the undesirable effects and nurses should then continue reinforcing the importance of supplements. Various strategies to overcome side-effects were proposed by the nurses. These included counseling pregnant women and advising them that the side-effects were normal and that minor discomforts would soon disappear. It is also critical that nurses give appropriate dietary advice when managing side-effects. Women need to be advised that it is helpful to take supplements together with food and plenty of fluids, or to take them in between food such as *sadza* (thick porridge made from mealie-meal) to overcome nausea. Another nurse raised a crucial point, that there is also a need for reinforcement on the importance of iron supplements.

Although nutrition education was being given regularly by nurses in the current study, more emphasis was placed on recommending iron-rich foods for pregnant women, than on the need to take iron supplements. Another strategy was that of interviewing women to establish other underlying factors contributing to these side-effects. Time of taking the supplement was another problem, therefore nurses needed to advise accordingly, depending on the type of side-effect. For instance, some women would feel weak every time they took iron supplements. Therefore, nurses needed to advise these women to take supplements when they were about to go to bed, as a way of coping with the side-effects.

Since all the nurses indicated that they offered health education talks at every visit where iron supplements were also discussed, attitudes and perceptions of pregnant women were bound to change with time. According to the WHO (2012), there is a need for implementation of

behaviour change communication (BCC) strategies, to communicate the benefits of the intervention and management of the side-effects. This is vital in improving the acceptability of and adherence to recommended supplementation schemes, like IFA. All pregnant women in developing countries should routinely receive iron and folate supplements, together with appropriate dietary advice to prevent anaemia (WHO 2012; WHO 2010). The dietary advice given should also address issues on the consumption of iron-rich foods and the role of vitamin C in enhancing iron absorption (WHO 2012). The WHO (2012) through the MOHCC, recommends that iron supplementation should continue until six weeks post-partum in normal cases, unless otherwise specified. In some cases, other women would continue taking supplements well after delivery, sometimes up to three months post-partum or until their Hb levels normalised (WHO 2012).

4.7 Conclusions

Although many women seemed to value the role of iron supplements in pregnancy, the onset, consistent adherence and the duration over which the supplements needed to be taken were not fully understood. The indication by the majority of pregnant women that they would stop taking supplements when they delivered was contrary to the WHO recommendations. These recommendations stipulate daily iron supplementation from the beginning of the second trimester up to six weeks post-partum. Therefore, appropriate knowledge on iron supplementation is critical for optimal iron supplementation, thus justifying the need for nutrition education. On the other hand, adequate supplies of iron supplements are also needed at the Mutare City Clinic to ensure consistent compliance with iron supplement regimens. Early bookings at Mutare City Clinic would likely enhance the use of iron supplements, because these would be offered to pregnant women during their first contact with nurses. Early bookings would also ensure that pregnant women receive early nutrition education on iron supplementation during ANC visits, thereby improving compliance as well as maternal outcomes.

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CHAPTER 5

[1]BARRIERS TO OPTIMAL IRON SUPPLEMENTATION BY PREGNANT WOMEN ATTENDING MUTARE CITY CLINIC, MANICALAND, ZIMBABWE

Abstract

Optimal use of iron supplements is important in ensuring healthy pregnancy outcomes. This is achieved through consistent use of the iron supplements during pregnancy, from the beginning of the second trimester until six weeks post-partum. This is in line with the recommendations from the World Health Organization (WHO). However, some limitations or barriers may prevent the optimal use of iron supplements by pregnant women, especially those living in developing countries. This subsequently results in iron deficiency anaemia (IDA), which threatens the health of both the pregnant woman and her fetus. This study aimed to identify the possible barriers to optimal iron supplementation by pregnant women. The barriers were identified from the outcome of eight focus group discussions (FGDs) with pregnant women. Study participants comprised 64 pregnant women, ranging from 17 to 39 years in age. They were purposively selected from all pregnant women who were either in their second or third trimester of pregnancy, attending the Mutare City Clinic for ante-natal care (ANC). Data were analysed using the inductive approach, where major themes and concepts arising from the data were identified. Several barriers were identified as preventing the optimal use of iron supplements by pregnant women. The major barrier noted was the erratic supply of the iron supplements at the clinic. In most cases, the women would arrive at the clinic only to find that the monthly supplies of iron supplements were already out of stock. Religious and cultural beliefs, side-effects of iron supplementation, poverty, general dislike, ignorance and influence of family members, were other factors that prevented pregnant women from optimally using iron supplements. Most women were accustomed to receiving the iron supplements free of charge from the clinic. Thus, when the supplies were out of stock, most women could not afford to buy them from the private pharmacies, resulting in them defaulting with iron supplementation. Because of their religious affiliations, some women did not attend ANC visits at the clinic and delivered at home or at their church, where there were organised "birth shrines" with the assistance of elderly women as birth attendants.

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Results revealed that apart from limited supplies at the clinic, compliance remained poor because some women were not aware of the benefits of using iron supplements. For others, previous experiences of iron supplements overshadowed the importance or need for supplements. Religious and cultural beliefs, as well as side-effects were other notable barriers. Others indicated that they would buy their supplies from the private pharmacies if they were not available from the clinic. Continuous reinforcement of positive iron supplementation practices could motivate the women to persevere with iron supplementation. Intensive nutrition education programmes on indigenous knowledge and diet, may help to improve the perceptions of women and their families towards iron supplements. This could therefore help to overcome the barriers to effective iron supplementation, thus reducing IDA among pregnant women in Zimbabwe.

5.1 Introduction

Iron deficiency anaemia remains the most common and prevalent global public health nutritional disorder. This is despite many efforts by health ministries worldwide to increase the availability of iron supplements (WHO 2018; WHO 2016; Bilimale, Anjum, Sangoli & Mallapur 2010; Habib, Alabdin, Alenazy & Noo 2009). Iron deficiency anaemia is most prevalent in developing countries where nutritional deficiency, malaria and other parasitic infections contribute to increased maternal and perinatal mortality and morbidity (Alam, Rasheed, Khan, Sharmin, Huda, Arifeen & Dibley 2015; Bilimale *et al* 2010). Pregnant women are among the most vulnerable populations affected by IDA, despite routine iron supplementation during pregnancy (Ugwu, Olibe, Obi & Ugwu 2014; Bilimale *et al* 2010). Milman, Paszkowski, Cetin & Castelo-Branco (2016), also confirm that in the developing world, pregnancy presents a challenge from a nutritional perspective. This is because micronutrient intake during the pre-conception period and during pregnancy affects fetal organ development and maternal health. Pregnant women in particular are at high risk of IDA caused by inadequate iron intake. This is worsened by the significantly increased iron requirements during pregnancy (Alam *et al* 2015; Habib *et al* 2009).

Regardless of large-scale anaemia interventions, the prevalence of IDA continues to rise in developing countries (Bilimale *et al* 2010). The current estimates from the WHO indicate that the highest prevalence rate of 61.3% was found among pregnant women in Africa and 52.5% among women in South-East Asia (Gebre & Mulugeta 2015). There is evidence to suggest that over 90% of maternal anaemia may be due to the inadequate consumption of dietary iron, thus

reflecting the increased demands for iron during pregnancy (WHO 2015; WHO 2008). In addition, increased blood loss due to hookworm, bleeding, vitamin deficiencies, human immunodeficiency virus (HIV), and genetic disorders such as sickle cell anaemia add to the prevalence of anaemia in pregnant women (WHO 2015; Bilimale *et al* 2010). The impaired immune system associated with HIV could possibly trigger various opportunistic infections (OIs). Some of these OIs can result in blood loss (Gebre & Mulugeta 2015; WHO 2015).

Iron supplementation during pregnancy is currently the most common strategy used to address and control IDA among pregnant women. This is especially so in developing countries, where pregnant women consume diets inadequate in iron and with little variety (Ugwu *et al* 2014; Bilimale *et al* 2010; Sanghvi, Harvey & Wainwright 2010; Habib *et al* 2009). Iron supplementation is important in that it increases ferritin levels, and haemoglobin (Hb) by 1.13 g/dl during pregnancy. It also improves maternal iron stores during the puerperium (WHO 2016; Alam *et al* 2015; Bilimale *et al* 2010; Sanghvi *et al* 2010). The correct use of iron supplements during pregnancy is beneficial to both the mother and fetus. Most of the irreversible damage in children due to malnutrition occurs during gestation and in the first 24 months of life (Gould 2013; Gautam, Saha, Sekhri & Saha 2008). Mineral deficiencies, such as iron deficiency cause hidden hunger, which may not be visible to the naked eye [United Nations Children's Fund (UNICEF) 2017; Food and Agriculture Organization of the United Nations (FAO) 2011]. Hidden hunger is insidious, does not produce typical hunger and is not felt physiologically. On the outside, a person with hidden hunger may appear to be consuming an adequate amount of food, especially staples, yet it impacts negatively on his/her health and nutritional status (HarvestPlus 2018; UNICEF 2017; FAO 2013; FAO 2011).

Although iron supplements are prescribed during pregnancy, there are many barriers preventing optimal use of the supplements (Ugwu *et al* 2014). The major barrier to iron supplementation in pregnancy is compliance (Ugwu *et al* 2014; Habib *et al* 2009). Habib *et al* (2009) note that IDA is significantly associated with non-compliance with iron supplementation. Compliance to therapy is inconsistent and thus, a potential driver to persistent high prevalence of anaemia in pregnant women (Agrega Sadore, Gebretsadik & Hussen 2015; Ugwu *et al* 2014; Habib *et al* 2009). The major threats to compliance with iron supplementation include inconsistent availability of supplies, gastrointestinal side-effects from iron supplements and religious and cultural factors. The high cost of iron supplements, poor ANC service delivery from healthcare centres, forgetfulness and inadequate counselling of pregnant women also affect compliance. Other barriers include the shortage of motivated staff at healthcare

centres and shortage of community manpower and lack of healthcare resources, such as equipment to test Hb levels at clinic level (Agrega Sadore *et al* 2015; Ugwu *et al* 2014; Bilimale *et al* 2010; Habib *et al* 2009).

Despite the many barriers that prevent the optimal use of iron supplements, iron supplementation during pregnancy remains a key strategy for controlling IDA. The prevalence of maternal anaemia can be reduced substantially if action is taken to launch focused large-scale iron supplementation programmes (Sanghvi *et al* 2010). The aim of this study was to identify the possible barriers to optimal iron supplementation amongst pregnant women and to suggest possible strategies for alleviating these barriers.

5.2 Materials and methods

This study employed a qualitative approach through the use of eight FGDs with pregnant women. The study aimed to identify the possible barriers to optimal iron supplementation by pregnant women.

5.2.1 Sample selection

This study could not include every single pregnant woman attending Mutare City Clinic, therefore it was necessary to select a sample. Participants were purposively selected from those attending the Mutare City Clinic for ANC. Purposive sampling is where a non-probability sample is selected based on the characteristics of a population and objectives of the study (Crossman 2018). Purposive sampling, also known as judgemental, selective, subjective or deliberate sampling, is widely used in qualitative research (Crossman 2018; Palinkas, Horwitz, Green, Wisdom, Duan & Hoagwood 2013). This deliberate sampling technique is used when the researcher is looking for some specific traits and information which cannot be randomly obtained from anyone. Therefore, participants are selected based on their familiarity with an issue. In this study, a homogenous purposive sample comprising 64 pregnant women was selected. A homogeneous purposive sample is one that is selected for having a shared characteristic and is often useful in reducing variation and in facilitating group discussions (Crossman 2018; Palinkas *et al* 2013). For the purposes of this study, the sample specifically included pregnant women who were in their second or third trimester of pregnancy. They were recruited when they came in for their routine ANC visits. The nurses used the health records of pregnant women to establish whether the women qualified for participation in the study

based on gestation stage. Pregnant women who met the inclusion criteria, that is, those who were in their second and third trimester of pregnancy, were referred to the researcher.

5.2.2 Focus group discussions

Focus group discussions were the preferred method of data collection in the current study because they enable large amounts of qualitative, primary data to be collected within a short time (Nyumba, Wilson, Derrick & Mukherjee 2018; Alshenqeeti 2014; Omona 2013). Focus group discussions are forums used to gain in-depth understanding by soliciting participants' perspectives and opinions about certain issues or ideas. This data gathering technique enables data to be drawn from the complex personal experiences, beliefs, perceptions and attitudes of the participants through moderated interaction among research participants (Alshenqeeti 2014). The group is said to be focused because it involves collective activity in addressing a specific issue or topic (Nyumba *et al* 2018; Guest, Namey & McKenna 2017).

The interactive setting offered by FGDs encourages participants to discuss thoughts freely with each other (Maguire & Delahunt 2017). In general, participants are more willing to talk than to write. Therefore, in the current study, substantial amounts of qualitative information was obtained through FGDs with pregnant women, which would not have been possible if questionnaires were used (Maguire & Delahunt 2017; Alshenqeeti 2014). Thus, FGDs are ideal for inductive approaches aimed at generating concepts and hypotheses (Nyumba *et al* 2018; Guest *et al* 2017). According to Nyumba *et al* (2018), FGDs aim to obtain data from a purposively selected group of individuals, rather than from a statistically representative sample of a broader population.

In the current study, the number of participants in each FGD ranged from six to ten, depending on the number of ANC attendees on a particular day. However, even though there were variations in the number of participants in the FGDs, this was still according to the recommendations by various authors. The ideal number of participants in a FGD is eight to ten, however, for most non-commercial topics, the ideal size is five to eight participants, depending on the topic being discussed (Guest *et al* 2017). Focus group discussions should not be planned for more than 10 participants because large groups are difficult to control (Guest *et al* 2017; Maguire & Delahunt 2017; Alshenqeeti 2014). It also limits the opportunity for participants to share insights and observations (Guest *et al* 2017; Maguire & Delahunt 2017). Small or mini-FGDs with four to six participants are becoming increasingly popular. According to Guest *et al* (2017), as few as four individuals can render accurate information with a high confidence

level, if they possess a high degree of knowledge of the topic under discussion. In the current study, FGD questions were generated prior to the study in English (Appendix I), translated into into Shona (Appendix J) and then translated back to English to check for accuracy in translation.

5.2.3 Pilot study

The purpose of the pilot study was to detect and correct any form of ambiguity or methodological or typographical errors in the FGD questions before the main study. Eight pregnant women participated in one pilot FGD. The participants were purposively recruited from the ANC unit at Mutare City Clinic, when they came for their routine ANC visits. To ensure that the women who participated in the pilot study did not participate in the main study, women were selected on the basis that their pregnancies were at 36 weeks gestation and above. Since the main study was to be conducted starting from the third week after the pilot study, these women would have either delivered or were not yet due for the next month's ANC visit. Pregnant women would come for ANC visits after every four weeks of each month and around the same date, until they delivered. The outcome of the pilot study was that the Shona versions of the FGD questions required some modifications to suit the different Shona dialects in Mutare. Women preferred both Shona and English alike. There was no prompting needed for questions. The procedure to be followed during FGDs was established and confirmed. In addition, the time required or set aside to conduct each FGD was estimated to be between 45 minutes to 1 hour.

5.2.4 Informed consent

Before the FGDs commenced, the researcher first explained the purpose of the study to the pregnant women. This was done when pregnant women came for their routine ANC visits at Mutare City Clinic. Pregnant women who were willing to participate were given consent documents to read. The women signed the consent documents to indicate their willingness to participate, to be audio-recorded, to be photographed and to have their photographs reproduced. Consent documents were prepared in both English (Appendix K) and Shona (Appendix L).

Figure 5.1: Focus group discussion session with some of the pregnant women

5.3 Procedure for data collection

Eight FGDs were used to collect data from 64 pregnant women. The FGD sessions were conducted on Mondays and Fridays consecutively, for four weeks until a point of data and meaning saturation was reached. The researcher determined that a point of data and meaning saturation had been reached when new data collected no longer presented any new findings. The researcher also ensured that FGDs were not repeated with the same participants, who would come for ANC check-up visits after every 4 weeks. The numbers of participants depended upon attendance on the particular day. There was a fixed designated place and time at the clinic premises, where discussions were held. The researcher conducted the FGD sessions with the assistance of a trained facilitator and two research assistants, who were fluent in both Shona and English. One research assistant took notes during the FGD and also observed and noted non-verbal cues. The discussions were recorded using a digital voice recorder. Figure 5.1 shows a focus group discussion in session with some pregnant women.

5.4 Data analysis

All the FGD recordings were translated verbatim from Shona into English by the FGD facilitator, before being cross-checked by another Shona-English speaking person for accuracy. The inductive analysis approach was used to analyse the FGD data. According to Guest *et al* (2017), with an inductive or open coding approach, themes and codes are generated from the data. In the current study, the transcribed focus group data were categorised according to similarities. Four key themes emerging from the findings were identified. These were

indigenous knowledge systems (IKS), attitudes and perceptions and poverty and innovations. From these key themes, sub-themes or concepts were also developed and specific verbatim excerpts were identified for each theme. The key themes and conceptual categories that were generated were then integrated into a larger theoretical and philosophical framework. According to Maguire & Delahunt (2017), the process of identifying themes or patterns within qualitative data is called thematic analysis. Therefore, in this study, narrative text was used to thematically analyse the data.

The grounded theory, which is primarily inductive and qualitative, was employed to generate rich, detailed and meaningful themes from discussions with the pregnant women. In qualitative research, the impact of this process is to aggregate data into a small number of themes (Creswell, 2014, p172). Foley & Timonen (2015) stress that the grounded theory can be effectively applied during the data analysis stage, aiming to generate innovative and substantive theoretical frameworks emerging from the data [Society for Research & Child Development (SRCD) 2012]. Grounded theorists seek to understand people's experiences in detail and to gain deeper understanding of how the social phenomenon being studied operates (Maguire & Delahunt 2017; SRCD 2012). The current study, sought to identify the possible barriers to optimal iron supplementation by pregnant women. Therefore, the conclusions drawn were based on the outcomes of FGDs with pregnant women, justifying the inductive analysis approach. Thematic analysis is not tied to a particular epistemological or theoretical framework, thus it is flexible enough to build theory (Maguire & Delahunt 2017; Foley & Timonen 2015).

5.5 Results

There were varying numbers of participants in all eight FGDs conducted with the pregnant women. The least attended FGD session had a total of six participants, while the most attended session had 10 pregnant women, as illustrated in Table 5.1. The number was determined by the number of ANC attendees on that particular day.

Table 5.1: Numbers of participants in the eight focus group discussions (n=64)

FGD session	n	%
1	8	12.5
2	8	12.5
3	9	14.1
4	10	15.6
5	9	14.1
6	6	9.4
7	6	9.4
8	8	12.5

5.5.1 Socio-demographic characteristics of participants

The socio-demographic characteristics of the participants were presented in Chapter 4 (Table 4.1).

5.5.2 Accessibility, commencement and side-effects associated with iron supplements

A total of 64 pregnant women participated in the eight FGDs held at Mutare City Clinic. Issues discussed included accessibility of iron supplements, commencement of supplementation, as well as side-effects associated with iron supplements (Table 5.2). Table 5.2 indicates that out of the 64 pregnant women who participated in the FGDs, just over half (56.3%; n=36) accessed iron supplements during their first ANC visit, depending on the gestation month of registration. A slightly smaller group (43.8%; n=28), did not get any iron supplements from the clinic, as supplies were already out of stock.

One woman said she obtained her supplements from other clinics, because they did not receive any supplies from their local clinic. Sometimes, they actually bought from Sakubva market from cross border traders who imported these from Mozambique (*Isu mapiritsi tinotopihwa kune dzimwe clinic, because pano hatimbomawane*. *Dzimwe nguva we actually buy from Sakubva kumusika kune vaya ma*cross*border anobva nemapiritsi kuMoza*).

Table 5.2 shows when women commenced with their iron supplements, inclusive of those who bought from pharmacies and those who obtained their initial supplies from the clinic. As shown in Table 5.2, the majority of participants started taking supplements from 16 weeks gestation onwards, and this delay in commencement of iron supplementation was a matter of concern. Out of the 64 women in the sample, 28.1% (n=18) started taking supplements in the fourth month of pregnancy, 20.3% (n=13) started in the fifth month, while 21.9% (n=14) started in

the sixth month. Only 12.5% (n=8) of the pregnant women started taking supplements at three months, while 3.1% (n=2) started at two months (Table 5.2).

As shown in Table 5.2, the majority of women (81.3%; n=52) encountered side-effects from the iron supplements they were taking. However, 18.8% of the participants (n=12) indicated that they had no side-effects at all.

Table 5.2: Accessibility, commencement and side-effects associated with iron supplements (n=64)

Variable	n	%*
Iron supplements received at the clinic		
Yes	36	56.3
No	28	43.8
When were iron supplements commenced?		
2 months gestation	2	3.1
3 months gestation	8	12.5
4 months gestation	18	28.1
5 months gestation	13	20.3
6 months gestation	14	21.9
7 months gestation	8	12.5
8 months gestation	1	1.6
Side-effects due to use of iron supplements		
Yes	52	81.3
No	12	18.8

*Percentage of sample (n=64)

5.5.3 Inadequate knowledge on importance of iron supplements as a barrier to iron supplementation in pregnancy

All participants indicated that they were aware of the role of iron supplements in pregnancy. However, the adequacy of their knowledge was not clear, since there were challenges with compliance with iron supplements. Combined group responses per FGD indicated that participants were able to identify the role of iron supplements during pregnancy (Table 5.3). Pregnant women acknowledged the importance and critical role of iron supplements in elevating blood volume during pregnancy. One of them said iron supplements are good because they increase the blood volume of the woman when she is pregnant (*mapiritsi akanaka nekuti anowedzera ropa ramai pavanenge vakazvitakura*). Others explained that the mother and infant needed enough iron so that the infant would be strong, without depleting the mother's iron stores after delivery. Thus, there was also a need to have enough iron to balance the needs of

both mother and infant. Yet another woman indicated that when the mother delivers her baby, she should have adequate iron stores, because if her reserves were depleted, this would result in poor health. When the mother's blood volume is adequate, it means the delivered infant will also have sufficient iron to meet its needs and it will be strong and healthy (*Amai kana vachinge vasununguka mwana, havafanirwe kusara vasina ropa rakakwana, because hutano hwavo hauzoite zvakanaka. Even mwana akawana ropa rakakwana haazopedzi ropa raamai uye anozvarwa akasimba uye aine hutano hwakanaka*).

One pregnant woman stressed that since they had not yet delivered, they were not sure of the blood loss to be encountered during delivery. Therefore, the iron supplements will help to keep my blood volume well before delivery (*Handisati ndazvara, saka handizive kuti ndicharasikirwa neropa rakawanda sei pandinozosununguka. Saka mapiritsi anobatsira kuti ropa rangu rigare rawanda kuitira pakuzozvara*). Another woman emphasised that supplements were really helpful because she previously had very little blood stores. The first time she came to the clinic for ANC visits, she was anaemic and had very depleted bloodstores, until she started taking iron supplements (*Mapiritsi aya akandibatsira zvikuru. Kare turopa twacho twaiita zvekufinyinya turi tushoma ndisati ndaakumwa matablets*). Yet another woman explained that the supplements helped with oxygen supply to both mother and fetus and ensured good breathing and safe delivery (*Mapiritsi anobatsira kuti mai nemwana wawane mweya wekufema wakakwana uye amai havazonete pakusununguka mwana, vanobva vazvara zvakanaka*). The iron supplements help to reduce complications like fainting due to a shortage of blood and oxygen, as well as decrease in numbness in hands and feet (*Dambudziko rekutadza kufema nekuda kweropa shoma nechiveve mumaoko nemakumbo chinobva chapera*). However, although one woman agreed that supplements were good, she doubted if they were effective for all individuals. She indicated that they are not very helpful to her because she vomits them together with the food she would have eaten (*Kwandiri haashande, anogona kunge achiitira hawo kune vamwe. Pese pandioamwa ndinoarutsa pamwe chete nechikafu chandinenge ndadya*). The various roles of iron supplements during pregnancy as perceived by the pregnant women are summarised in Table 5.3.

Table 5.3: Roles of iron supplements during pregnancy as perceived by pregnant women (n=64)

Roles of iron supplements during pregnancy	Combined responses per FGD
To add to the woman's blood volume which increases in pregnancy.	8
To have enough blood for both pregnant mother and developing fetus.	6
To prepare and allow for the blood losses at delivery, to avoid iron depletion.	7
To ensure good and safe delivery and avoid complications.	4
To allow for normal oxygen delivery and breathing of mother and fetus.	5
For the mother to remain fit after delivery.	3
To stop numbness of feet and hands in the mother.	2

5.5.4 Major themes generated from FGDs on barriers to optimal iron supplementation regimens

Four major themes were generated from FGDs on barriers to optimal iron supplementation, as illustrated in Figure 5.2. These include indigenous knowledge systems (IKS), attitudes and perceptions, poverty, as well as innovations.

Figure 5.2: Themes generated from focus group discussions on barriers to optimal iron supplementation

5.5.4.1 Indigenous knowledge systems (IKS)

Culture and religion had a very strong influence on the use of iron supplements by pregnant women, and this was inclined to their indigenous knowledge systems (IKS) (Table 5.4).

Table 5.4: Influence of indigenous knowledge systems on the use of iron supplements

Discussion topics	Theme	Concept	Responses	Quotes
Influence of culture and tradition on the use of iron supplements.	Indigenous knowledge systems • Culture and tradition.	Knowledge as influenced by traditional norms and values.	Pregnant women are often forced by tradition and culture to take alternative supplements, which are supposedly meant to make delivery less complicated. There are often threats that if one does not take these traditional 'concoctions', they are likely to experience complications like delivery through caesarean section. Failure to take the traditional medications is usually considered as insubordination to family authority. Therefore, pregnant women develop a fear of being blamed should any complication arise, due to failure to take traditional medication.	'*The mothers-in-law force us to drink homemade concentrated concoctions, usually avocado, guava and mango leaves boiled in a big pot*.' '*Culture is still very powerful in giving us directions on what to eat, and sometimes it's better to take the concoctions than to have complications*.' '*Tsika dzedu dzine* problem*, irikutotisunga vazhinji vedu, titori kukwikwidzana. Vanotiti imwai maHerbs*. *We don't know who will win the match*.' (*Our culture has a problem, forcing many of us to drink the home made herbs when we don't want. We are actually competing and we will see the winner*).
Belief systems vs. scientific systems.	Indigenous knowledge systems • Religion.	Traditional ways as influenced by a deity.	Religious beliefs and respect for a deity often conflicts with scientific knowledge in most cases. Spirituality is often seen in traditional communities as superior and incomparable to scientific knowledge. The food recommended during pregnancy, such as meat is usually discouraged by some denominations. This may cause some church members to take the foods or supplements privately or else they risk being malnourished. Some religious sects are gradually opening up to the concept of scientific interventions related to the use of supplements. They have become more liberal in allowing their followers to take supplements and foods they wish to consume. Participants felt that religion should not be very restrictive, but rather help its members to stay healthy.	'*Religion is very powerful to the extent that some pregnant women are not even coming here for check-up. They are not allowed even to come to collect the tablets.*' '*Havana kwekuto awanira chero vachimada*' *(Women can't even access tablets even if they want to).* '*I told them at my church that when I am pregnant like now, they should forgive me, because I will not stop eating meat, like pork, because I like it. It is also very appetising. Or else I will stop going to church until I have delivered my baby.*' '*But some, especially the Apostolic sects are slowly changing. Some members are now coming to the clinic.*' '*The church should help teach us when we go for ladies' meetings how to cook good food for our families, not to blame us.*'

5.5.4.2 Attitudes and perceptions as determinants of compliance to iron supplementation

The outcome of iron supplementation programmes is influenced by the behaviour, attitudes and perceptions of the pregnant women themselves (Nisar *et al* 2014; Fathi Najafi *et al* 2014). Some may not even want to take the tablets (Fathi Najafi *et al* 2014; Bilimale *et al* 2010). Thus, in the current study the attitudes of the pregnant women towards the use of supplements had a strong influence on compliance (Table 5.5). Attitudes may be influenced by levels of knowledge, ethnicity, myths and truths derived from culture and religion, previous experiences and/or side-effects (Kamau *et al* 2018; Onyeneho, I'Aronu, Chukwu, Agbawodikeizu, Chalupowski & Subramanian 2016; Nisar *et al* 2014).

Table 5.5: Attitudes and perceptions of pregnant women towards iron supplementation

Discussion topics	Theme	Concept	Responses	Quotes
Awareness and importance of iron supplements during pregnancy.	Attitudes and perceptions towards supplements: 1. Educational level. 2. Myths and truths derived from culture e.g. pica. 3. Reaction to side-effects. 4. Forgetfulness.	Personal perceptions towards supplements.	Educational level and knowledge about the importance of iron supplements has a positive influence on attitudes and perceptions towards compliance. Most women knew the importance of iron supplements in boosting blood volumes. However, their continued acceptance and use of iron supplements was entirely dependent on their perceptions and attitudes towards the supplements. This is also based on what they acquired from their culture. Some felt that iron supplements were expensive, as they had to purchase them from pharmacies. This is because the free supplies from the clinics were not available. Others discontinued use of iron supplements because of side-effects and they ended up preferring indigenous alternatives, perceived to be healthier and with minimal side-effects. Although some acknowledged the importance of iron supplements, they forgot to take the supplements consistently.	'*When I deliver, I may lose a lot of blood, so I must have enough to avoid complications.*' '*Since there will be sharing between the mother and child, it means mother need to have more blood.*' '*Oxygen moves with the blood, so if the mother has enough, the baby and mother will breathe very well.*' *(Ropa rikawanda zvinobatsira kuti mwana namai vake vafeme zvakanaka).* '*These tablets are very expensive at the chemists.*' '*The nurses told us to buy, at the clinic we were only given once, because they are in short supply.*' '*Anomisa moyo, dzimwe nguva kurutsisa iro dzungu, nechirungurira*' *(They cause nausea, sometimes they induce vomiting, dizziness and heartburn).* '*Running stomach or diarrhoea.*' '*Haanakidze, anodakumwa waakurara kuti asakutambudza,anoitakakurwarisa. Sometimes I experience excessive hunger.*' '*The main challenge is that I forget them home when travelling. This disturbs the pattern.*' '*Sometimes, even when I am home I may forget to take them because I will be very busy.*'

(a) Lack of adequate health education

In the current study, a lack of adequate health education about anaemia was found to reduce compliance with iron supplementation. Some women indicated that in some instances they would be given the iron supplements without any explanations on their use and importance. One woman cited the need to have clear explanations to help one to understand and gain more information (*Tsanangudzo dzinodiwa nekuti dzinobetsera kuti munhu ave neruzivo*). Other women warned of the dangers of just taking tablets without adequate knowledge. When you are given iron supplements, even if you are not educated, you need to ask, why have you given me these supplements? What is the frequency of taking? How do they help me? Do not just swallow tablets without adequate information (*Uchipihwa matablets nyangwe usina kuenda kuchikoro, bvunza kuti munondipirei? Ndoamwa sei? Anokosherei? kwete kungokabira mapiritsi*). In justifying the importance of nutrition education, a certain pregnant woman explained that, '*if one has no knowledge and even if she has money, one can choose to buy foodstuffs rather than iron supplements. Ruzivo ndirwo runokosha* (Knowledge is power). *Even if I don't have money, I will borrow because knowledge will help me.*'

(b) Side-effects associated with iron supplementation

The most common side-effects noted by most pregnant women in this study were nausea, *(kusvotwa/ kumiramoyo/ kuita kunge ave pahuro)*, flatulence *(kufufutirwa)*, heartburn (*chirungurira)*, dizziness *(dzungu)* and diarrhoea *(manyoka)*. Other side-effects were constipation *(tsvina inonetsa kubuda, apa tunenge twakaita tunhoko)* and black stools *(tsvina inenge iine ruvara rutema)*. Other pregnant women stated that iron supplements also caused excessive hunger *(anozvambura nenzara)* such that one had to have food close by. Other women indicated that iron supplements caused general body weakness and feeling faint. They indicated that whenever they took them, they would spend the whole day weak and unable to do anything. On days when they did not take supplements, they would be fine (*Mapiritsi aya anopedza simba/anonetesa zuva rose, uchinzwa musoro wakareruka kunge munhu arikuda kufenda. Hapana kana basa rinozokwaniswa kushandwa mushure mekutora mapiritsi iwaya, asi ukangorega kumanwa unenge watove right*).

(c) Myths and truths derived from culture

Focus group discussions revealed that certain myths derived from culture, negatively affected optimal use of iron supplements by pregnant women. Use of iron supplements is usually

discouraged in the Shona culture. In fact, these supplements are believed to cause overweight babies, leading to complications at delivery. The caesarean section, which is not culturally acceptable, is the only option and this creates an unnecessary financial burden for the family. Instead, they believe in boiling strong concoctions for pregnant women to drink, to boost their blood volumes. One pregnant woman explained that mothers-in-law usually force them to take the strong concoctions, usually made by boiling leaves of the avocado, mango, guava and other trees *(Vana amweme kunyanya ndivo vanototi timwe by force. Kazhinji mishonga yacho inenge yakabhoiliswa mashizha emu avo, mumango, mugwavha nezvimwewo, zviri very strong*). The strong position of influence occupied by the mother-in-law, usually leaves the pregnant woman with no choice but to give in. Yet another woman highlighted that if she refused the supplements and there were challenges at delivery or if the child died, she would be sent back to her parents' home because of disobedience (*If you refuse, zvikazonetsa pakusununguka kana kuti mwana akafa, unodzoswa kumusha uchinzi hauteereri*).

It was also revealed that some Shona communities used herbs, not only for increasing blood volume, but more importantly for widening the birth canal, through which the baby would come (*kuvhura nzira).* Some women had fears that if they did not take traditional medicines to widen the birth canal, they would face complications at delivery. One of them mentioned that during delivery, you will be told that the delivery space is too small for the baby to come out. Then, they will take a pair of scissors and widen the opening because you would not have opened the passage on your own (*Waakuzvara unonzi mwana haasi kukwana*. *Vanotora chigero vocheka kuwedzera nzira kuti mwana akwane nekuti unenge usina kuvhura nzira wega*). Therefore, it is better to use traditional medicine to avoid complications at delivery (*Saka kushandisa mishonga yechivanhu kurinani kuti usazosangana nematambudziko pakuzvara*).

(d) Forgetfulness

Most pregnant women identified forgetfulness as a major barrier to compliance with iron supplements. Women are usually carried away by many activities at home, such that they end up forgetting to comply with the iron supplementation regimen. One woman had this to say, '*Sometimes, even when I am home I may forget to take them because I will be very busy.*'

5.5.4.3 Influence of poverty on optimal use of iron supplements

In this study, most pregnant women failed to obtain iron supplements from the clinic due to inadequate supplies. These erratic supplies were a barrier to optimal iron supplementation for most pregnant women and was due to the national socio-economic challenges, which also affects health services. Results from this study reveal that poverty was a major barrier to optimal iron supplementation during pregnancy (Table 5.6). This challenge is most prevalent in developing countries, including Zimbabwe (WHO 2015; WHO 2012).

Table 5.6: Poverty as a major barrier to optimal iron supplementation during pregnancy

Discussion topics	Theme	Concept	Responses	Quotes
Disruptions to optimal supplementation.	Poverty • Expensive health services. • Unavailability of supplements. • Poor health delivery system.	Influence of socio-economic status on the use of supplements.	Escalating pregnancy registration fees at the clinic and the need to buy iron supplements from pharmacies, were a threat to the financial stability of most women. Many were unemployed and depended on their spouses and families for money to register, which resulted in late registrations. The other challenge was erratic supplies of iron supplements, which were offered free of charge. Those who could not afford iron supplements would stop supplementing until they got a free supply. Some, who could afford iron supplements, would not take supplements on a daily basis for fear of running out of supplies too quickly. All this would negatively impact on the well-being of the mother and fetus. On the other hand, the health delivery system in Zimbabwe needs to improve. Ineffectiveness and inconsistency in the procurement and delivery system of iron supplements to clinics, resulted in poor compliance with supplementation.	'*Ane mari yake anogona kutozvi ignore zvekumirira kupihwa pano, otozvitengera.*' *(Those with money can simply go and buy from pharmacies rather than coming here where there is nothing).* '*Without money, a person can even die because the pharmacies will not give you for free and even the clinic cannot register you, so you won't get any supplies.*' '*It's expensive to register pregnancy at the clinic. Ko munhu haagone here kungouya achitora mapiritsi even asina hake kunyoresa nhumbu yacho.*' *(Can't we be given supplements even before we register?)* '*Money on its own is nothing, people need to be educated first so that they are able to read and understand.*' '*Our country is buying or manufacturing the iron tablets in bits and pieces. They need to be in bulk orders.*' '*We are not getting enough yet we are staying in town, so what will happen to pregnant women in the rural areas.*'

5.5.5 Innovations and strategies for improving iron supplementation regimens

There is a need to improve compliance with iron supplements among pregnant women for improved maternal and paediatric health outcomes (Birhanu, Birarra & Mekonnen 2018; WHO 2012). To increase compliance with iron supplements, practical and effective strategies should be implemented (WHO 2015; WHO 2012; Bilimale *et al* 2010). Possible strategies and innovations for improving iron supplementation are presented in Table 5.7. These strategies, when employed tactfully, may help to reduce the prevalence of IDA in pregnant women (WHO 2015).

Table 5.7: Innovations and strategies for improving iron supplementation during pregnancy

Discussion topics	Theme	Concept	Responses	Quotes
Strategies for improving supplementation.	Innovations • Health education. • Motivation of nurses. • Dietary diversity. • Family responsibility. • Consistency and compliance.	Knowledge on the importance of iron supplements by pregnant women.	Participants stressed the need for adequate health education and guidance by the nurses. They mentioned the need for information on the use of iron supplements and the correct management of side-effects. According to the FGD participants, the nurses were in some instances not motivated enough to work with the women and to give them the help they needed. Good communication and counselling from the nurses would help increase acceptance and use of iron supplements by women. Dietary sources need to be diversified to include iron-rich food sources and those that promote its absorption. There is a need for balanced diets and increased mineral consumption during pregnancy. Family members need to be educated on suitable diets for pregnant women.	'*Keep reminding us, we want more teachings so that we keep trying to improve and to be able to manage side effects.*' '*Sometimes nurses are in very bad mood, they just give you tablets without telling their use.*' '*Some of them are very rude, but vana sekuru varinani pane vakadzi*' *(the male nurses are better to work with as compared to females).* '*At the same time, the supplements should not come in short supply like they are doing now.*' '*Teach my family members importance of iron tablets and the foods I must eat and they will remind me.*' '*My mother-in-law should also come with me to the clinic so that she will know what food I must eat.*' '*I will tell my husband or my children to remind me to take them.*' '*Put them in a place where you will constantly see them.*'

5.6 Discussison

Findings reveal that accessibility of iron supplements was a challenge to pregnant women. The majority of women had to wait for supplies to arrive in the following month, thus negatively impacting on their iron supplementation. The supplies were only delivered at the clinic once a month, and in most cases were in limited amounts and failed to meet demand. Only a few participants could afford to buy from private pharmacies, while others bought cheaper stocks from black markets, especially medicines imported from Mozambique.

In the current study, some of the major barriers preventing the optimal use of iron supplements were unavailability, inadequate and erratic supplies of iron supplements at the clinic. The major factors affecting compliance were the ineffective and irregular supply or distribution of iron supplements by clinics, resulting in inadequate supplies to the pregnant women (Agrega Sadore *et al* 2015). A similar study by Nisar *et al* (2014), revealed that in rural and urban Pakistan, optimal use of iron supplements was also hindered by erratic availability of supplies at healthcare centres. In most developing countries like Zimbabwe, socio-economic challenges usually result in delayed and inadequate procurement of iron supplements, as well as logistical difficulties at national level. This may result in insufficient supervision of drug delivery to healthcare centres (Agrega Sadore *et al* 2015; Fathi Najafi, Latifnejad Roussori & Hejazi 2014; FAO 2011; Bilimale *et al* 2010). This subsequently reduces the availability of iron supplements to pregnant women who obtain them from local clinics.

As shown in Table 5.2, the majority of participants were late with commencing with iron supplementation. Only a few complied with the WHO (2015) recommendation that supplementation should commence as soon as possible, or at 12 weeks gestation, under normal circumstances. The late commencement of supplementation by most women could have been caused by late registration due to a lack of money. Alternatively, some women might have deliberately postponed accessing ANC services at the healthcare centre, assumming there was nothing new to rush for, based on their previous pregnancies. Late commencement of iron supplementation could also have been due to unavailability of supplements at the clinic and most women could not afford to buy supplements from private pharmacies, as they are expensive. Concurring with the current findings, a study by Ba *et al* (2019) indicated that adherence to iron supplements varies across countries in relation to factors such as number of ANC visits, education and level of family wealth. Thus, there is still a need for increased efforts to improve iron supplementation among pregnant women in SSA. According to the WHO

(2015), late commencement of iron supplementation during pregnancy results in IDA, which threatens the health of both the pregnant woman and her fetus. Pregnant women in the developing world in particular, are at high risk of IDA caused by inadequate iron intake and worsened by significantly increased requirements of iron during pregnancy (Milman *et al* 2016; Alam *et al* 2015). Thus, iron supplementation should begin as early as possible, or at 12 weeks gestation (WHO 2015

While the aforementioned side-effects could have been due to other issues related to pregnancy, the pregnant women highlighted that once they stopped taking iron supplements, these effects would subside. Therefore, these side-effects, which pregnant women associated with the use of iron supplements, prevented them from effectively using the supplements (Tolkien *et al* 2015). The most common side-effects noted were nausea, dizziness, vomiting, heartburn, hunger and thirst. These side-effects resulted in some women discontinuing use of the supplements, despite knowing their importance during pregnancy. Fathi Najafi *et al* (2014) concur with Kamau, Mirie & Kimani (2018), on the fact that noncompliance may also be associated with gastrointestinal side-effects, such as nausea, diarrhoea, heartburn and vomiting. However, Agrega Sadore *et al* (2015) highlight that although side-effects are a barrier to compliance, they are not the main reason for non-compliance. Inconvenient dosing regimens and the bad smell and taste of the iron supplements may also prevent optimal use of supplements. It has been suggested that supplements could be taken with food to disguise the taste and smell (Kamau *et al* 2018; Agrega Sadore *et al* 2015).

The general appreciation of the important role of iron supplements by most women in Zimbabwe is a pointer towards possible improved compliance. Ugwu *et al* (2014) state that pregnant women in developing countries usually have inadequate iron levels because their diets lack variety. Iron is critical in ensuring improved ferritin levels, especially during pregnancy (Bilimale *et al* 2010). To increase iron supplementation in pregnant women, the WHO (2018) has encouraged health ministries worldwide to improve the availability of supplements.

There is a strong influence of culture and tradition on the use of iron supplements (Group 2016; Bilimale *et al* 2010). Culture encompasses worldview, art, dress, marriage, music, food and dance (Group 2016; Chirozva, Mubaya & Mukamuri 2010). People connect to their cultural or ethnic groups through similar food patterns. Although food is often selected with some attention to physical need, the values or beliefs a society attaches to food makes it a means of

retaining cultural identity. Countries are frequently associated with certain foods (Group 2016; Bilimale *et al* 2010; Chirozva *et al* 2010).

During pregnancy, women make rational compliance decisions about the costs and benefits of prescribed supplements, depending on their socio-cultural circumstances (Bilimale *et al* 2010; Gautam *et al* 2008). In other words, the degree of compliance is affected by particular cultural beliefs and ethnicity (Agrega Sadore *et al* 2015; Fathi Najafi *et al* 2014; Gautam *et al* 2008). Cultures that do not promote the use of contemporary medication may reflect negative attitudes towards iron supplementation in pregnancy, thus contributing to noncompliance among the women (Agrega Sadore *et al* 2015; Bilimale *et al* 2010).

Culture dictates food taboos that may be followed by people, regardless of the health consequences these may have. These taboos affect mostly pregnant women and female children (Milman *et al* 2016; Siamonga 2016). Sinyoro (2017), explains that in the Zimbabwean culture, fish, eggs, *kapenta* (dried salted small fish), mopani worms (*madora*), sugar-cane, sweets, pepper, left-over thick porridge (*sadza*) and okra are all forbidden during pregnancy. Eggs and okra are believed to cause balding, while eggs are also believed to contribute to infertility in women (Sinyoro 2017; Siamonga 2016). Fish and *kapenta* (dried salted small fish) are said to cause scales on the skin of the newborn, which may also develop into ringworm and eczema (Sinyoro 2017; Milman *et al* 2016; Siamonga 2016). Mopani worms are also believed to contribute to rough, dry and itchy skin (Siamonga 2016). Sinyoro (2017) emphasises that pregnant women are discouraged from consuming sugar-cane and sweets for fear of causing excessive discharge of fluids during delivery. Sugar is believed to cause whitish pimples on the infant's skin (Sinyoro 2017; Siamonga 2016). According to Sinyoro (2017), the remedy for this is to add sugar to the baby's bath water daily until all the pimples disappear. In some cultures, pregnant women are also prohibited from eating clotted blood (*musiya*). Clotted blood is extracted from animal veins and cooked. It is believed to be very rich in iron, which is also needed in increased amounts during pregnancy. However, other cultural and religious groups do not allow its consumption among pregnant women, for fear of giving birth to infants with excessive volumes of blood (Sinyoro 2017; Siamonga 2016). The Brosankro community in Ghana, like Zimbabwe, has strong cultural and religious beliefs and practices governing iron supplement use in pregnancy. However, despite various beliefs, most people still appreciate the importance of iron supplements (Dwumfour-Asare & Kwapong 2013).

Married pregnant women are expected to comply with the family cultural doctrines and to be submissive to their husbands and in-laws. They only eat what is socio-culturally accepted and recommended (Sinyoro 2017; Siamonga 2016; Bilimale *et al* 2010). Therefore, the decision to use iron supplements in pregnancy and the onset as well as duration of supplementation are not decisions made by pregnant women alone. These are family responsibilities, which are governed by their cultural and traditional norms and values (Group 2016; Siamonga 2016).

Religion refers to beliefs and practices relating to unseen things (Fathi Najafi *et al* 2014; Bilimale *et al* 2010; Chirozva *et al* 2010). Religion plays an important role in the lives of most Zimbabweans, with Christianity being the main religion (Chirozva *et al* 2010). Religion helps to shape families' ideologies towards gender and defines how people ought to live and behave. Therefore, some food beliefs and practices are due to religious beliefs (Dwumfour-Asare & Kwapong 2013). In other words, religion has an important role in forbidding the consumption of certain foods (Augustine 2018; Musimwa 2018). For instance, Muslims do not eat pork, Hindus do not eat beef and are commonly vegetarians (Dwumfour-Asare & Kwapong 2013). Christians, especially orthodox Catholics observe holy days and months like Lent, which are devoted to prayer and fasting (Dwumfour-Asare & Kwapong 2013; Chirozva *et al* 2010). Consumption of meat is not allowed during these months and this also pertains to pregnant women, regardless of their physiological needs (Chirozva *et al* 2010).

Findings from Mutare City Clinic revealed that religion played a significant role in pregnant women's perceptions and use of iron supplements. This points towards the strong impact of religion in influencing supplementation programmes, either positively or negatively. The following excerpt was from one of the FGDs participants, '*without mentioning names, there are certain churches who say clinics are not helpful. Thus, their faith is disturbed when it comes to taking supplements. Some apostolic sects believe in church delivery and hospitalisation is viewed with scorn.*' Religion is powerful to the extent that other pregnant women are not even allowed to attend clinics for ANC (Musimwa 2018). Findings of the current study are consistent with those from Ghana, where some religious sects were devoted to prayer and fasting only, and discouraged members from accessing ANC services at the clinic (Dwumfour-Asare & Kwapong 2013).

Personal communication with two religious analysts, Mr Musimwa (2018) and Mr Augustine (2018), who are also lecturers at a local satellite theological seminary in the city of Mutare, revealed how other Apostolic sects operated. Some of these sects only allow their members to

come to clinic for delivery only, while ANC visits are not allowed. Some of the Apostolic sects do not allow their pregnant members to take iron supplements because they have their own herbal concoctions especially prepared by elderly women and prayed for by the Bishops in these sects. These concoctions are believed to cleanse pregnant women from all forms of disease or ailments and are also necessary to ensure safe and normal delivery (Augustine 2018; Musimwa 2018). However, if these women develop anaemia, they have no means of determining their haemoglobin levels and severity of anaemia, due to a lack of screening. In the event of complications arising during delivery, the Apostolic sects associate these with demons or powers of darkness operating at the clinics (Augustine 2018; Musimwa 2018).

Even though all the participants in this study indicated a 100% Christian religion affiliation with religious food prescriptions, dietary practices varied widely, even among people of the same faith. Such variations may be due to various denominations, or families' own degree of religious adherence (Augustine 2018; Musimwa 2018; Chirozva *et al* 2010). Some religious groupings such as *Mwazha, Zviratidzo, Madzibaba*, and Seventh Day Adventists (SDA) do not eat pork, mice, or mopani worms. Other Apostolic sects discourage the consumption of meat during the whole course of pregnancy (Augustine 2018; Musimwa 2018). The consumption of meat in these Apostolic sects, is believed to cause the pregnant woman and the unborn baby to contract the demonic forces operating in the animals. However, findings revealed that despite some of these restrictions, some pregnant women could not resist the temptation and still ate the restricted foods. They would only go to church and make confessions after delivery. However, some women were afraid of sinning before their God and church and therefore would not eat any restricted foodstuffs, even though they were aware that it could negatively affect their health. Religion is a very strong influence on the effectiveness of iron supplementation programmes. Thus, many pregnant women who take iron supplements, do so mainly because their religion permits it and not because of their physiological needs (Augustine 2018; Musimwa 2018).

A lack of adequate health education is a notable barrier to optimal iron supplementation amongst pregnant women. Agrega Sadore *et al* (2015) concur with Nisar *et al* (2014), that some health professionals do not communicate to patients the importance of iron supplements and even the need to purchase supplements should they be depleted at the clinic. Women who have good patient-doctor relationships are usually knowledgeable about anaemia, and their adherence to iron supplements is positive (Agrega Sadore *et al* 2015; Nisar *et al* 2014).

Therefore, a lack of knowledge about anaemia and its prevention during pregnancy affects compliance and is one of the main causes of the high prevalence of IDA (WHO 2016; Nisar *et al* 2014). Inadequate counselling of pregnant women may also result in misunderstanding of instructions (Kamau *et al* 2018; Kumar & Priya 2018; Onyeneho *et al* 2016). Typically, non-compliance or non-adherence to medical advice is assumed to reflect a lack of knowledge, inability to retain medical instructions, or other behavioural factors. According to the WHO (2016), there is a need for behaviour change communication (BCC) to improve compliance with iron supplement regimens among pregnant women.

Even though ferrous sulfate remains the most commonly prescribed iron supplement, specifically ideal for pregnant women, it is still associated with a significant increase in gastrointestinal side-effects (Tolkien, Stecher, Mander, Pereira & Powell 2015; WHO 2015). According to Tolkien *et al* (2015), these gastrointestinal side-effects cause inflammation of the gastrointestinal tract and poor tolerance, thus significantly reducing compliance. A similar study by Ba *et al* (2019), also state that pregnant women in most SSA countries complained about side-effects due to use of ferrous sulfate. Milman *et al* (2016) concur with the WHO (2012) on the need to reduce the dosage to less than or equal to 50-60 mg iron/day, or to offer the supplement intermittently in order to reduce side-effects.

Tolkien *et al* (2015) explain that due to the body weakening and other side-effects, many women do not like taking iron supplements or they would rather take them at bedtime so that they would not experience much discomfort. Supplement characteristics, such as the form of the supplement, administration mode, duration, colour, smell and its usually unappealing taste may also contribute to non-compliance (Nisar *et al* 2014; Fathi Najafi *et al* 2014; Gautam *et al* 2008). Therefore, the attitude of women towards iron supplements is to a great extent influenced by the side-effects experienced. For many years, side-effects associated with oral iron supplementation have been the main cause of poor compliance among many pregnant women (Kumar & Priya 2018; Tolkien *et al* 2015).

According to Tolkien *et al* (2015), since gastrointestinal side-effects associated with iron supplements are the major deterrent to compliance, it is necessary to inform pregnant women that these side-effects are generally transient and not harmful. Where intolerable, they could be significantly ameliorated by taking supplements with food (Agrega Sadore *et al* 2015; Bilimale *et al* 2010; Habib *et al* 2009). The WHO advises that women should be equipped with strategies to manage the side-effects (Kimau *et al* 2018; WHO 2018; WHO 2016; WHO 2015). Women

must be advised that side-effects are possible and may diminish with time. If side-effects persist, women can be advised to break the iron tablet in half to reduce the dosage and take them at separate times in the day. Another strategy is to take the supplements with a small amount of food (Bilimale *et al* 2010; Habib *et al* 2009; Gautam *et al* 2008).

According to Bilimale *et al* (2010), some myths associated with cultural and traditional practices induce fear in some women. Women would stop using iron supplements, fearing that they would increase their blood volumes, resulting in large babies and difficult delivery (Alam *et al* 2015; Bilimale *et al* 2010). Some women prefer to eat clay (*dongo*) or soil from the anthills (*mujuru*), instead of iron supplements. Pica, which is a craving by some women for non-food items like stones and soil, indicates that these women are at a higher risk for anaemia. The pica habit disrupts adequate iron supplementation (Siamonga 2016; Gould 2013; Bilimale *et al* 2010). Therefore, some myths and truths also affect perceptions and attitudes towards compliance with iron supplements and may impact negatively on the health of the mother and fetus (Group 2016; Dwumfour-Asare & Kwapong 2013).

Forgetfulness is a significant barrier to the use of iron supplements (Bilimale *et al* 2010). Gautam *et al* (2008) also confirmed that forgetfulness is another critical factor preventing compliance and triggering IDA during pregnancy. In the current study, some women indicated that whenever they travelled away from home, they forgot to take their iron supplements with them. Others would be home, but still forgot to take them, as they would be preoccupied with very busy schedules at home. Thus, it is necessary to counsel women during ANC visits on possible strategies that could help them remember to take their iron supplements. For instance, placing iron supplements in areas that they would see every day, for example, on the breakfast table or bedside (Bilimale *et al* 2010). Some researchers suggested that direct supervision helped pregnant women improve compliance with iron supplements (Bilimale *et al* 2010; Gautam *et al* 2008). According to Birhanu, Birarra & Mekonnen (2018), pregnant women who are married could be reminded by their spouses to take their iron supplements daily.

Poor utilisation of ANC services by pregnant women is another poverty-driven barrier to optimal iron supplementation (Bilimale *et al* 2010). Women have to pay a registration fee of $2 500 Zimbabwean dollars (R500) before they can start accessing ANC services at the clinic. Since most women may not be able to afford the registration fee, they may delay ANC visits. The majority come to register at the clinic towards the end of the second trimester, when the pregnancy has advanced (WHO 2012). Hence, if some women have IDA from the first

trimester, this is not usually detected until they come to the clinic. This predisposes the fetus to many health risks, growth retardation and failure-to-thrive (FTT) (Yussolf, Wan Daud & Ahmad 2013; WHO 2012; Bilimale *et al* 2010). Poor access to ANC services may also be due to the long distances some women have to travel to access health care facilities. The transport costs incurred may limit availability and use of iron supplements by pregnant women (Bilimale *et al* 2010).

Poor socio-economic status is a potential barrier to compliance. Low income groups usually comprise a higher portion of anaemic patients, as compared to high income groups (Chowdhury, Ahmed, Jebunessa, Akter, Hossain & Shahjahan 2015). The majority of women are not gainfully employed, and do not usually control the family finances or determine compliance with the supplementation program (UNICEF 2017; FAO 2016). In general, when females rather than males have control over finances, the family diet is likely to be better since women generally spend more time with family and have a better appreciation of individual needs (UNICEF 2017). Unfortunately, Zimbabwe has failed to curb the escalating unemployment crisis, resulting in poverty (Mutasa 2015). Most women are unemployed and have little control over family finances, subsequently leading to the consumption of unbalanced meals (UNICEF 2017; FAO 2016; Mutasa 2015).

The above findings are not specific to Zimbabwe only. A study of pregnant women in 22 SSA countries by Ba *et al* (2019), revealed a generally low level of adherence to iron supplementation regimens. Many pregnant women do not adhere to iron supplementation due to a lack of knowledge about anaemia, inadequate supply of tablets, poor utilisation of ANC services, inability to pay for supplementation, complaints about side-effects, forgetfulness and poor counselling (Ba *et al* 2019; FAO 2016; Nisar *et al* 2014).

According to Habib *et al* (2009), there is a need to implement strategies to improve compliance with iron supplements and ensure optimal iron supplementation among pregnant women. To increase compliance with iron supplements, there is a need to develop specific tools and approaches to address the difficulties of a daily regimen (Bilimale *et al* 2010). Some strategies should include home visits, counselling pregnant women and their families, as well as assessment of Hb levels (Agrega Sadore *et al* 2015; Bilimale *et al* 2010).

Pregnant women should be motivated to take iron supplements (WHO 2018). Although pregnant women may be aware of the symptoms of anaemia, they need to be convinced that these symptoms are not a normal part of pregnancy and that they can be prevented or cured.

Gautam *et al* (2008) stress the need for pregnant women to be persuaded that anaemia is a serious concern during pregnancy and recommends that iron supplementation be given without food, to maximise absorption. However, Milman *et al* (2016), argue that although absorption is enhanced when given on an empty stomach, nausea and epigastric pain sometimes result. Alleviation of these side-effects can be achieved by lowering the iron dose given between meals (Milman *et al* 2016). Another strategy to improve compliance is to give iron supplements together with meals. However, food reduces the absorption of medicinal iron by about 67%. Alternatively, oral iron supplements can be taken every few days (WHO 2018; Milman *et al* 2016).

Effective communication strategies with pregnant women about diet and healthy eating is essential to inform, teach and improve compliance among women (WHO 2018; Gould 2013; Yussolf *et al* 2013). This is vital for improving the acceptance and adherence to iron supplementation programmes. This can be achieved by training nurses or volunteer distributors. If feasible, they could assist with home visits to pregnant women in their first few days of taking supplements and through effective counselling (Trentmann, Reinhard & Vierck 2015). Pregnant women need to be informed or educated on the purpose and health benefits of iron supplements, both for their unborn children and themselves (Trentmann *et al* 2015; Yussolf *et al* 2013).

Compliance with iron supplementation is one of the most important factors that affect the effectiveness and outcome of an iron supplementation programme. Compliance can be defined as the extent to which a person's behaviour coincides with medical advice (Bilimale *et al* 2010). However, non-compliance is a major contributing factor to inadequate iron supplementation in developing countries (Agrega Sadore *et al* 2015; Bilimale *et al* 2010). Findings from this study revealed that the barriers to optimal iron supplementation included erratic supply of supplements to the clinics, lack of adequate health education and counselling among women, and religious, cultural and socio-economic factors. Findings also revealed that negative attitudes due to side-effects also reduced compliance with iron supplementation regimes among pregnant women.

5.7 Conclusions

This study has identified many barriers to optimal use of iron supplements by pregnant women. Barriers included poor communication and inadequate nutrition education by nurses on the need and importance of iron supplements during pregnancy. A lack of knowledge on the

importance of iron supplements affected their use. Unavailability or in some cases, inadequate supplies of iron supplements from healthcare centres was another critical barrier. This may be due to poor logistics of distribution from national health reserves. In some instances, when pregnant women arrived at the clinic for ANC visits, the monthly supplies of iron supplements had already run out. Those who could afford it, bought from private pharmacies. It was therefore a serious health threat to those who were financially constrained and could not afford to buy iron supplements from private pharmacies. Although some pregnant women either bought or obtained their supplies of iron supplements from the clinic, it was also noted that compliance remained a serious barrier. Side-effects associated with oral iron supplementation (usually ferrous sulfate) contributed to poor compliance, because some pregnant women would avoid ANC visits for months for fear of being given more supplements. They would thus fail to fully utilise the ANC services at their disposal. Religious and cultural restrictions, forgetfulness, poor socio-economic status and low levels of education, were other barriers identified as preventing optimal iron supplementation by pregnant women. Some religious affiliations and cultural groups did not allow their followers to take any form of medication or nutritional supplements and even certain types of food. This has a negative impact on the health of pregnant women, as these religious and cultural groups have no scientific strategies for establishing the Hb levels of their followers, prior to or at the onset of pregnancy. Thus, complete alleviation of IDA among pregnant women may be difficult to achieve in Zimbabwe. However, for pregnant women who were not strongly influenced by culture or religion, there are nutritional interventions or strategies that can be employed to reach out to them, so as to ensure correct and adequate use of iron supplements. If more supplements were available at clinics free of charge, compliance would likely improve. Women need to be motivated to obtain iron supplements from clinics and to be reminded to take the supplements effectively. Strategies for the management of side-effects and the duration of iron supplementation need to be clarified for increased compliance. Irrespective of the many barriers that affect optimal use of iron supplements by pregnant women, most barriers can be addressed by ensuring consistent availability of supplements at clinics and adequate nutrition education on iron supplements. This should also include strategies for managing side-effects and reminding women to take supplements consistently.

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CHAPTER 6
DEVELOPMENT OF A NUTRITION EDUCATION TOOL ON IRON SUPPLEMENTATION FOR PREGNANT WOMEN

Abstract

The development of a nutrition education tool for use by pregnant women may increase awareness of iron supplements and help improve compliance with iron supplement regimens. The issuing of iron supplements to pregnant women without an accompanying nutrition education tool may prevent them from using the iron supplements optimally. This is because women have nothing to remind them about the need for iron supplements and how to take them. Therefore, iron supplements alone may not be effective in addressing IDA. A combination of a nutrition education tool and the iron supplements may be more effective in encouraging compliance with the iron supplements. Hence, the development of a nutrition education tool on iron supplementation for use by pregnant women, may contribute to improved awareness of iron supplements and increased compliance with iron supplement use among pregnant women. A nutrition education tool is a key strategy in improving pregnancy outcomes as it may improve awareness, and consequently compliance with iron supplementation regimens. The objectives of this study were to (i) ascertain from pregnant women the form of nutrition education tool most preferred, the importance of the tool and information and language to be used in the tool, as part of their ANC, (ii) develop a nutrition education tool for pregnant women based on the input from pregnant women, in order to improve awareness of iron supplements, (iii) test the developed nutrition education tool to determine if it is user-friendly and acceptable to pregnant women. A total of 67 pregnant women were purposively selected from pregnant women attending the Mutare City Clinic, Manicaland, Zimbabwe for ANC services at the time of the study. Mutare city in Manicaland province, was specifically chosen as the study site because there is no nutrition education tool currently being issued with iron supplements for pregnant women in this area. In order to be included in the study, the pregnant women had to be either in the second or third trimester of pregnancy. Eight focus group dicussions (FGDs) were conducted with pregnant women over a period of six weeks, to establish the tool they most preferred, the language to use and the information to include in the nutrition education tool. After the nutrition education tool was developed, three additional FGDs were conducted with 28 women over a period of three weeks to assess how user-friendly the developed tool was to the pregnant women. The collected data from FGDs was thematically analysed and discussed. A pamphlet was identified as the most preferred nutrition education tool by 49.3%

(n=33) of the pregnant women. English was the most preferred language for use in the pamphlet, along with some Shona phrases to clarify the names of certain foodstuffs and for easier understanding. The Developing and Assessing Nutrition Education Hand-outs (DANEH) checklist was used to test the pamphlet amongst the pregnant women. The pamphlet was found user-friendly as it was written in simple and easy to read language, and font. Specific basic information was identified as being critical and warranted inclusion in the pamphlet. This included information on the effects of IDA, the importance of iron supplements, dosage, onset and duration of iron supplementation, management of side-effects and iron and vitamin C-rich foods. The first trimester, at the point of registration was identified as the most ideal stage to offer the pamphlet, together with iron supplements. Three sites were noted as being ideal for disseminating the developed pamphlet to the pregnant women. These included the clinics during ANC sessions, private pharmacies where women would go to buy iron supplements if supplies run out at clinics and during church gatherings. The absence of adequate nutrition education and unavailability of specific education materials for pregnant women on iron supplementation, is a serious challenge in nutrition education endeavours. The issuing of iron supplements to pregnant women alone, may not encourage optimal use of supplements by pregnant women. However, a combination of iron supplements with a nutrition education tool, may improve awareness and thus motivate compliance with iron supplements, among pregnant women. Thus, this study addressed the need to empower pregnant women with nutrition education through the development of a nutrition education tool on iron supplementation.

6.1 Introduction

Iron supplementation has been the preferred intervention to prevent IDA among pregnant women (Peña-Rosas, De-Regil, Garcia-Casal & Dowswell 2015). However, the use of iron supplements alone, without a complementary nutrition education tool may prevent pregnant women from using the iron supplements optimally (Pavord, Myers, Robinson, Allard, Strong & Oppenheimer 2011; Joshi & Vijayalaxmi 2009). According to Joshi & Vijayalaxmi (2009), a challenge with intervention programmes to control malnutrition among pregnant women in SSA, is the absence of adequate nutrition education and the scarcity of appropriate education materials. For Zimbabwe in particular, no nutrition education tools related to IDA were developed previously. Pregnant women need something to consult at home to be reminded of the need for iron supplements, onset and frequency of supplementation (Lucas, Charlton & Yeatman 2014; Joshi & Vijayalaxmi 2009). According to Lucas *et al* (2014), evidence regarding the adequacy and extent of nutrition education for pregnant women is scarce. A lack

of knowledge about IDA and its prevention, is one of the main causes of its high prevalence during pregnancy (Kumar & Priya 2018). On the other hand, a lack of time and resources, inadequate counselling, as well as the lack of relevant training of nurses, usually result in pregnant women receiving inadequate nutrition education (Mbhenyane & Cherane 2017; Lucas *et al* 2014; Joshi & Vijayalaxmi 2009).

Lucas *et al* (2014), stress the need to identify the most effective nutrition strategies to improve nutritional knowledge and dietary behaviours of women. Mbhenyane & Cherane (2017) explain that compliance with iron supplements can be increased by providing women with clear instructions and educating them on the health benefits of supplements. When pregnant women have increased awareness, they are more likely to be motivated, thus positively impacting on compliance (Oluwoye & Adebukola 2018; Mbhenyane & Cherane 2017; Lucas *et al* 2014). This, therefore justifies the need to develop a nutrition education tool on iron supplementation for women to use along with iron supplements. A combination of the nutrition education tool and iron supplements may be more effective in improving awareness and encouraging compliance with the iron supplements (Oluwoye & Adebukola 2018; Mbhenyane & Cherane 2017). Thus, there is a need to create awareness of iron supplements and to provide continuous counselling about IDA during pregnancy, in order to improve the health status of pregnant women (Mbhenyane & Cherane 2017). According to Pavord *et al* (2011), as much as women need nutrition information or education through discussions with nurses, this should also be consolidated with the provision of a nutrition education tool in the appropriate language.

A nutrition education tool could inform women of the need to take iron supplements, according to the World Health Organization (WHO) recommendations (WHO 2016a). The WHO recommends that nurses give adequate, specific and acceptable nutrition-related advice to pregnant women during every ANC visit (Oluwoye & Adebukola 2018; Zelalem, Endeshaw, Ayenew, Shiferaw & Yirgu 2017). Pregnant women need to be given dietary information to help them understand conditions that inhibit or enhance the absorption of iron (Pavord *et al* 2011). Nutrition education can help to promote dietary diversification and modification (DDM), leading to an increased intake of total bioavailable iron [Food and Agriculture Organization of the United Nations (FAO) 2014]. Zelalem *et al* (2017) explains that nutrition education during pregnancy has a significant impact on the dietary habits of women and on maternal and birth outcomes of pregnancy. It has been noted that compliance with iron supplements during pregnancy can also be increased through nutrition education as well as behaviour change

communication (BCC) (Oluwoye & Adebukola 2018; Ugwu, Olibe, Obi & Ugwu 2014; WHO 2016a; WHO 2016b; WHO 2012). There is a need to strengthen health education strategies for controlling IDA, through the use of a nutrition education tool (Onyeneho, I'Aronu, Chukwu, Agbawodikeizu, Chalupowski & Subramanian 2016; Alam, Rasheed, Khan, Sharmin, Huda, Arifeen & Dibley 2015).

A nutrition education tool for pregnant women should include information on the importance of maintaining adequate iron stores in pregnancy and details of iron-rich food sources (Pavord *et al* 2011). According to the WHO (2012), pregnant women also need information on iron supplementation from the beginning of the second trimester to six weeks post-partum. Information on dietary diversification is also important as it may help families to improve their use of locally available foods [United Nations Children's Fund (UNICEF) 2017; Girard & Olude 2012].

The use of learning theories contributes to the development of effective adult education resources (Papadakos, Papadakos, Catton, Houston, McKernan & Jusko 2014). The adult learning theory known as andragogy, identified and developed by Malcolm Knowles, is an important theory for use by nurses [Teaching Excellency in Adult Literacy (TEAL) 2011]. Malcolm Knowles (1913-1997) identified andragogy and defined it as the art and science of adult learning [United States Department of Agriculture & US Department of Health and Human Services (USDA-HHS) 2018]. Knowles made assumptions that adult learners have a well-established sense of self and move from dependency to increasing self-directedness. Past experiences play a pivotal role in adult learning and mistakes are often the most valuable teacher (USDA-HHS 2018; TEAL 2011). According to Knowles, adult learning is purpose driven and readiness to learn is driven by internal motivation rather than external factors (TEAL 2011). Adult educators collaborate with learners to select methods and resources for instruction, then evaluate the quality of the learning experience and make adjustments, while assessing needs for further learning (TEAL 2011). Therefore, the effective use of andragogy may help nurses to develop educational resources which will be useful to adult learners (FAO 2012; TEAL 2011; Joshi & Vijayalaxmi 2009).

According to Carter (2014), various forms of tools such as pamphlets, fliers, booklets, posters, magazines, brochures and newspapers can all be used in nutrition education programmes for pregnant women. Therefore, this study aimed to develop a nutrition education tool for pregnant women on iron supplementation. The tool was developed after ascertaining the opinions of

pregnant women and nurses on the form of nutrition education tool they preferred most, the type of information to include and the preferred language to use. The study also aimed to test the developed nutrition education tool for user-friendliness and acceptability by pregnant women. The nutrition education tool on iron supplementation could possibly increase awareness among pregnant women and encourage compliance with iron supplementation.

6.2 Materials and methods

6.2.1 Sample selection

When conducting research, it is often impractical to survey every member of a particular population because of size, thus there is a need to select a sample. A sample is a subset of a population that is used to represent the entire group (Sim, Saunders, Waterfield & Kingstone 2018; Sharma 2017; Omona 2013; Palinkas, Horwitz, Green, Wisdom, Duan & Hoagwood 2013). In this study, only 67 women attending the Mutare City Clinic met the inclusion criteria, by virtue of being in the second or third trimester of pregnancy. Therefore, they were purposively sampled. Purposive sampling is a type of non-probability sampling widely used in qualitative research (Sharma 2017; Guetterman 2015; Palinkas *et al* 2013). Purposive sampling, also known as selective, expert or subjective sampling is based on objectives of the study and not statistical calculations (Sim *et al* 2018; Guetterman 2015; Omona 2013). It involves seeking out information-rich cases, individuals with certain characteristics or those that meet specific criteria (Sharma 2017; Palinkas *et al* 2013). However, the main disadvantage of purposive sampling is that it is highly prone to researcher bias (Sharma 2017; Guetterman 2015).

The 67 pregnant women were recruited by the nurses during their monthly routine ANC visits. The nurses usually keep records of pregnant women which they continually update as the women come in for ANC visits. The nurses used these records to establish if a pregnant woman met the inclusion criteria for the study.

6.2.2 Instruments for data collection

Annum (2017) defines instruments as tools for data collection. The researcher must ensure that the instruments chosen are valid and reliable. In this study, the main instrument used was the FGD interview guide. The Developing and Assessing Nutrition Education Hand-outs (DANEH) checklist was another data collection tool which was used to assess userfriendliness of the nutrition education tool.

6.2.2.1 Focus group discussions

Focus group discussions were the preferred method to use to collect data because they enable substantial amounts of qualitative data to be collected within a short time, which may not be achieved with questionnaires alone (Nyumba *et al* 2018; Guest *et al* 2017; Alshenqeeti 2014; Omona 2013). In general, participants are more willing to talk than to write (Magwa & Magwa 2015, p343; Jamshed 2014). Focus group discussions typically refer to group interviews or in-depth discussion forums, meant for gathering information by gaining insights or opinions from participants about certain phenomenon (Magwa & Magwa 2015, p343; Jamshed 2014; Omona 2013; Cooper, Chenail & Fleming 2012). These discussions involve free interaction between research participants in a conducive environment and are frequently used when collecting qualitative data. Participants in a FGD respond to specific questions, drawing from their complex personal experiences, beliefs, perceptions and attitudes. Therefore, FGDs are inductive in nature (Nyumba, Wilson, Derrick & Mukherjee 2018; Guest, Namey & McKenna 2017; Omona 2013; Cooper *et al* 2012). The aim of the FGDs was to gather data on which nutrition education tool should be developed for pregnant women, as well as the ideal language to use and important information on iron supplements to include in the tool.

In the current study, an interview guide with FGD questions were generated prior to the study in English (Appendix M) and were then translated into Shona (Appendix N). In the current study, focus group discussion interview guide questions were developed in English, and were later translated into Shona. The FGD questions were formulated based on the study objectives, which sought to develop a nutrition education tool for pregnant women and to test the user-friendliness and acceptability of the developed tool by pregnant women. To validate the questions and check for consistency in the FGDs, a pilot study was undertaken (see section 6.2.3). The procedure followed for conducting FGDs is outlined in section 6.2.4. Since it was not possible to have all pregnant women participate in the FGDs, a smaller group had to be purposively sampled from all the pregnant women attending Mutare City Clinic for ANC.

6.2.2.2 Developing and Assessing Nutrition Education Hand-outs (DANEH) checklist

The Developing and Assessing Nutrition Education Hand-outs (DANEH) checklist was used to test the developed nutrition education tool for user-friendliness. The researcher and two research assistants went through the checklist after every FGD. According to ANDF (2016), the DANEH checklist is used to develop quality nutrition education materials and to monitor

existing ones. There were 15 identified constructs, which were categorised into five main parts, that is, relevance of content and language used, behaviour emphasis, traditional thoughtfulness or cultural sensitivity, written word as well as orderliness or text organisation. The last category was readability of the content, addressing aspects on font type and size, appropriate use of colour, clarity of images, as well as the printing material (ANDF 2016). The DANEH checklist was used to assess the relevance and adequacy of information on iron supplements in the nutrition education tool (Table 6.6). Information on importance, dosage and duration of supplementation was also verified against the WHO guidelines (WHO 2012).

6.2.3 Pilot study

6.2.3.1 Pilot study on the development of a nutrition education tool

A single focus group discussion was conducted as a pilot study before the main study on the development of a nutrition education tool. The pilot study aimed to detect any typographical or methodological errors or biases in the focus group questions, and to subsequently correct these. Six pregnant women, who met the inclusion criteria participated in the pilot study. The nurses who worked in the ANC unit at Mutare City Clinic recruited the women during their routine ANC visits. Since the ANC nurses had the ante-natal records of these women, they first established whether or not the pregnant women met the inclusion criteria to participate in the study, by virtue of their gestation stages. Pilot study findings revealed that question 6, which sought to establish the ideal stage for issuing the nutrition education tool to pregnant women, had two options of answers which were almost the same. One option was ‘end of first trimester’, while the other one was ‘beginning of second trimester’, which is about the same time. Therefore, the options were changed to read ‘during the first trimester’ and ‘beginning of second trimester.’ The pilot study helped to validate the instruments and check their degree of consistency.

The FGD facilitators first explained the purpose of the study to the pregnant women. Those who agreed to participate were given consent forms to read and sign (Appendices O and P). As a measure to ensure that the women who participated in the pilot study did not participate in the main study, women were selected on the basis of their pregnancies being at 36 weeks or later. The main study was conducted four weeks after the pilot study. By then, these women would have either delivered or would have been referred to higher care centres if their pregnancies exceeded 40 weeks. The Shona versions of the FGD interview guide (Appendix N) had some ambiguous statements and some minor typographical errors, which were corrected to standard Shona, so as to cater for the different Shona dialects. Since most women preferred

the English version (Appendix M), as compared to the Shona version (Appendix N), more copies of the English FGD interview guide had to be printed, based on the outcome of the pilot study. The procedure to be followed during FGDs was established and confirmed. The time set aside to conduct the discussions was estimated to be 45 minutes to one hour, depending on the participants on that particular day.

6.2.4 Procedure for data collection

6.2.4.1 Focus group discussions with pregnant women on the development of a nutrition education tool

The eight FGD sessions were conducted over a period of six consecutive weeks, until a point of data and meaning saturation was reached, where new data collected no longer revealed any new insights. During the first two weeks, FGDs were conducted twice a week, on Mondays and Fridays. However, in the following four weeks, FGDs were conducted on Fridays only, as Mondays were reserved for examination and screening by the nurses. The FGDs were conducted in a fixed designated area within the clinic premises, away from interferences of other clinic activities, but within easy reach of ANC nurses. The duration of the FGDs ranged from 45 minutes to one hour. Magwa & Magwa (2015, p345), emphasise the need to create a comfortable atmosphere for conducting FGDs, including the provision of food and refreshments, as well as ensuring confidentiality. A comfortable atmosphere was created for this study by conducting discussions in a space with minimum interference from other patients visiting the clinic. Refreshments in the form of drinks, biscuits, roasted dried corn and groundnuts (*maputi nemutsege*) and citrus fruits were served at the end of each FGD session.

Participants gave their written consent to participate in the FGDs, to be photographed, and to be audio-recorded before the commencement of the discussions (See Appendix O and Appendix P for the informed consent document in English and Shona, respectively). Two trained research assistants, who were fluent in both Shona and English, facilitated the FGD sessions. While one ensured that data were properly audio-recorded using a digital voice recorder, the other concentrated on managing or directing the FGDs. The researcher took note of other non-verbal gestures and behaviour among the pregnant women. The presence of the researcher and research assistants in the focus group discussion sessions helped to eliminate single observer effects.

6.2.4.2 Focus group discussions with pregnant women to test the user-friendliness and acceptability of the nutrition education tool

After the nutrition education tool was developed, it was taken back to the clinic for pre-testing, where three FGD sessions, comprising 28 pregnant women, were conducted. The purpose of going back to the clinic with the tool, was to establish whether the tool was acceptable and user-friendly to the pregnant women. The Developing and Assessing Nutrition Education Hand-outs (DANEH) checklist by the Academy of Nutrition and Dietetics Foundation (ANDF) (2016), was used to test the nutrition education tool. The 'Yes' and 'No' options on the DANEH checklist were filled in by the researcher with the help of two research assistants, after first transcribing data from the FGDs. Women did not present their answers to questions individually, rather these were combined and presented for each FGD session. There was a separate checklist for each of the three FGD sessions and these were later combined to come up with the final checklist. Figures 6.1 and 6.2 illustrate one FGD on the development of a nutrition education tool and one FGD assessing user-friendliness of the developed nutrition education tool, respectively.

Figure 6.1: Focus group discussions on development of the nutrition education tool

Figure 6.2: Focus group discussions assessing user-friendliness of the nutrition education tool

6.3 Informed consent

Pregnant women who were willing to participate in the study, also consented to photography and audio-recording by signing consent documents prior to participation in the study. The researcher first explained to the women the purpose of the study and that they were allowed to withdraw at any stage if needed.

6.4 Data analysis

All the recordings from the eight FGDs were transcribed and the Shona versions were then translated into English verbatim by one of the FGD facilitators, and then cross-checked by the second facilitator, for accuracy. According to Dudovskiy (2017), transcribing involves converting audio recordings on voice recorders into words, as accurately as possible. The data were then grouped in order to identify common and emerging themes and sub-themes. Concepts were generated based on the similarity of the data. The sub-themes or concepts were evaluated using responses from FGDs and direct quotes. Thus, in this study, FGD data were analysed using the inductive analysis approach, based on the grounded theory (Nyumba *et al* 2018; Cooper *et al* 2012). Inductive or open-coding approaches enable themes and codes to be generated from qualitative data, in an effort to acquire deep understanding and appreciation of social phenomenon (Nyumba *et al* 2018; Guest *et al* 2017; Guetterman 2015). In this study,

pregnant women gave their input on the form of the nutrition education tool they most preferred, the language to be used and information to be included, through FGDs. Three main themes, with eleven sub-themes were generated from these discussions with pregnant women. The key themes and sub-themes were then integrated into a larger theoretical framework. According to Nyumba *et al* (2018), in the grounded theory, the theoretical framework is generated based on the study findings. Thus, the nutrition education tool was developed based on what pregnant women regarded as being the most important to know.

6.5 Results

6.5.1 Demographic characteristics of pregnant women

A total of 67 pregnant women participated in eight FGDs. The participants were aged between 17 and 42 years. The highest number of participants (n=41; 61.2%) fell into the 21-30 year age group. They were either in their second (n=28; 41.8%) or third (n=39; 58.2%) trimester of pregnancy (Table 6.1).

Table 6.1: Age and gestation stages of women who participated in focus group discussions on the development of the nutrition education tool (n=67)

Variables	n	%*
Age in years		
17-20	8	11.9
21-25	24	35.8
26-30	17	25.4
31-35	12	17.9
36-42	6	9.0
Gestation stage		
Second trimester	28	41.8
Third trimester	39	58.2

*Percentage of sample (n=67)

6.5.2 The nutrition education tool

6.5.2.1 Importance of a nutrition education tool to pregnant women

All the participants agreed that a nutrition education tool on iron supplements was important and they appreciated the need for its development. The nutrition education tool would be a good reference point even when at home, as it would remind them of the importance, onset and duration of taking iron supplements (Table 6.2). One woman stated that having some form of reminder was very helpful because they tended to forget (*kurangaridza kunobatsira because* kukanganwa kunowanda) (Table 6.2). Some felt the need for some point of reference to support

what they were taught at the clinic. Yet another woman stressed that they needed something to support and attach to their health cards so that they would not forget what they were taught (*Nekuti tinogona kuzokanganwa saka zvakanaka kuti tinge tiine chinotiragaridza*) (Table 6.2). Pregnant women indicated that the nutrition education tool would be important for informing pregnant women. One woman stressed that iron supplements normally caused some upsets, so when they read something, they will be encouraged to continue taking iron supplements because of the benefits, despite their side-effects (*anomisa moyo, saka tikaverenga tinobva tadzidza kuti anokosherei, even if zvichishata tinoshingirira because of the benefits*). The women would also be knowledgeable on the right time to start taking supplements. One of the pregnant women indicated that it would be helpful so that they know the right time to start taking the supplements [*Zvinotibatsira kuti tibva taziva kuti nyangwe nhumbu iri pa2 months* (two months gestation stage) *zvinoita here kuti titange kuamwa*].

Table 6.2: Importance of developing a nutrition education tool for use by pregnant women

Discussion topics	Themes	Concepts	Responses	Quotes
Importance of nutrition education and iron supplementation for pregnant women.	Motivating pregnant women's acceptance of the nutrition education tool	Attitude of women towards a nutrition education tool.	Pregnant women are usually offered iron supplements during ANC sessions, yet compliance is poor. This is mainly due to the lack of adequate nutritional knowledge or forgetting to take the iron supplements. Most pregnant women stressed the need for some form of nutrition education tool to have with the iron supplements. This would be a point of reference at home, as well as a reminder to take the iron supplements.	'*We need something to support and attach to our health cards so that we will not forget.*' '*Yes, there should be some point of reference to support what we were taught by the nurses.*' '*Kurangaridza kunodikanwa because kukanganwa kunowanda.*'*(We need some tool to remind us because we normally forget).*
		Form of nutrition education tool most preferred (pamphlet).	The pamphlet was the most preferred form of nutrition education tool. Most pregnant women cited that it is portable, thus easy to travel with, even in small handbags. It has neither too much nor too little information. It contains just enough information to inform the reader.	'*Pamphlet is portable zvekuti ndinokwanisa kufamba naro.*' *(The size of a pamphlet makes it easy to travel with).* '*Pamphlet riri right pakuti harina information yakawandisa, it is not too big or too small.*' *(Pamphlet is good because it has just enough information).*

Table 6.2 continued: Importance of developing a nutrition education tool for use by pregnant women

Discussion Topics	Themes	Concepts	Responses	Quotes
		Ideal language to use in the nutrition education tool.	English was the preferred language for many pregnant women, followed by Shona. Other women felt that since Manicaland is a Shona speaking province, the use of Shona was not to be abandoned completely. However, the use of English helped overcome many ambiguities in Shona due to its many dialects. English, being an international language would enable many to understand the information in the pamphlet. Some terms like 'anaemia' or 'haemoglobin' have no Shona translations, thus justifying the need for English in addition to Shona.	'*Mainly English and just a bit of Shona. No to Ndebele, because we are in Manicaland.*' '*English should dominate and Shona to follow.*' '*English is also ideal for foreigners who may visit the country.*' '*Mix Shona and English in the same document, but English should dominate.*'

6.5.2.2 The most preferred form of the nutrition education tool

From the FGDs with pregnant women, various forms of possible nutrition education tools were noted, as indicated in Table 6.3. Almost half of the pregnant women (n=33; 49.3%) indicated their preference for a pamphlet as the most ideal nutrition education tool (Table 6.3). Another group (n=16; 23.9%) preferred to have discussions or talks on iron supplements, while two other groups of equal size (n=4; 6.0%) preferred the use of booklets and radio advertisements, respectively.

One woman who indicated her preference for discussions or talks had this to comment, '*it is good to talk so that we can ask each other in case I may not understand, rather than a poster or pamphlet. We can talk here at the clinic and give each other ideas.*' Another woman argued that discussions were ideal because they were not limited to the clinic only, but could also be extended to churches and funerals. Table 6.3 presents the various forms of nutrition education tools preferred by pregnant women.

Table 6.3: Form of nutrition education tool preferred by pregnant women (n=67)

Form of nutrition education tool	N	%*
Booklet	4	6.0
Discussions/Talks	16	23.9
Drama/Role play	1	1.5
Flier	2	3.0
Internet	1	1.5
Newspapers	1	1.5
Pamphlet	33	49.3
Poster	2	3.0
Radio advertisements	4	6.0
Talk show	1	1.5
Telephone messages	1	1.5
WhatsApp	1	1.5

*Percentage of sample (n=67)

6.5.2.3 The most appropriate language to be used in the nutrition education tool

There were diverse opinions from the pregnant women concerning the most appropriate language to be used in the nutrition education tool. Some preferred the native Shona, others preferred English, while some preferred a combination of the two languages. As illustrated in Table 6.4, English was the most preferred language (n=27; 40.3%) for use in the development

of the nutrition education tool, followed by Shona (n=17; 25.4%). Twenty women (29.9%) preferred the use of a combination of both Shona and English. Only three women (4.5%) supported the use of Ndebele in developing the nutrition education tool.

One woman stated that, '*we mainly need English and a bit of Shona. No to Ndebele because we are in Manicaland.*' She indicated that they are in a Shona speaking environment. Those who do not understand Shona will use English. Let us use both Shona and English. However, English should dominate because it is an internationally recognised language, which different countries can use for effective communication *(Kuno kunotaurwa Shona. Ngatishandisei zvese Shona nechirungu kuitira kuti vasinganzwi Shona, vanoshandisa chirungu. Chirungu ngachiwande kudarika Shona nekuti ndiwo mutauro unoita kuti nyika dzose dzinzwanane pakutaura*) (Table 6.2). However, one woman who had a preference for Shona as a medium of communication in the nutrition education tool, stated that almost every one of them understood Shona as their native language (*Shona is our indigenous language and is more easily understood. Almost munhu wese anonzwa Shona pano patiri*) (Table 6.2).

Table 6.4: The most appropriate language for use in developing the nutrition education tool (n=67)

Languages	n	%*
Shona	17	25.4
English	27	40.3
Shona/English	20	29.9
Ndebele	3	4.5

*Percentage of sample (n=67)

6.5.2.4 Information to be included in the nutrition education tool

Many ideas were given by pregnant women on the type of information to be included in the nutrition education tool. The information focused on the importance of iron supplements, recommended dosage, foods rich in iron and vitamin C, as well as the signs and symptoms of iron deficiency, as presented in Table 6.5.

All FGD participants indicated that information on iron-rich food sources, importance or benefits of taking iron supplements, as well as signs and symptoms of iron deficiency should be included in the nutrition education tool. More than half of the participants (n=48; 71.6%) indicated that the correct dosage, frequency, onset and duration of taking supplements also needed to be included in the nutrition education tool. Approximately two-thirds of the pregnant

women (n=43; 64.2%) argued that eye-catching pictures of iron-rich foods such as liver, red meat, dark green leafy vegetables and citrus fruits, would help women to easily identify recommended foods, rich in iron and vitamin C. More than half of the participants (n=39; 58.2%) indicated that it was important to specify the side-effects associated with iron supplements and how to manage these to ensure compliance with iron supplements.

Table 6.5: Type of information to be included in the nutrition education tool for pregnant women (n=67)

Type of information	n	%*
Iron-rich food sources encouraged during pregnancy.	67	100
Eye-catching pictures of liver, offal, dark greens, red meat, poultry, pork.	43	64.2
Importance and benefits of iron supplements.	67	100
Dosage and frequency of iron supplements.	48	71.6
Signs and symptoms of iron deficiency.	67	100
Trimester requirements for iron.	13	19.4
Importance of ante-natal care check-ups.	6	9.0
Onset of iron supplementation and duration.	21	31.3
Side-effects associated with iron supplements.	39	58.2
Factors that enhance the absorption of iron.	17	25.4

*Percentage of sample (n=67)

6.5.3 Testing the user-friendliness of the pamphlet for pregnant women

After the pamphlet was developed based on the outcomes of the FGDs, the DANEH checklist (Table 6.6) was used to test the developed nutrition education pamphlet for user-friendliness. In the current study, 12 out of 15 (80%) constructs on the checklist were positive. This suggests that the pregnant women were satisfied with the pictures of a healthy looking pregnant woman and the iron-rich foods illustrated. One participant commented that the images were very clear, relevant and culturally sensitive (*mapikicha akajeka arikunyatsa kuonekwa, plus colour dzacho dzakashandiswa dzirikuenderana*). Some participants felt that English and Shona were the most ideal languages to use in the pamphlet. One participant stated that specifying the names of foods in both English and Shona made it easy for women to identify and comprehend (*kunyora mazita echikafu chinokurudzirwa muchirungu zvese nechishona kunobatsira kuti tinzwisise*). Some of the foods illustrated were also culturally recommended. For instance, pumpkin leaves (*muboora*), black-jack (*nhungumira/ tsine*), liver (*chiropa*), offals (*maguru, matumbu, rwatata*) and cowpeas (*nyemba*). Since the pamphlet was to be taken home, this would make it easy for husbands and other family members to buy the recommended foodstuffs

for the pregnant women. One woman explained that they would appreciate having written information and pictures of foods that are recommended, so that the people at home would easily buy these for pregnant women (*Kana tiine mapikicha nepakanyorwa zvatinotarisirwa kuti tidye, zviri nyore kutengerwa. Muromo mumwe chete*).

Table 6.6: Results of testing the user-friendliness of the developed pamphlet among pregnant women using the Developing and Assessing Nutrition Education Hand-outs (DANEH) checklist

1.	**Content/information**	**Yes**	**No**
	Current and accurate (dosage, onset, frequency, duration of iron supplements)	✓	
	Relevant for pregnant women	✓	
	Consistent with the World Health Organization guidelines	✓	
	Clear, simple and familiar language(s) (English and Shona)	✓	
	Cultural sensitivity	✓	
2.	**Images**		
	Clear	✓	
	Relevant	✓	
	Good use of colour	✓	
	Cultural sensitivity/socially acceptable	✓	
3.	**Written text organisation**		
	Easy to read font type and size		✓
	Size of texts and sequencing		✓
	Informative headings	✓	
	Space around text and headings		✓
4.	**Printed version**		
	Quality of printing	✓	
	Durability and quality of printing paper	✓	

Other findings from the DANEH checklist indicated a need to increase the font size on the last panel on strategies for addressing IDA. All sub-headings were clear, however, they needed to be bold, but in lower case for uniformity and consistency. Concerning information to include in the pamphlet, one pregnant woman commented that it was helpful and important to include information on when they were supposed to commence and stop the iron supplementation, as well as the recommended dosage per day (*izvi zvakanaka izvi, nekuti ndinofanira kuziva kuti ndinotanga riini kumwa mapiritsi, uye kwenguva yakareba sei, uye kuti ndinomwa mangani pazuva*). Concerning the quality of the printing paper, yet another pregnant woman indicated that the paper that was used for printing was good quality and thin enough to be attached to the

ANC booklets. The quality of ink was good and the printing was clear and readable (*paper rakashandiswa kuprinta rakanaka, because harifaniri kuzokoresa, otherwise harizoiti kunamira pamabook edu aya. Even, ink yacho haina kuti pwasha pwasha kurasikira. Zvakajeka uye zvinonyatsoverengeka*). Thus, the nutrition education pamphlet proved to be acceptable and user-friendly to pregnant women. They were eager to take it home to share with other family members.

6.5.4 Major themes derived from focus group discussions on the development of the nutrition education tool

Three major themes were derived from focus group discussions with pregnant women. These were: motivating pregnant women's acceptance of the nutrition education tool, baseline information on the development of the nutrition education tool and dissemination of the nutrition education tool to pregnant women (Figure 6.3). Eleven sub-themes were generated from the three main themes.

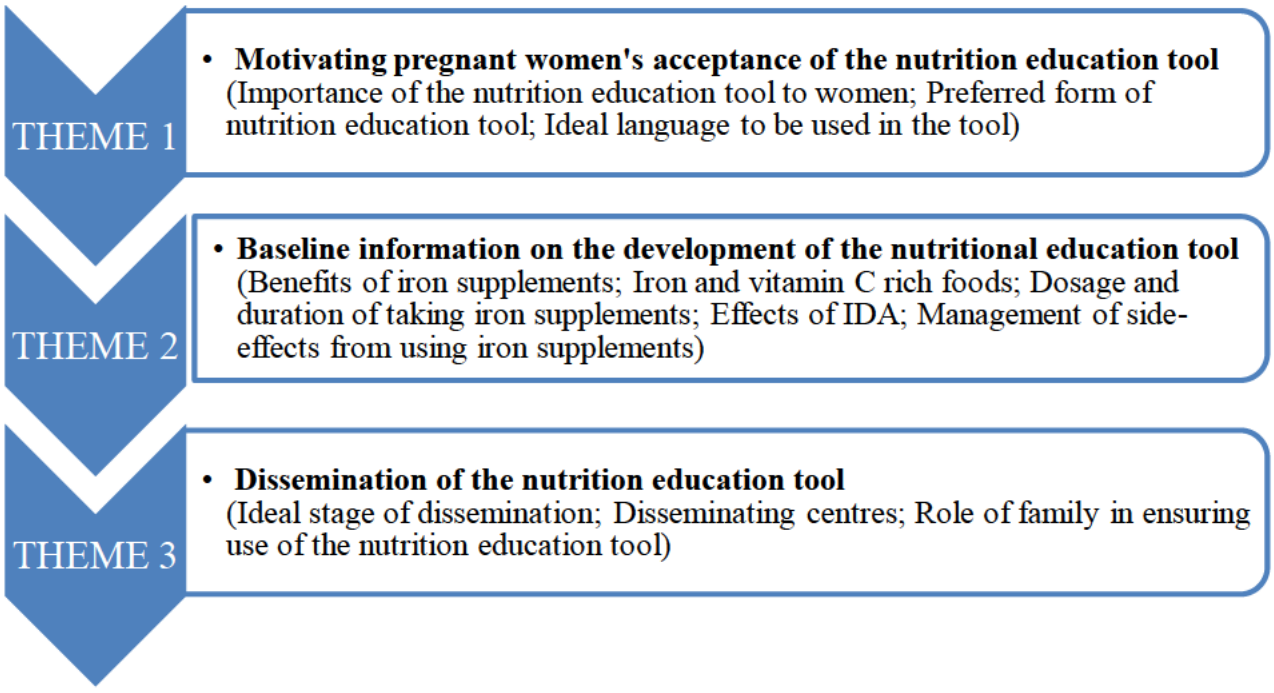

Figure 6.3: Major themes and sub-themes derived from focus group discussions with pregnant women.

6.5.4.1 Motivating pregnant women's acceptance of the nutrition education tool

The first major theme addressed was motivating pregnant women's acceptance of the nutrition education tool (Table 6.2). Although women were usually given iron supplements free of

charge at the clinic, compliance remained poor. It was therefore necessary to devise some strategy for encouraging compliance. The concepts derived from the theme included importance of the nutrition education tool to pregnant women, the most preferred form of the tool and the most ideal language(s) to use in the tool (Table 6.2).

Since the majority of participants indicated their preference for the pamphlet as the most ideal nutrition education tool, one woman referred to it saying, '*it encourages women to read and share with others.*' Still another woman highlighted that, '*we need something with information but not too small or too big. Booklet is too big and has a lot of detail, who will read all that? The flier is too small.'* She indicated that the flier is too small to contain all the needed information *(Flier idiki saka harina information yakakwana*) (Table 6.2). Yet another woman explained that the pamphlet contained all the required information and was very portable. Therefore, she could travel with it conveniently (*Pamphlet rinogona kuve nehunyorwa hwese hwakakwana uye ndinokwanisa kufamba naro nekuti harinetse kutakura*) (Table 6.2).

6.5.4.2 Information to be included in the development of the pamphlet

In developing the pamphlet, certain information needed to be included for it to be useful to pregnant women (Table 6.7). The information included benefits of iron supplements, iron-rich foods, dosage and duration of taking supplements, effects of IDA, as well as management of side-effects (Table 6.7).

Table 6.7: Information to be included in the development of a pamphlet for use by pregnant women

Discussion topics	Themes	Concepts	Responses	Quotes
Development of a pamphlet.	Information to be included in the development of a pamphlet.	(i) Benefits of iron supplements in pregnancy.	All participants indicated the need for information on the importance and benefits of iron supplements during pregnancy. Knowledge on the importance of iron supplements is critical to ensure compliance among pregnant women. With knowledge of the benefits, pregnant women would be self-motivated to effectively take iron supplements.	'*What are iron supplements?*' '*We need to know why we take supplements.*' '*Kutongoziva kuti anokosherei, ndinoamwirei.*' *(To know their importance or reason for taking).*
		(ii) Iron and vitamin C-rich foods.	Pregnant women indicated the need for information on iron and vitamin C-rich foods, with supporting pictures for easy identification. Thus, if this nutritional information was included in the pamphlet, it would help create awareness among the pregnant women.	'*Information on food that provide us iron.*' '*Pictures of liver, red meat, black-jack, oranges and dark greens, nartjies, strawberries and fruit juices, is important.*' '*Kuti iron supplements anotorwa nechikafuu chakadii.*' *(Type of food to take with supplements).*
		(iii) Dosage and duration of taking iron supplements.	Most women indicated that they were not very sure at which stage of pregnancy to commence iron supplementation. Even the duration and specific time of taking was not clear to many women. Therefore, it was important to include information on the recommended dosage and duration to avoid overdosage or deficiencies.	'*Frequency of taking, how many tablets per day, for how long.*' '*Zvakanaka kuziva kuti tinoatora nguvai.*' *(It is good to know the time of taking supplements).* '*Tinotanga kumwa kana nhumbu yakura sei, tozomirira riini.*' *(When should we start and stop taking iron supplements).*

Table 6.7 continued: Information to be included in the development of a pamphlet for use by pregnant women

Discussion topics	Themes	Concepts	Responses	Quotes
		(iv) Effects of IDA.	Pregnant women indicated that the pamphlet needed to inform of the dangers caused by poor supplementation, such as preterm delivery, low birth-weight infants, and poor oxygen delivery to body tissues. Therefore, inclusion of information on signs and symptoms and the effects of IDA, would make the pamphlet useful to pregnant women.	'*Pamphlet must inform us kuti chii chinoitika ndikarega kunwa matablets.*' *(The tool must inform on dangers of poor supplementation).* '*It should tell us the signs and symptoms of iron deficiency and the effects of IDA to me and my child.*'
		(v) Management of side-effects.	Most pregnant women indicated that their compliance with iron supplements was affected by side-effects. Therefore, the pamphlet should inform pregnant women on the management of side-effects associated with iron supplements. Counselling by health care workers on taking supplements with plenty of fluids or food or around bed time, may help to manage side-effects.	'*In case of upsets like nausea, what do I do?* '*Saka tinenge tichida kudzidziswa kuti toashandisa sei asingatirwarise sezvaanoita.*' *(We need information on how best to use them without causing illnesses in us).*

Therefore, all the study participants supported the idea of developing a nutrition education tool, to take home together with the iron supplements that they were given. Since many women tend to forget what they are taught, the tool would help as a good point of reference, in case women needed to use it while at home. Many women preferred the pamphlet because of its portable nature and its ability to contain adequate information. English was the most preferred language because of its international recognition, while Shona was used to clarify and enhance understanding of some foods. Information to be included in the pamphlet included benefits of iron supplements in pregnancy, examples of iron-rich vitamin C-rich foods, recommended dosage and duration of taking supplements. Information on side effects of IDA and management of side-effects was also included in the pamphlet.

6.5.4.3 Dissemination of the pamphlet to pregnant women

After development of the pamphlet, it should be well disseminated so that it reaches as many pregnant women as possible, together with their families. It should also be disseminated at the most ideal time or stage of pregnancy to ensure its optimal utilisation by pregnant women.

The majority of women stated that the pamphlet should be given at registration or at first contact with the nurses, without delay (Table 6.8). One of the participants said that pregnant women should be given the nutrition education pamphlet when they come for booking. This should not be delayed because their levels of grasping concepts varied (*Munhu ngaapihwe mapiritsi paanondouya kuzonyoresa nhumbu. Do not delay because tinonzwisisa zvakasiyana*) (Table 6.8). The ideal stage for disseminating the pamphlet was believed to be at three months or earlier, as long as it was during the first trimester. One of the pregnant women (Table 6.8) indicated that the tool should be given very early in the first trimester, probably from two weeks. This is despite their usual inability to do early registration (*Panguva ino patakazvitakura tinofanira kupihwa chinhu chekuverenga nekukurumidza, kunyanya pamwedzi mitatu yekutanga, kunyangwe tisinganyanyi kuzvigona hedu zvekukurumidza kunyoresa nhumbu*).

Some pregnant women felt that the pamphlet could be given to women before they even got pregnant, for reading and understanding when planning for the next baby. One of the participants stated that the pregnant woman should be knowledgeable before getting pregnant so as to start eating well in preparation for pregnancy (*Munhu ngaagare aziva asati aita nhumbu obva atanga kudya zvineutano*) (Table 6.8). This is a measure to ensure that women

would not enter pregnancy with depleted iron stores and during pregnancy they would take iron supplements to boost their iron stores. Table 6.8 presents findings on the best time and places for disseminating the pamphlet.

Table 6.8: Dissemination of the pamphlet to pregnant women

Discussion topics	Themes	Concepts	Responses	Quotes
Making optimal use of the pamphlet.	Dissemination of the pamphlet.	Ideal stage for disseminating the pamphlet.	The developed pamphlet should be disseminated at the right time to ensure maximum use by pregnant women. Most participants highlighted the need to have the tool as early as possible, especially at registration, at three months or even earlier. However, others thought that the pamphlet should be disseminated to women before pregnancy. This would help them to eat well and to appreciate the need for taking supplements on time. Various centres were identified as ideal for disseminating the pamphlet. The church was seen as an effective dissemination point, since most women meet for prayers and ladies fellowships (*Ruwadzano*). Road shows could also help to inform communities at large and to disseminate the pamphlet. Private pharmacies are also very strategic dissemination centres as women usually buy iron supplements from the pharmacies when clinic supplies run out.	'*Kungoti tange-tange patinouya kuzonyoresa,*' (At registration). '*Preferably at 3 months or earlier.*' '*Havafanire kunonoka, tinonzwisisa zvakasiyana,*' (It should not delay, some may take long to understand). '*Munhu ngaave neruzivo asati atoita mimba yacho,*' (Well before pregnancy).
		Dissemination centres for the pamphlet.		'*Kuchurch kumibatanidzwa neruwadzano,*' (During ladies church gatherings). '*Mumaradio and road shows,*' (Radios and road shows). '*KumaChemists kunotengwa matablets,*' (In pharmacies when we buy supplements). '*Social media e.g. paWhatsApp and sms.*'

Table 6.8 continued: Dissemination of the pamphlet to pregnant women

Discussion topics	Themes	Concepts	Responses	Quotes
	Dissemination of the pamphlet.	The role of family or spouse in ensuring use of the nutrition education tool.	The family, especially spouses have a very important role in supporting the pregnant woman throughout the pregnancy. If time allows, they are encouraged to accompany their wives for ANC visits. They could also read the pamphlet together with their wives, share ideas and also remind pregnant women to take their supplements.	'*Ngavaperekedze madzimai avo kuScale,*' *(To accompany women for ANC check-up sessions).* '*Kuverenga pamphlet pamwechete nekurangaridza madzimai kumwa matablets,*' *(Reading pamphlet together and reminding women to take supplements).* '*Ngavazive chikafu chekutengera madzimai avo chineutano,*' *(To know nutritious foods to buy for their wives.)*

6.6 Discussion

All the participants indicated that there was need to develop a nutrition education tool, which would serve as a point of reference, while at home. According to Pavord *et al* (2011), in addition to nutrition education given to pregnant women, there is a need for additional written material for pregnant women to take home. Pregnant women identified 12 nutrition education tools. Because the pamphlet was the most preferred nutrition education tool, a pamphlet was selected as the tool to be developed. The pamphlet was preferred by almost half of the participants (n=33; 49.3%). A pamphlet is defined as a small, unbound booklet or leaflet that contains information on a single subject. Pamphlets are usually educational in nature (USDA-HHS 2018; Carter 2014). A pamphlet can also be referred to as an unbound printed publication, consisting of a single sheet of paper that is printed on both sides and folded in half, thirds or fourths (USDA-HHS 2018; Carter 2014; Carbone & Zoellner 2012; FAO 2012).

A pamphlet is a more user-friendly nutrition education tool and is usually written in simple, easy to understand language (Carter 2014; Hawkes 2013; Carbone & Zoellner 2012; FAO 2012). Pamphlets give information on a particular subject and are ideal for promoting initiatives that require more awareness because they are easy to share and can spread new ideas quickly (Carter 2014; Papadakos *et al* 2014; Hawkes 2013; Carbone & Zoellner 2012). There are generally three types of pamphlets; the civic, educational and cultural; with the educational pamphlet being the most commonly used in healthcare systems (USDA-HHS 2018; Carter 2014). The ideal pamphlet should be concise, focus on one topic, be reader-friendly and be written in simple language, which is easy to understand. Images should be clear and relevant [USDA-HHS 2018; Carter 2014; Academy of Nutrition & Dietetics Foundation (ANDF) 2016; FAO 2012].

The procedure for making pamphlets occurs in three phases, which include designing, formatting, and finally printing. When designing, the purpose and target audience of the pamphlet are considered (USDA-HHS 2018; Carter 2014). This helps in choosing text and images that are most effective. Use of relevant images that provide visual interest and colour that is closely tied to emotion, helps to arouse an emotional response in the reader (USDA-HHS 2018; Nyilasy, Lei, Nagpal & Tan 2016; FAO 2012). According to the USDA-HHS (2018), there is a need to provide valuable and accurate information on the subject, and to consider layout and size. Because the space in a pamphlet is limited, it should be precise and use basic font like Times New Roman and

Arial, with texts being broken with images in an organised way (USDA-HHS 2018; Carter 2014; Hawkes 2013). The print version of the pamphlet should be test-run to verify if it meets the expected outcome. Printing should be done using a duplex printer to allow two-sided printing. Use of durable printing paper like cardstock prevents the pamphlets from tearing or crumbling. After folding, the pamphlet should be distributed to places where it is best received (USDA-HHS 2018; ANDF 2016; FAO 2012).

In the current study, the pamphlet was developed based on principles from the Andragogy Adult Learning Theory by Malcolm Knowles (1913-1997) (TEAL 2011). According to Knowles, andragogy is the art and science of adult learning, based on some set assumptions (TEAL 2011). The growing recognition of the importance of patient education provides evidence for the need to use learning theories, in order for healthcare providers to effectively develop patient education resources. Successful nutrition education is determined by good use of theories or philosophies and prototypes in health education (Khorambadi, Dolatian, Hajian, Zamanian, Taheripanah, Sheikhan, Mahmoodi & Seyedi-Moghadman 2016; Papadakos *et al* 2014). According to the ANDF (2016), a good checklist must have at least 76% of the constructs being positively scored. In the current study, 12 out of 15 (80%) constructs were positive.

Knowles' andragogy principles informed the development of the nutrition education pamphlet for the study. The pamphlet was a standard six-panel, tri-fold style, with two pages (TEAL 2011). It was entitled 'Importance of iron supplements for healthy maternal and paediatric outcomes' (Appendix Q). The pamphlet had a picture of a pregnant woman on the front, which was meant to arouse interest and an emotional response in pregnant women. The images and colours used were also meant to reflect the purpose of the pamphlet. The pamphlet had a pink-reddish colour to represent the colour of haemoglobin. According to Carter (2014), bright images that are relevant also encourage the audience to take action in some way. Colour attention theory posits that colour plays a role in the understanding and enhancing of nutritional information, thus resulting in more accurate food perceptions (Khorambadi *et al* 2016; Nyilasy *et al* 2016; Carter 2014). Thus, in this study, the food images featured in the pamphlet were intended to help ease identification of iron and vitamin C rich foods, as a way of motivating pregnant women's action.

The first panel of the pamphlet was an explanation on the importance of iron supplements during pregnancy (WHO 2017; Yakout, Taha, Badawy & Al-Salooly 2014). Recommended doses, onset, duration and benefits of iron supplements, as well as the signs and symptoms of IDA were outlined in the second panel. The third panel comprised a list of foods rich in iron and vitamin C (ascorbic acid), with their native Shona names in brackets. Carter (2014) stresses the need to use simple language when developing pamphlets. Thus, in this study, the use of both English and Shona helped to enhance communication and ensured that all pregnant women benefited. Pictures of the recommended foods were inserted in the fourth panel to enhance understanding. Common side-effects associated with iron supplements, possible ways to manage these, as well as other strategies for addressing IDA, appeared on the fifth panel. The pamphlet was printed on an A4 size paper, which after printing, could be folded and attached to the ANC books (small booklets with the gestation history and progess for each pregnant woman at registration).

Information on iron and vitamin C-rich food sources, such as liver, red meat, dark green vegetables, citrus fruits was found to be critical. Even though liver and red meat are expensive, they were included in the pamphlet so that pregnant women could be acquainted with iron-rich food sources and to encourage the few who could afford to buy them. The need to know the correct dosage of iron supplements, the frequency of taking them, as well as the duration of supplementation were also given. Information on the signs and symptoms and effects of IDA, side-effects associated with iron supplements and their management, needed to be included in the pamphlet for it to be useful to pregnant women.

The Knowledge, Attitudes and Behaviour (KAB) model has been found to be effective in developing nutrition education tools for women (Contento 2008). The model posits that changes in knowledge (K) lead to changes in attitudes (A), which subsequently leads to modifications in behaviour (B), as illustrated in Figure 6.4.

Figure 6.4: The knowledge, attitudes, behaviour (KAB) process model (Contento 2008)

Overall, the pamphlet should be disseminated to pregnant women at the appropriate time, especially in the first trimester or at registration. This helps to ensure that pregnant women start iron supplementation timeously. The pamphlet could be more effective if it is given together with iron supplements and nutrition education (WHO 2012; Pavord *et al* 2011). This could enhance awareness on the importance of iron supplements in the first trimester and also to ensure that the pregnant women do not forget what they would have been taught. However, according to Sey-Sawo & Tunkara-Bah (2016), most women usually booked late for ANC, thus, in the event of some women being anaemic, it would be detected later. Delayed ANC bookings would also delay commencement of iron supplementation, since these were usually given to the women on their first visit at the clinic for ANC. According to Sey-Sawo & Tunkara-Bah (2016), the family, especially spouses have a role to play in ensuring early registration and correct use of iron supplements by pregnant women. Husbands or other family members can assist by supporting pregnant women throughout their pregnancies (Sey-Sawo & Tunkara-Bah 2016). They can remind women to take their supplements as prescribed, read the pamphlet together and if possible, accompany women to ANC visits at the clinic. Pregnant women should receive iron supplements together with the appropriate dietary advice to prevent IDA (Da Silva Lopes, Takemoto, Garcia-Casal & Ota 2018; WHO 2016a; WHO 2016b; WHO 2012).

6.7 Conclusions

Nutrition education programmes on iron supplementation, if well implemented, promote awareness among pregnant women and are likely to improve compliance with iron supplementation routines. Adequate nutrition knowledge is a strong determinant of a pregnant woman's health, as compared to other variables such as age, income, race or educational level. Therefore, offering a nutrition education tool on iron supplementation to pregnant women could be an effective strategy in motivating towards compliance with iron supplements. A nutrition education tool in the form of a pamphlet was most preferred by pregnant women. The pamphlet was developed in simple English, with some Shona phrases to clarify the names of certain foods to maximise comprehension. A pamphlet could help pregnant women to comply with iron supplements, despite side-effects. For the pamphlet to be user-friendly to pregnant women, it was tested to assess if it contained information that was adequate, simple and relevant. Therefore, the

information in the pamphlet included the importance and benefits of iron supplements, pictures of iron and vitamin C-rich foods and the correct iron dose that should be taken daily (60 mg/day). Information on onset, frequency and duration of iron supplementation, management of side-effects, as well as the signs and symptoms of IDA, were also included in the pamphlet. Offering the pamphlet together with iron supplements could improve awareness and motivate towards compliance and appreciation of the benefits of taking iron supplements. This would also help avoid late commencement of iron supplementation because diet alone is not sufficient to meet the iron requirements in pregnancy. Currently, there is no nutrition education tool being offered with iron supplements for pregnant women in Mutare, Zimbabwe. Therefore, this study was the first to develop a nutrition education pamphlet on iron supplementation for pregnant women in Mutare, Zimbabwe. However, a more substantial contribution could be achieved with follow-up consultations to ensure effective implementation of all aspects highlighted in the pamphlet.

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CHAPTER 7
CONCLUSIONS, STUDY LIMITATIONS AND RECOMMENDATIONS

This chapter presents the study conclusions, limitations and recommendations. There are no published studies addressing iron supplementation during pregnancy in Mutare, Zimbabwe. Hence, the aim of this study was to assess the knowledge and acceptance of iron supplements among pregnant women, attending Mutare City Clinic, Manicaland, Zimbabwe. The study also aimed to identify possible barriers to optimal use of iron supplements among pregnant women. In addition, the study aimed to develop and test a nutrition education tool with the aim of creating awareness regarding the importance and use of iron supplements among pregnant women, thus improving acceptance and use of the supplements. The objectives of this study were as follows: (i) to assess knowledge on the importance of iron supplements during pregnancy amongst pregnant women attending Mutare City Clinic, Manicaland, Zimbabwe (ii) to assess the acceptance levels of iron supplementation given during pregnancy amongst pregnant women attending Mutare City Clinic, as perceived by nurses and pregnant women attending Mutare City Clinic for ANC (iii) to identify the barriers to optimal iron supplementation by pregnant women attending Mutare City Clinic (iv) to ascertain from pregnant women attending Mutare City Clinic, the form of the nutrition education tool to be developed, the importance of the tool, information and language to be used in the tool (v) to develop a nutrition education tool for pregnant women attending Mutare City Clinic with the purpose of creating awareness of iron supplements (vi) to test the developed nutrition education tool to determine its user-friendliness and acceptability among pregnant women attending the Mutare City Clinic.

7.1 Conclusions

Inadequate knowledge on iron supplementation during pregnancy was found to negatively affect acceptance and use of iron supplements by pregnant women attending the Mutare City Clinic for ANC. Limited knowledge on iron supplementation during pregnancy could possibly result in pregnant women failing to appreciate the importance of iron supplementation during pregnancy. As such, pregnant women would not be motivated to consistently take iron supplements. Although some pregnant women may appreciate the importance of iron supplements, their level of appreciation would be limited, even with high literacy levels. Early ANC bookings, combined with

nutrition education would likely improve acceptance and use of iron supplements amongst pregnant women.

The many barriers to optimal use of iron supplements contributed to poor compliance among most pregnant women. The reasons why some pregnant women did not use iron supplements after collecting them from the clinic, could possibly be due to a lack of adequate nutrition education or lack of strategies for managing side-effects. Thus, poor compliance remained a serious barrier. Since certain religious and cultural groups do not allow their followers to take iron supplements and eat certain types of food, these pregnant women could be reached through community-based nutrition intervention programmes. The intervention programmes could include visiting women in their homes, conducting road shows or through radio broadcasting. The importance of iron supplements during pregnancy should be highlighted during the nutrition intervention programmes. However, many other pregnant women who were not strongly influenced by culture or religion, could benefit from nutritional interventions employed to ensure optimal use of iron supplements. Consistent availability of iron supplements at the clinics free of charge, would likely improve compliance. Women need adequate nutrition education on iron supplements, inclusive of strategies for managing side-effects. Strategies for reminding women to consistently take supplements as well as the onset and duration of supplementation need to be implemented for increased compliance.

The development of a nutrition education tool for use by pregnant women could be effective in improving knowledge regarding iron supplementation. Nutrition education programmes on iron supplementation, if well implemented, could promote knowledge and awareness among pregnant women. A nutrition education tool in the form of a pamphlet was developed because of its portable and concise nature. Testing the pamphlet for user-friendliness to pregnant women, ensured that it was acceptable, culturally sensitive and contained information which was adequate, simple and relevant. Offering the pamphlet together with iron supplements could be effective in increasing awareness and improving compliance with iron supplements. There is currently no nutrition education tool being offered with iron supplements for pregnant women in Mutare district, Manicaland. The development of a pamphlet on iron supplementation could help to improve knowledge on iron supplementation among pregnant women and improve compliance with iron supplements. Thus, a combination of daily iron supplementation, regular nutrition education

sessions with nurses and a nutrition education tool in the form of a pamphlet could effectively reduce the prevalence of IDA amongst pregnant women in Mutare.

7.2 Study limitations

7.2.1 The study on the acceptance and use of iron supplements was only conducted on pregnant women attending Mutare City Clinic, in Manicaland province, due to financial constraints. However, the city of Mutare, which is in an urban setting, is not the only city affected by maternal IDA. Therefore, findings on knowledge, acceptance and barriers to iron supplementation can only be generalised to Mutare City Clinic, with a limited inference for other provinces including rural areas in Zimbabwe.

7.2.2 This study was limited to pregnant women only, specifically those in the second and third trimesters of pregnancy. Thus, the findings on iron supplement use is limited to pregnant women in the second and third trimester of pregnancy and not all pregnant women, or women of child-bearing age.

7.2.3 This study focussed on iron only, even though other micronutrients are needed in higher amounts during pregnancy, but are consumed in inadequate quantities. Therefore, the findings of this study are limited to iron only.

7.2.4 The study employed non-probability sampling of pregnant women in their second and third trimesters. This sampling technique, combined with the small sample size limited the generalisability of the findings.

7.3 Recommendations for programming

7.3.1 Although iron supplements are offered free of charge at Mutare City Clinic, erratic supplies at the clinic remains a concern. It is recommended that the responsible health authorities ensure consistent and timeous procurement and delivery of iron supplement supplies to the clinic and subsequently to pregnant women.

7.3.2 Inadequate nutrition education and poor communication between nurses and pregnant women, to some extent, contributed to poor use of iron supplements. The mode of delivering nutrition education conducted at Mutare City Clinic should be improved. The

nutrition education sessions should promote active participation and learning among pregnant women. These could be conducted in such a way so as to include a system of follow-up and feedback to assess effectiveness of the nutrition education.

7.3.3 Cultural and religious barriers could be limiting some women's access to ANC services provided at Mutare City Clinic, including education on the importance of iron supplements in pregnancy, as well as iron and vitamin C-rich foods. The training of trainers (TOT) programmes by ANC nurses and nutritionists should be adopted, where women from the community volunteer to undergo nutrition training. These women will then be able to teach peers in the community, churches and other gatherings, where nurses cannot reach.

7.3.4 It is recommended that the pamphlet developed in this study should be disseminated to pregnant women by the researcher, with the approval of the Ministry of Health and Child Care (MOHCC), during ANC sessions at Mutare City Clinic. This may enhance awareness on the importance of iron during pregnancy among pregnant women. Dissemination of the pamphlet on iron supplementation with MOHCC approval will ensure that the printing costs are covered by the government, thus ensuring sustainable availability of the pamphlet. It is also recommended that the researcher train nurses at Mutare City Clinic on the use of the pamphlet.

7.4 Recommendations for future research

7.4.1 Future studies should also focus on other micronutrients not covered in this study, such as the role of ascorbic acid (vitamin C) in preventing and treating iron deficiency anaemia.

7.4.2 Food fortification and biofortification are key strategies for alleviating IDA in pregnant women, in addition to iron supplementation. Fortification or biofortification of maize may be effective since maize is a staple food consumed by the majority of pregnant women in Zimbabwe and other countries in SSA. Future studies should investigate the feasibility of implementing these strategies in Zimbabwe.

7.4.3 Some iron-rich foods recommended for consumption during pregnancy are generally expensive and unaffordable. Other vegetable varieties, which are cheaper, are only

available seasonally, for example pumpkin leaves, cowpea leaves and blackjack. Future studies should explore IKS with a focus on home or community food gardens and small livestock farming to ensure varied, balanced and affordable diets.

7.4.4 Future studies should focus on intensive intervention strategies for reaching out to pregnant women who belong to religious and cultural groups that do not allow their followers to take iron supplements and eat certain types of food.

7.4.5 The design of future studies should cover Hb testing so that one could determine how the identified barriers affect pregnant women's Hb levels and iron deficiency anaemia. Therefore, the availability of Hb testing equipment at clinics is recommended so that women can be tested during the course of pregnancy.

APPENDIX A: ETHICS APPROVAL FROM THE UNIVERSITY OF KWAZULU-NATAL

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

08 April 2016

Mrs **Phaccedia Mahundi (215074942)**
School of Agricultural, Earth & Environmental Sciences
Pietermaritzburg Campus

Dear Mrs Mahundi,

Protocol reference number: HSS/0369/016D
Project title: Acceptance, knowledge and barriers to effective use of iron supplements amongst pregnant women attending Mutare City Clinic in Manicaland, Zimbabwe

Full Approval – Expedited Application
In response to your application received on 07 April 2016, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol have been granted FULL APPROVAL.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number.

Please note: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

[redacted]

Dr Shenuka Singh (Chair)

/ms

Cc Supervisor: Dr Kirthee Pillay and Dr Nicola Wiles
Cc Academic Leader Research: Dr O Mutanga
Cc School Administrator: Ms Marsha Manjoo

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APPENDIX B: LETTER OF APPROVAL TO CONDUCT RESEARCH AT MUTARE CITY CLINIC FROM MUTARE MUNICIPALITY HEALTH DEPARTMENT

ALL COMMUNICATIONS TO BE ADDRESSED TO THE MEDICAL OFFICER OF HEALTH
CITY OF MUTARE
HEALTH DEPARTMENT

IF CALLING OR TELEPHONING PLEASE REFER THE MATTER TO:
T. S. MASHABABE EXT. 203

THE MEDICAL OFFICER OF HEALTH
CITY OF MUTARE HEALTH DEPT
P.O. Box 910, Mutare, Zimbabwe
Phone: 64412 Fax: 60271

Your Ref:

Our Ref : TSM/acn/research

15 December 2015

Plaxcedia Mabundi
Mutare Polytechnic College
Box 640
MUTARE

Dear Sir,

Re: REQUEST FOR PERMISSION TO CONDUCT RESEARCH AT MUTARE CITY CLINIC BARRIERS TO EFFECTIVE USE OF IRON SUPPLEMENTS AMONGST PREGNANT WOMEN ATTENDING MUTARE CITY CLINIC

The above matter refers.

I have no objection to your carrying out the above-mentioned research on the following conditions:

1) You will be able to share your findings with us.
2) The study is purely for education purposes and the results will therefore not be published for public use without the permission of council.

Yours faithfully

[redacted]

T. S. Mashababe
ACTING DIRECTOR OF HEALTH SERVICES

APPENDIX C: SURVEY QUESTIONNAIRE FOR PREGNANT WOMEN IN ENGLISH

Please write your responses in the spaces provided or supply the requested information by ticking in appropriate boxes.

Section A: Demographic Information

1. Date of birth: ……

2. Marital status:

   Married ☐ Divorced ☐ Single ☐

3. Religion: Christian ☐ Islamic ☐ African Traditional Religion ☐

   Other: (Specify)……

4. Highest Education Level:

   Grade 7 ☐ Form 1-2 ☐ 'O' Level ☐

   'A' Level ☐ Diploma ☐ Degree ☐

Any other: Specify)…….....

5a. Employment status:

   Unemployed ☐ Formally employed ☐

Informally employed/ self-employed ☐

5b. If formally employed, specify occupation: ……..

5c. If self-employed, specify the type of job you do: …….

Section B

6. How far along are you in your pregnancy? …….. Months

7. How many times have you been pregnant before? Never ☐ Once ☐

   Twice ☐ Thrice ☐

   Four times and above ☐

8. How many of your previous pregnancies were successful?

All pregnancies ☐ None of the pregnancies ☐

One pregnancy ☐ Two Pregnancies ☐

Three pregnancies ☐ Four or more ☐

9a. Have you experienced any complications in previous pregnancies? Yes ☐ No ☐

9b. If 'Yes' to 9a, can you please specify type of complications: ……

10. How many children do you have? …….

11a. How would you describe your iron level before this pregnancy? Low ☐ High ☐

Normal ☐ No idea ☐

11b. If your response to 11a. is Low; High or Normal, who informed you of your iron level?

Doctor ☐ Nurse ☐ Any other: (Specify)……..

Section C

12. How often do you come for check-up visits here at the clinic?

Once every month ☐ Once every two weeks ☐ Once every week ☐

Other: Specify ……

13. Are you aware that pregnant women need to take iron supplements? Yes ☐ No ☐

14a. Are you taking iron supplements? Yes ☐ No ☐ Sometimes ☐

14b. If you answered 'NO' to 14a, why are you not taking the iron supplement?

I just don't like them ☐

My church does not allow use of tablets ☐

They are expensive ☐

They cause discomforts like constipation and heartburn ☐

Any other (Specify)……..……

14c. If your response to 14a is 'Yes', why do you take iron supplements?

They increase my blood volume ☐

Nurses at the clinic encourages us to take the supplements ☐

Any other (Specify)……..

14d. If 'Yes' to 14a, when in your pregnancy did you start taking the iron supplements?

…….....

15a. Where do you obtain your iron supplements from, if you are using supplements?

Given at the clinic ☐

Bought from pharmacy ☐

15b.If obtained from the clinic, how often are you offered iron supplements?

Once a month ☐

Once in two months ☐

Once in three months ☐

Other (Specify)…….

15c.How often do you take the supplement?

Daily ☐ Once a week ☐

Twice a week ☐ Thrice a week ☐

Others: Specify …….

16. For how long do you intend to take the supplements? ……

17a. Do you receive information on the use and importance of iron tablets at the clinic during ante-natal checkups? Yes ☐ No ☐ Sometimes ☐

17b. If you answered 'Yes' or 'Sometimes' to 17a, in what form is the information given?

Talk/Discussion ☐

Pamphlets/ Flyers ☐

Any other (Specify): ……

18. In your own assessment, do you think iron supplements are really necessary in pregnancy?

Yes ☐ No ☐

Justify your answer:

……

……

Thank you for taking your time to respond

APPENDIX D: SURVEY QUESTIONNAIRE FOR PREGNANT WOMEN IN SHONA

Ongororo yekugamuchira uye ruzivo rwemadzimai akazvitakura pamusoro pekushandiswa kwemapiritsi anowedzera ropa

Murayiridzo

1. Ndinokumbira kuti mupindure mibvunzo **yose** inotevera nechokwadi chizere uye sekukwanisa kwenyu.
2. Pamhinduro yamunenge masarudza maona yakakodzera isai (X) muzvibhokisi zvakaratidzwa kana kuti nyorai mhinduro muzvinzvimbo zvakasiiwa.

Chikamu chekutanga: Ruzivo pamusoro pemadzimai akazvitakura

1. Zuva rokuberekwa: ……

2. Zviri maringe nekuwanikwa:

1.	Ndakaroorwa	
2.	Handisati ndaroorwa	
3.	Takarambana	
4.	Zvimwewo:Tsanangurai	

3. Chitendero:

1.	Chikiristu	
2.	ChiIslam	
3.	Chivanhu	
4.	Zvimwewo:Tsanangurai	

4. Makadzidza kusvika padanho ripi?

1.	Gwaro rechinomwe	
2.	Fomu 1-2	
3.	Fomu 3-4	
4.	Fomu 5-6	
5.	Dhipuroma	
6.	Dhigirii rekutanga	
7.	Dhigirii rechipiri	
8.	Dhokotera wezvefundo	

Zvimwewo: (Tsanangurai)…….....

5a. Zviri maringe nebasa ramunoita:

1.	Handiende kubasa	
2.	Ndinoenda kubasa	
3.	Ndinozviitira basa rangu ndega	

5b. Kana muchienda kubasa, munoita basa rei?.....

5c.Kana muchizviitira basa, munonyatsoita nezvei?……..

Chikamu chepiri: Nhoroondo maringe nemimba uye ruzivo rwemadzimai akazvitakura

6. Pamuviri penyu pakura zvakadini?…….

7. Makamboita nhumbu ngani kumashure?

1.	Handina kumboita	
2.	Kamwe chete	
3.	Kaviri	
4.	Katatu	
5.	Kana nekupfuura	

8. Panhumbu dzamakaita kumashure ingani dzakabudirira kusvika pakuberekwa?

1.	Hapana kana imwe	
2.	Imwe chete	
3.	Mbiri	
4.	Nhatu	
5.	Ina nekupfuura	

9a. Makambosangana nezvigozhero here panhumbu dzenyu dzakapfuura?

1.	Hongu	
2.	Kwete	

9b. Kana mhinduro pa 9a iri 'Hongu', donongodzai zvigozhero zvamakasangana nazvo:

1.	Kubva kwepamuviri/ kupfukudzika	
2.	Kubuda kweropa ivo mai vaine pamuviri	
3.	Kukwira kweBP nekuda kwepamuviri	
4.	Mwana kukundikana kurarama ari muchibereko chaamai	
5.	Muviri wamai waipera simba	

Zvimwewo: (Tsanangudzai) ……..……

10. Mune vana vangani vekubereka?

1.	Handisati ndave naye	
2.	Umwe chete	
3.	Vaviri	
4.	Vatatu	
5.	Vana	
6.	Vashanu kana kupfuura	

11a. Mungatsanangudza here mamiriro anga akaita huwandu hweropa mumuviri menyu musati mave nepamuviri pamuinapo?

1.	Rakawandisa	
2.	Ririshoma	
3.	Rakanaka	
4.	Handina kana ruzivo nezvazvo	

11b. Kana mhinduro yenyu pa 11a ichiratidza kuti raiva 'Rakawandisa', 'Ririshoma' kana kuti 'Rakanaka', ndiani wakakuzivisai mamiriro eropa renyu?

1.	Chiremba	
2.	Mukoti	
3.	Vamwewo (Tsanangudzai)	

Chikamu chetatu: Kugamuchirwa kwemapiritsi nemadzimai akazvitakura

12. Munowanzouya kuzoongororwa pakiriniki pano kwapera nguva yakareba sei?

1.	Kamwechete pasvondo	
2.	Kamwechete pamasvondo maviri	
3.	Kamwechete pamwedzi	
4.	Zvimwewo: (Tsanagudzai)	

13. Munozviziva here kuti madzimai anenhumbu anokurudzirwa kumwa mapiritsi eropa?

1.	Hongu	
2.	Kwete	

14a. Imi muri kuashandisa here mapiritsi aya?

1.	Hongu	
2.	Kwete	
3.	Dzimwenguva	

14b. Kana mhinduro yenyu pa 14a iri 'Kwete', nei musi kushandisa mapiritsi aya?

1.	Handiafariri	
2.	Chinamato changu hachinditenderi kushandisa mapiritsi	
3.	Mapiritsi acho anodhura	
4.	Anonditadzisa kugadzikana, chirungurira nekusaenda kuchimbuzi zvakanaka	

Zvimwewo: Tsanangudzai ……

14c. Kana mhinduro pa 14a iri 'Hongu', nechikonzero chei muchishandisa mapiritsi aya?

1.	Anowedzera ropa mumuviri mangu	
2.	Vanamukoti kukiriniki ndivo vakati tiashandise	
3.	Tinongoonawo achishandiswa nemadzimai anenge aine nhumbu	

Zvimwewo (Tsanangudza) ……

14d. Kana mhinduro yenyu pa 14a iri 'Hongu' makatanga kushandisa mapiritsi pamuviri penyu paine mwedzi mingani?

1.	Pasati pasvika mwedzi mitatu	
2.	Ndiine mwedzi mitatu	
3.	Ndiine mwedzi mina	
4.	Ndiine mwedzi mishanu	
5.	Ndiine mwedzi mitanhatu	
6.	Ndapfuura mwedzi mitanhatu	

Zvimwewo: (Tsanangudzai)……

15a. Kana muchishandisa mapiritsi ekuwedzera ropa, munowanzoawana kupi?

1.	Tinopihwa kuchipatara	
2.	Tinotenga muzvitoro zvinotengesa mishonga	

15b.Kana muchiawana kubva kuchipatara, munowanzoapihwa kwapera nguva yakareba sei?

1.	Once a month	
2.	Once in two months	
3.	Once in three months	

Other (Specify)…….....

15c. Mapiritsi aya munoashandisa pazvinhambo zvakaita sei?

1.	Mazuva ese	
2.	Kamwe pasondo	
3.	Kaviri pasondo	
4.	Katatu pasondo	

Zvimwewo: Tsanangudzai……

16. Munotarisira kushandisa mapiritsi aya kwenguva yakareba zvakadii?

1.	Kusvika pandinosununguka	
2.	Kusvika kwapera mwedzi mitatu mushure mekusununguka	
3.	Zvimwewo: (Tsanangudzai)	

17a. Mune dzidziso here dzamunowana pamusoro kwekushandiswa nehukoshi hwemapiritsi eropa aya kubva kuchipatara pamunoenda kundoongororwa?

1.	Hongu	
2.	Kwete	
3.	Dzimwenguva	

17b. Kana mhinduro yenyu pa 17a iri 'Hongu' kana 'Dzimwenguva', dzidziso iyi munoiwana yakamisikidzwa nemutowo upi?

1.	Zvipepa zvidiki zvakanyorwa zvekuti madzimai anoenda nazvo kumba	
2.	Hurukuro	
4.	Zvipepa zvekunamira zvakakura	

Any other (Specify): ……...

18. Mukuonawo kwenyu imi, mapiritsi eropa aya anonyanya kukosha here zvekuti mai vese vakazvitakura vangakurudzirwa kuashandisa?

1.	Hongu	
2.	Kwete	

Tsigirai mhinduro yenyu: ……

Tinotenda nenguva yenyu yamatora kupindura mibvunzo iyi.

APPENDIX E: CONSENT DOCUMENT FOR QUESTIONNAIRE IN ENGLISH

University of KwaZulu-Natal
College of Agriculture, Engineering and Science
Pietermaritzburg Campus
Dear Participant

My name is Plaxcedia Mahundi. I am a Human Nutrition PhD student from the Discipline of Dietetics and Human Nutrition at the University of KwaZulu-Natal, Pietermaritzburg campus, South Africa. I am interested in learning and deepening knowledge on improved maternal health care, especially in pregnancy. My study specifically aims at assessing levels of acceptance, knowledge and barriers to effective use of iron supplements amongst pregnant women. I am studying pregnant women from Zimbabwe's Manicaland province, attending Mutare city clinic for their ante-natal check-ups. Specific reference is made to pregnant women in their second and third trimesters (from 3 to 9 months). You have been selected to take part in this study. You are required to fill in the survey questionnaire here-attached.

Please note that:

- Confidentiality is guaranteed. Your identity and all the information that you are going to give will not be attributed to you in person, but will rather be reported only as a population member opinion.
- Any information given by you cannot be used against you, and the collected data will be used for study purposes of this research only and nowhere else.
- The questionnaire may take about 25 minutes to fill in and you can fill it in whilst you are still here at the clinic.
- Data will be stored in secure storage and destroyed after 5 years.
- You have a choice to participate, not participate or stop participating in the research at any given time. You will not be penalized for taking such an action.
- Your involvement is purely for academic purposes only, and there are no financial benefits involved.

For any further information, please do not hesitate to contact me on:

Email: mahundi.placky@gmail.com

Cell: +263712750604 or +263782080695.

My supervisor is Dr. Kirthee Pillay and my co-supervisor is Doctor Nicola Wiles. They are both located at the School of Agricultural, Earth and Environmental Sciences, Scottsville, Pietermaritzburg campus of the University of KwaZulu-Natal, South Africa.

Doctor Kirthee Pillay
PhD Supervisor
pillayk@ukzn.ac.zawilesn@ukzn.ac.za
+27 (0)33 2605674

Doctor Nicky Wiles
PhD Co-Supervisor
+27 (0)33 260 5430

If you are willing to take part in this study, may you please fill-in and sign in the section below?

DECLARATION

I…… (Full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project. I consent to participating on the understanding that my involvement in the study is strictly confidential and anonymous.

I understand that I am also at liberty to withdraw from participating in the study at any given time, should I so desire and without fear of any undesirable consequences.

SIGNATURE OF PARTICIPANT **DATE**

…… ……

Thank you for participating in this study.

APPENDIX F: CONSENT DOCUMENT FOR QUESTIONNAIRE IN SHONA

University of KwaZulu-Natal
College of Agriculture, Engineering and Science
Pietermaritzburg Campus
Wadiwa Mubatidzi

Zita rangu ndiPlaxcedia Mahundi. Ndiri mudzidzi weHuman Nutrition padanho rePhD muchikoro cheDietetics neNutrition pa yunivhesiti ye KwaZulu-Natal, Pietermaritzburg, mu South Africa. Ndinofarira kudzidza zvine udzamu pamusoro pehutano hwakanaka hwemadzimai, kunyanya akazvitakura. Donzo rezvidzidzo zvangu rakanangana nekugona kuongorora magamuchirirwe uye mashandisirwe emapiritsi ekuwedzera ropa anowanzopihwa kunaana amai vakazvitakura. Zvipingaidzo zvingakanganisa kushandiswa kwemapiritsi aya zvichatariswawo zvakare muongororo iyoyi. Ndirikudzidza pamusoro pemadzimai akazvitakura anogara muZimbabwe, dunhu reManicaland uye guta remaMutare vanoenda kundovhenekwa paMutare City Clinic. Madzimai arikuongororwa ndeaya avenepamuviri pavenemwedzi mitatu kusvika kumipfumbamwe (3-9). Imi muri mumwe wemadzimai akasarudzwa kubatsira muchidzidzo chandiri kuita. Naizvozvo, munokumbirwa kuti munyore mhinduro muzvinzvimbo zvakasiyiwa papepa remibvunzo rakabatana nerino.Ndapota, cherechedzai kuti:

- Mashoko uye ruzivo rwese rwatichawana runenge rwakachengetedzwa. Zita renyu uye zvose zvamuchatibatsira nazvo hazvizoshandiswe kukurwisai kana kuziviswa kuti zvabva kwamuri sedungamunhu, asi zvinozotsanangudzwa zvakabatana nezvemunhu wese pasina zita remunhu ringadomwa.
- Masoko ese amuchataura achaunganidzwa ndeekushandisa muzvidzidzo zvino chete, hakuna kumwe kwaachashandiswa.
- Mibvunzo iyi ingangokutorerai maminitsi angaita makumi maviri nechidimbu kuti mupedze kuipindura. Munogona kupindura muchiri zvenyu pano pakiriniki.
- Mashoko uye ruzivo rwese ruchachengetedzwa pakavanzika muchikoro cheDietetics neHuman Nutrition kwemakore anokwana mashanu.
- Munesarudzo yekupinda muzidzidzo zvino kana kurega chero panguva yamunenge mafunga. Hapana kupihwa mhosva kwamunozoitwa musarudzo ipi neipi yamungatora.
- Kubatsira kwenyu ndekwekuti zvidzidzo zvino zvibudirire uye hakuna mubhadharo wemari kana zvimwewo ungazotevera.

Kana paine zvimwe zvamungada kuziva, makasununguka kundibata pa:

Email: mahundi.placky@gmail.com Cell: +263712750604 or +263782080695.

Mudzidzisi wangu ndiDoctor Kirthee Pillay vachibatsirana na Doctor Nicola Wiles. Vanowanikwa pachikoro cheAgricultural, Earth and Environmental Sciences, pa univhesiti ye KwaZulu-Natal irimuScottsville, Pietermaritzburg munyika yeSouth Africa.

Doctor Kirthee Pillay
PhD Supervisor
pillayk@ukzn.ac.zawilesn@ukzn.ac.za
+27 (0)33 2605674

Doctor Nicky Wiles
PhD Co-Supervisor
+27 (0)33 260 5430

Kana makasununguka kubatirana nesu muzvidzidzo zvino, ndaikumbira kuti munyore muchizadzisa zvindima zvakasiyiwa pazasi uye nekusaina.

CHITSIDZO

Ini…… (Zita rizere) ndanzwisisa zvose zvirimuzvinyorwa zvino uye mamirire ezvidzidzo zvino. Ndinobvuma kuva mumwe vevabatsiridzi muhurukuro dzino ndichinzwisisa kuti zvichabuda muhurukuro ino zvakachengetedzwa uye mazita evabatidzi haachazoshambadzwi. Ndinonzwisisa zvakare kuti ndakasununguka kubuda mukubatsiridza muhurukuro dzino chero panguva ipi zvayo kana ndafunga kuita saizvozvo, ndisina kana kutya kuti pane zvakashata zvingaitwa kwandiri.

SAINAI PAZASI **DHETI**

……..... **……**

Tinotenda nekubatsira kwamaita muzvidzidzo izvi.

APPENDIX G: INTERVIEW GUIDE FOR NURSES

Date: ……..

Introductions

1. For how long have you been working at this clinic? ……..

2. What is the approximate number of women attending ante-natal visits per day?

……

3. At what stage of pregnancy do the majority of pregnant women start registering their pregnancies at the clinic?

1st trimester ☐

2nd trimester ☐

3rd trimester ☐

4a. Do you offer iron supplements to pregnant women? Yes ☐ No ☐

4b. If 'Yes' to (4a), at what stage of the pregnancy do you offer iron supplements to pregnant women? .....

5. What are the perceptions of pregnant women towards iron supplements?

Negative ☐ Positive ☐ Uncertain ☐

6a. How often do you suggest that the iron supplements be taken by the pregnant women that you see?

Once a day ☐ Once a fortnight ☐

Once a week ☐ Once a month ☐

Twice a week ☐ Others (Specify)…….

6b. When offering supplements to women, do you discuss the importance of iron supplements and consequences of IDA in pregnancy?

Yes ☐ No ☐

7a. Do you encourage women to stop taking the iron supplements later in pregnancy?

Yes ☐ No ☐

7b. If 'Yes' to 7a, at what stage do you encourage women to stop taking the supplement? ……

7c. If response to 7a is 'No', what are the reasons for discouraging women from stopping supplements? …….

8. In your own assessment, why do pregnant women receive the iron supplements? ……

9a. Have you received any reports from women on challenges faced during iron supplementation? Yes ☐ No ☐

9b. If 'Yes' what are the challenges mentioned? ……

9c. What has been done to address these challenges of supplementation mentioned in 9b…….

10. Any additional contributions you want to make to this research?

……
……
……

Thank you very much for sparing your time to engage in this interview.

APPENDIX H: INTERVIEW INFORMED CONSENT DOCUMENT FOR NURSES

University of KwaZulu-Natal,
College of Agriculture, Engineering and Science
Pietermaritzburg Campus.

Dear Participant

Study Title: Acceptance, Knowledge and Barriers to effective use of iron supplements amongst pregnant women attending Mutare city clinic, Manicaland, Zimbabwe.

My name is Plaxcedia Mahundi. I am a Human Nutrition PhD student from the discipline of Dietetics and Human Nutrition at the University of KwaZulu-Natal, Pietermaritzburg campus, South Africa. Part of my studies requires identification of barriers to effective supplementation by pregnant women, establishing ways of alleviating the barriers as well as the development of a nutrition education tool. The cases under study are pregnant women from 3 to 9 months, who regularly attend ante-natal check-ups at Mutare City Clinic. You have been selected to be one of the participants in the Focus Group Discussions.Please note that:

- Any information given by you cannot be attributed to you in person or used against you, but will be kept confidential and all participants will remain anonymous. The collected data will be used for purposes of this research only, thus guaranteeing your confidentiality.
- Data gathered from this study will be stored in secure storage by the discipline of Dietetics and Human Nutrition and will be destroyed at least after 5 years.
- The focus group discussions can take approximately one and half ($1^1/_2$) to two (2) hours and can be segmented into 2 sessions if you so wish.
- Participation is voluntary. You may decide to participate, not participate or stop participating in the research at any time and will not be penalized or victimized in any way for taking such an action.
- There is going to be photography and reproduction of photos, audio and video recordings, of the focus group discussions to be used strictly for the purposes of this study and these will be kept confidential.
- Your involvement is purely for academic purposes only, and there are no potential benefits involved from participating in this study, however results from this study will be availed to participants.
- There are no payments or reimbursements of finances for participating in the study.

Please indicate by ticking in the box applicable, whether or not you are willing to take part in the focus group discussions which are going to be recorded using photographic, audio and video equipment:

Type of equipment	**Willing**	**Not willing**
Audio equipment		
Video equipment		
Photography		
Reproduction of photographs		

For further information, you can contact me on: Email: mahundi.placky@gmail.com

Cell: 0712750604 or 0782080695.

My supervisor is Dr. Kirthee Pillay and my co-supervisor is Doctor Nicola Wiles. They are both located at the School of Agricultural, Earth and Environmental Sciences, Scottsville, Pietermaritzburg campus of the University of KwaZulu-Natal, South Africa.

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+27 (0)33 2605674

Doctor Nicky Wiles
PhD Co-Supervisor
+27 (0)33 260 5430

If you are willing to participate in the focus group discussions, may you please fill in the section below and also put your signature.

DECLARATION

I…… (Full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project. I consent to participating in the focus group discussions on the understanding that my involvement in the study is strictly confidential and anonymous and that the information given will be used for research purposes only.
I understand that I am also at liberty to withdraw from participating in the study at any given time should I so desire, without fear of any undesirable consequences.

SIGNATURE OF PARTICIPANT **DATE**

…… ……

Thank you for your contribution to this research.

APPENDIX I: FOCUS GROUP DISCUSSION INTERVIEW GUIDE ON BARRIERS IN ENGLISH

Introductions and warming up

Good morning ladies.

You have been selected to participate in this focus group discussion on barriers to effective iron supplementation amongst pregnant women. Thank you very much for your acceptance to participate. Please note that your involvement in the discussion is purely for academic purposes and no financial benefits are involved. The discussion will last for at least one hour.

Rules to observe during FGDs

- All cellphones shall be switched off during discussions.
- All members shall have the priviledge to participate freely without any interjections.
- Differences in opinion and view points shall be accepted.
- Confidentiality of identity and information shall be observed at all times.

1a. Were you offered iron supplements by the clinic staff during your visits?

1b. If yes, at which stage of the pregnancy were they offered to you?

2. Are you facing any problems caused by taking the iron supplements?

3. What is the role of iron supplements during pregnancy?

4. Are iron supplements readily available at the clinic or do women get them from pharmacies?

5. What are the reasons why pregnant women do not take their iron supplements?

6. Does culture affect the use of iron supplements? If yes, how?

7. In what way can religion influence one's uptake of iron supplements?

8. In your own opinion, how does one's socio-economic status affect the way pregnant women take their supplements?

9. Do you think the education level of an individual influences their rate of taking iron supplements? Justify.

10. What can be done to help women take their supplements?

11. What role can be played by partners of pregnant women, in overcoming barriers to effective iron supplementation?

Conclusion of discussion

Researcher thanks participants for taking their time to participate in the discussion.

APPENDIX J: FOCUS GROUP DISCUSSION INTERVIEW GUIDE ON BARRIERS IN SHONA

Nhanganyaya

Mangwanani madzimai. Makasarudzwa kuti muve umwe wevabatidzi muhurukuro dzatirikuita muzvikwata pamusoro pezvirikudzivisa madzimai akazvitakura kushandisa mapiritsi ekuwedzera ropa avanopiwa naana mukoti. Tinokutendai nekubvuma kuva muhurukuro idzidzi. Ndinokuzivisai kuti hurukuro idzi dziripo maringe nekudzidza kwete nezvimwewo zvikonzero. Tinotarisira kutora awa rimwe chete muhurukuro ino.

Mitemo yekutevedzera panguva yehurukuro

- Nhare dzese dzichange dzakadzimwa panguva yehurukuro.
- Vese vabatidzi vachava nemukana wekutaura pfungwa dzavo vakasununguka.
- Pfungwa dzakasiyana dzinotenderwa nekugamuchirwa zvisina kupihwa mhosva.
- Zvese zvinotaurwa muhurukuro ino zvichange zvakachengeteka nguva dzose.

1a. Munombopihwa here mapiritsi eropa naana mukoti pamunouya kuzoonekwa?

1b. Kana mhinduro yenyu iri hongu, mapiritsi aya pamakaapihwa pamuviri penyu paive pakura zvakadii?

2. Munedambudziko here ringadaro ririkukonzerwa nekumwa mapiritsi eropa aya

3. Mukuonawo kwenyu mapiritsi aya anonyatsobatsira chii chaizvo kumadzimai akazvitakura?

4. Mapiritsi aya munoawana nyore nyore here kuchipatara kana kuti munoatenga kuzvitoro zvinotengesa mishonga?

5. Ndezvipi zvikonzero zvingakonzeresa madzimai akazvitakura kuti arege kumwa mapiritsi eropa sezvinotarisirwa?

6. Tsika nemagariro enyu dzine chekuita here nekumwa kungaitwa mapiritsi aya? Kana mhinduro iri hongu, dzinesimba rakadii pakushandiswa kwemapiritsi nemadzimai akazvitakura?

7. Chitendero chemunhu chine simba rakadii pakudzivisa kana kutendera kushandiswa kwemapiritsi nemadzimai akazvitakura?

8. Mumaonero enyu, mari nepfuma yemunhu zvinezvazvinoita here kuti vanamai vakazvitakura vatore kana kurega mapiritsi?

9. Danho rakasvikwa nemunhu pakudzidza rinokonzeresa zvakadii pamashandisirwe angaitwe mapiritsi nemadzimai anenhumbu? Tsigirai mhinduro yenyu.

10. Ngezvipi zvingaitwa kuti madzimai agone kushandisa mapiritsi zvakanaka vasingadarikire panguva yavanenge vakazvitakura?

11. Vanogara nemadzimai akazvitakura vangabatsiridza sei kuti madzimai aya akunde zvipingaidzo zvingaatadzisa kumwa mapiritsi eropa sezvakafanira?

12. Pfupiso yepfungwa huru dzabuda muhurukuro.

Mutungamiri wehurukuro anotenda vose vanga varimukati mehurukuro nebasa ravabata.

APPENDIX K: CONSENT DOCUMENT FOR FOCUS GROUP DISCUSSIONS ON BARRIERS IN ENGLISH

University of KwaZulu-Natal
College of Agriculture, Engineering and Science
Pietermaritzburg Campus

Dear Participant

My name is Plaxcedia Mahundi. I am a Human Nutrition PhD student from the Discipline of Dietetics and Human Nutrition at the University of KwaZulu-Natal, Pietermaritzburg campus, South Africa. I am interested in learning and deepening knowledge on improved maternal health care, especially in pregnancy. My study specifically aims at assessing levels of acceptance, knowledge and barriers to effective use of iron supplements amongst pregnant women. I am studying pregnant women from Zimbabwe's Manicaland province, attending Mutare city clinic for their ante-natal check-ups. Specific reference is made to pregnant women in their second and third trimesters (from 3 to 9 months). You have been selected to take part in this study. You will be required to participate in focus group discussions on barriers to effective iron supplementation with other pregnant women. During the discussions, you can also suggest possible strategies for alleviating the identified barriers. Please note that:

- Confidentiality is guaranteed. Your identity and all the information that you are going to give will not be attributed to you in person, but will rather be reported only as a population member opinion.
- Any information given by you cannot be used against you, and the collected data will be used for study purposes of this research only and nowhere else.
- Focus group discussions may last for about an hour to one and half hours.
- Data will be stored in secure storage and destroyed after 5 years.
- You have a choice to participate, not participate or stop participating in the research at any given time. You will not be penalized for taking such an action.
- Your involvement is purely for academic purposes. There are no financial benefits involved.
- Please indicate by ticking in the box applicable, whether or not you are willing to take part in the focus group discussions which are going to be recorded using photographic, audio and video equipment.

Type of equipment	**Willing**	**Not willing**
Audio equipment		
Video equipment		
Photography		
Reproduction of photographs		

For any further information, please do not hesitate to contact me on:

Email: mahundi.placky@gmail.com

Cell: +263712750604 or +263782080695.

My supervisor is Dr. Kirthee Pillay and my co-supervisor is Doctor Nicola Wiles. They are both located at the School of Agricultural, Earth and Environmental Sciences, Scottsville, Pietermaritzburg campus of the University of KwaZulu-Natal, South Africa.

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Doctor Nicky Wiles
PhD Co-Supervisor
wilesn@ukzn.ac.za
+27 (0)33 260 5430

If you are willing to take part in this study, may you please fill-in and sign in the section below?

DECLARATION

I…… (Full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project. I consent to participating on the understanding that my involvement in the study is strictly confidential and anonymous.

I understand that I am also at liberty to withdraw from participating in the study at any given time, should I so desire and without fear of any undesirable consequences.

SIGNATURE OF PARTICIPANT **DATE**

…… ……

Thank you for participating in the discussions

APPENDIX L: CONSENT DOCUMENT FOR FOCUS GROUP DISCUSSIONS ON BARRIERS IN SHONA

University of KwaZulu-Natal,
College of Agriculture, Engineering and Science
Pietermaritzburg Campus.
Wadiwa Mubatidzi

Study Title: Acceptance, Knowledge and Barriers to effective use of iron supplements amongst pregnant women attending Mutare city clinic, Manicaland, Zimbabwe.

Zita rangu ndinonzi Plaxcedia Mahundi. Ndiri mudzidzi wePhD Human Nutrition muchikoro che Dietetics ne Human Nutrition chepa yunivhesiti ye KwaZulu-Natal, Pietermaritzburg iri mu South Africa. Chimwe chikamu chezvidzidzo zvangu ndechekuongorora nekudoma zvipingaidzo zvingasangana nemadzimai akazvitakura mukushandiswa kwemapiritsi ekuwedzera ropa. Zvipingaidzo izvi zvinoda kuongororwa kuti zvinokonzerwa nei uye kuti zvingapedzwe sei. Vanhu varikuongororwa madzimai akazvitakura ane pamuviri pave nemwedzi mitatu kusvika mipfumbamwe (3-9), uye vanogara vachindoongororwa utano hwavo pakiriniki yeMutare City Clinic. Imi makasarudzwa kuva mumwe wevachabatsiridza muhurukuro dzichaitwa muzvikwata.Ndapota, cherechedzai kuti:

- Mashoko uye ruzivo rwese rwatichawana runenge rwakachengetedzwa. Zita renyu uye zvose zvamuchatibatsira nazvo hazvizoshandiswe kukurwisai kana kuziviswa kuti zvabva kwamuri sedungamunhu, asi zvinozotsanangudzwa zvakabatana nezvemunhu wese pasina zita remunhu ringadomwa.
- Masoko ese amuchataura achaunganidzwa ndeekushandisa muzvidzidzo zvino chete, hakuna kumwe kwaachashandiswa.
- Mibvunzo iyi ingangokutorerai maminitsi angaita makumi maviri nechidimbu kuti mupedze kuipindura. Munogona kupindura muchiri zvenyu pano pakiriniki.
- Mashoko uye ruzivo rwese ruchachengetedzwa pakavanzika muchikoro cheDietetics neHuman Nutrition kwemakore anokwana mashanu.
- Munesarudzo yekupinda muzidzidzo zvino kana kurega chero panguva yamunenge mafunga. Hapana kupihwa mhosva kwamunozoitwa musarudzo ipi neipi yamungatora.
- Kubatsira kwenyu ndekwekuti zvidzidzo zvino zvibudirire uye hakuna mubhadharo wemari kana zvimwewo ungazotevera.
- Ndapota ratidzai netiki muzvibhokisi zvakaratidzwa kuti makasununguka here kana kuti hamuna kusununguka kupinda muhurukuro dzino dzichazenge dzichirekodhwa dzichishandisa zvombo zvekurekodhesa nekutora mifananidzo zvakaratidzwa pazasi:

Rudzi rwezvombo	**Ndakasununguka**	**Handina kusununguka**
Zvombo zvekunzwa nazvo		
Zvombo zvekunzwa nekuona		
Kutorwa mifananidzo		

Kubuditsa mifananidzo yawanda		

Kana paine zvimwe zvamungada kuziva, makasununguka kundibata pa:

Email: mahundi.placky@gmail.com Cell: +263712750604 or +263782080695.

Mudzidzisi wangu ndiDoctor Kirthee Pillay vachibatsirana na Doctor Nicola Wiles. Vanowanikwa pachikoro cheAgricultural, Earth and Environmental Sciences, pa univhesiti ye KwaZulu-Natal irimuScottsville, Pietermaritzburg munyika yeSouth Africa.

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Kana makasununguka kubatirana nesu muzvidzidzo zvino, ndaikumbira kuti munyore muchizadzisa zvindima zvakasiyiwa pazasi uye nekusaina.

CHITSIDZO

Ini…… (Zita rizere) ndanzwisisa zvose zvirimuzvinyorwa zvino uye mamirire ezvidzidzo zvino. Ndinobvuma kuva mumwe vevabatsiridzi muhurukuro dzino ndichinzwisisa kuti zvichabuda muhurukuro ino zvakachengetedzwa uye mazita evabatidzi haachazoshambadzwi. Ndinonzwisisa zvakare kuti ndakasununguka kubuda mukubatsiridza muhurukuro dzino chero panguva ipi zvayo kana ndafunga kuita saizvozvo, ndisina kana kutya kuti pane zvakashata zvingaitwa kwandiri.

SAINAI PAZASI **DHETI**

……..... **……**

Tinotenda nekubatsira kwamaita muzvidzidzo izvi.

APPENDIX M: FOCUS GROUP DISCUSSION INTERVIEW GUIDE ON DEVELOPMENT OF A NUTRITION EDUCATION TOOL IN ENGLISH

Introductions and warming up

Good morning ladies.

You have been selected to participate in this focus group discussion on barriers to effective iron supplementation amongst pregnant women. Thank you very much for your acceptance to participate. Please note that your involvement in the discussion is purely for academic purposes and no financial benefits are involved. The discussion will last for at least one hour.

Rules to observe during FGDs

- All cellphones shall be switched off during discussions.
- All members shall have the priviledge to participate freely without any interjections.
- Differences in opinion and view points shall be accepted.
- Confidentiality of identity and information shall be observed at all times.

1. Is it important for pregnant women to receive some nutrition education with their iron supplements?
2. If you feel nutrition education is important, in what form should the nutrition education tool be provided?
3. What language is most ideal to use when developing a nutrition education tool for pregnant women?
4. What type of information should be included in the nutrition education tool to make it useful for you?
5. How should the information be put together or be arranged in the nutrition education tool?
6. At what stage in pregnancy should the nutrition education tool be given to women?
7. Should the nutrition education tool be given together with iron supplements or the supplements should come later after women have read and understood?
8. What is the role of the partner in ensuring that women take their iron supplements?
9. What can be done to remind women to take their supplements on a regular basis?
10. Apart from the clinic, where else can the nutrition education tool be given to expectant mothers?

Conclusion of discussion

Participants are thanked for their involvement in the discussion

APPENDIX N: FOCUS GROUP DISCUSSION INTERVIEW GUIDE ON DEVELOPMENT OF A NUTRITION EDUCATION TOOL IN SHONA

Nhanganyaya

Mangwanani madzimai. Makasarudzwa kuti muve umwe wevabatidzi muhurukuro dzatirikuita muzvikwata pamusoro pezvirikudzivisa madzimai akazvitakura kushandisa mapiritsi ekuwedzera ropa avanopiwa naana mukoti. Tinokutendai nekubvuma kuva muhurukuro idzidzi. Ndinokuzivisai kuti hurukuro idzi dziripo maringe nekudzidza kwete nezvimwewo zvikonzero. Tinotarisira kutora awa rimwe chete muhurukuro ino.

Mitemo yekutevedzera panguva yehurukuro

- Nhare dzese dzichange dzakadzimwa panguva yehurukuro.
- Vese vabatidzi vachava nemukana wekutaura pfungwa dzavo vakasununguka.
- Pfungwa dzakasiyana dzinotenderwa nekugamuchirwa zvisina kupihwa mhosva.
- Zvese zvinotaurwa muhurukuro ino zvichange zvakachengeteka nguva dzose.

1. Zvinokosha here kuti madzimai akazvitakura paanopihwa mapiritsi eropa awanewo dzidziso pamusoro pehukoshi pamwe nemashandisirwo emapiritsi aya?
2. Kana dzidziso iyi ichikosha, inofanira kuuya yakaiswa muchombo chakagadzirwa nemutowo upi? Semuenzaniso hurukuro, kana zvipepa zvekunamira zvakakura (posters), kana zvipepa zvidiki zvekuti vanamai vanotora kuenda nazvo kumba (pamhlets)?
3. Mutauro/ Mitauro yakanyanya kukodzera uye kureruka kushandisa pakugadzirwa kwechombo chekudzidzisa madzimai akazvitakura ungawa upi/ingawa ipi?
4. Ndezvipi zvinyorwa zvinoda kuiswa muchombo chekudzidzisa iichi kuti chive chinobatsira uye kunzwisiswa nemadzimai akazvitakura?
5. Zvinyorwa zvekuisa muchombo chekudzidzisa madzimai ichi zvinofanira kumisikidzwa kana kurongedzwa nemutoo upi?
6. Madzimai akazvitakura anofanira kupihwa chombo chekudzidza nacho kana pamuviri pavo pakura zvakadii?
7. Chombo chekudzidzisa nacho madzimai chinofanira kupihwa kumadzimai pamwe chete nemapiritsi here kana kuti mapiritsi anofanira kuzouya mumashure mekunge madzimai amboverenga nekunzwisisa zvidzidzo kubva pachombo chakagadzirwa?
8. Vanogara nemadzimai vangabatsiridza sei kuti madzimai akwanise kushandisa mapiritsi?
9. Ndezvipi zvingaitwa kurangaridza madzimai akazvitakura kushandisa mapiritsi pazvinhambo zvinotarisirwa vasingadarikiri?
10. Kunze kwekuchipatara, ndeipi imwe nzvimbo inogona kupihwirwa madzimai dzidziso maererano nekushandiswa zvakanaka kwemapiritsi panguva yavanenge vakazvitakura?
11. Kubatanidza pfungwa huru dzabuda muhurukuro

Mutungamiri wehurukuro anotenda vose nekubatsira kuti huruko ibudirire.

APPENDIX O: CONSENT DOCUMENT FOR FOCUS GROUP DISCUSSIONS ON THE NUTRITION EDUCATION TOOL IN ENGLISH

University of KwaZulu-Natal
College of Agriculture, Engineering and Science
Pietermaritzburg Campus

Dear Participant

My name is Plaxcedia Mahundi. I am a Human Nutrition PhD student from the Discipline of Dietetics and Human Nutrition at the University of KwaZulu-Natal, Pietermaritzburg campus, South Africa. I am interested in learning and deepening knowledge on improved maternal health care, especially in pregnancy. My study specifically aims at assessing levels of acceptance, knowledge and barriers to effective use of iron supplements amongst pregnant women. I am studying pregnant women from Zimbabwe's Manicaland province, attending Mutare city clinic for their ante-natal check-ups. Specific reference is made to pregnant women in their second and third trimesters (from 3 to 9 months). You have been selected to take part in this study. You will be required to participate in focus group discussions on development of a nutrition education tool, for use by pregnant women as a strategy for improving iron supplementation and healthy dietary habits. You are required to discuss your proposals of the type of information, type of tool and ideal language(s) to use in the developed nutrition tool. Please note that:

- Confidentiality is guaranteed. Your identity and all the information that you are going to give will not be attributed to you in person, but will rather be reported only as a population member opinion.
- Any information given by you cannot be used against you, and the collected data will be used for study purposes of this research only and nowhere else.
- The questionnaire may take about 25 minutes to fill in and you can fill it in whilst you are still here at the clinic.
- Focus group discussions may last for about an hour to one and half hours.
- Data will be stored in secure storage and destroyed after 5 years.
- You have a choice to participate, not participate or stop participating in the research at any given time. You will not be penalized for taking such an action.
- Your involvement is purely for academic purposes. There are no financial benefits involved.
- Please indicate by ticking in the box applicable, whether or not you are willing to take part in the focus group discussions which are going to be recorded using audio and video equipment.

Type of equipment	**Willing**	**Not willing**
Audio equipment		
Video equipment		
Photography		
Reproduction of photographs		

For any further information, please do not hesitate to contact me on:

Email: mahundi.placky@gmail.com Cell: +263712750604 or +263782080695.

My supervisor is Dr. Kirthee Pillay and my co-supervisor is Doctor Nicola Wiles. They are both located at the School of Agricultural, Earth and Environmental Sciences, Scottsville, Pietermaritzburg campus of the University of KwaZulu-Natal, South Africa.

Doctor Kirthee Pillay

PhD Supervisor
pillayk@ukzn.ac.zawilesn@ukzn.ac.za
+27 (0)33 2605674

Doctor Nicky Wiles

PhD Co-Supervisor
+27 (0)33 260 5430

If you are willing to take part in this study, may you please fill-in and sign in the section below?

DECLARATION

I…… (Full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project. I consent to participating on the understanding that my involvement in the study is strictly confidential and anonymous.

I understand that I am also at liberty to withdraw from participating in the study at any given time, should I so desire and without fear of any undesirable consequences.

SIGNATURE OF PARTICIPANT DATE

…… ……

Thank you for participating in the discussions.

APPENDIX P: CONSENT DOCUMENT FOR FOCUS GROUP DISCUSSIONS ON THE NUTRITION EDUCATION TOOL IN SHONA

University of KwaZulu-Natal
College of Agriculture, Engineering and Science
Pietermaritzburg Campus

Vadiwa Vabatsiridzi

Tsamba yekuzivisa madzimai akazvitakura pamwe nekuita sarudzo yekupinda kana kubuda muzvidzidzo

Zita rangu ndiPlaxcedia Mahundi. Ndiri mudzidzi weHuman Nutrition padanho rePhD muchikoro cheDietetics neNutrition pa yunivhesiti ye KwaZulu-Natal, Pietermaritzburg, mu South Africa. Ndinofarira kudzidza zvine udzamu pamusoro pehutano hwakanaka hwemadzimai, kunyanya akazvitakura. Donzo rezvidzidzo zvangu rakanangana nekugona kuongorora magamuchirirwe uye mashandisirwe emapiritsi ekuwedzera ropa anowanzopihwa kunaana amai vakazvitakura. Zvipingaidzo zvingakanganisa kushandiswa kwemapiritsi aya zvichatariswawo zvakare muongororo iyoyi. Ndirikudzidza pamusoro pemadzimai akazvitakura anogara muZimbabwe, dunhu reManicaland uye guta remaMutare vanoenda kundovhenekwa paMutare City Clinic. Madzimai arikuongororwa ndeaya avenepamuviri pavenemwedzi mitatu kusvika kumipfumbamwe (3-9). Imi muri mumwe wemadzimai akasarudzwa kubatsira muchidzidzo chandiri kuita. Mukubatsiridza kwenyu munokumbirwa kuzopinda muhurukuro pamwe nemamwe madzimai akazvitakura. Muhurukuro idzi munezenge muchitaura pamusoro pezvingaitwa kuti tigadzire chombo chekuti madzimai ashandise muzvidzidzo zvavo kuchipatara, kanazve varikumba. Ndapota, cherechedzai kuti:

- Mashoko uye ruzivo rwese rwatichawana runenge rwakachengetedzwa. Zita renyu uye zvose zvamuchabatsira nazvo hazvizoshandiswe kukurwisai kana kuziviswa kuti zvabva kwamuri sedungamunhu, asi zvinozotsanangudzwa zvakabatana nezvemunhu wese pasina zita remunhu ringadomwa.
- Masoko ese amuchataura achaunganidzwa ndeekushandisa muzvidzidzo zvino chete, hakuna kumwe kwaachashandiswa.
- Mibvunzo iyi ingangokutorerai maminitsi angaita makumi maviri nechidimbu kuti mupedze kuipindura. Munogona kupindura muchiri zvenyu pano pakiriniki.
- Hurukuro dzamuchaita nemamwe madzimai dzingangotora nguva ingakwana kuita awa imwe kusvika kuawa nechidimbu
- Mashoko uye ruzivo rwese ruchachengetedzwa pakavanzika muchikoro cheDietetics neHuman Nutrition kwemakore anokwana mashanu muyunivhesiti yeKwaZulu Natal.
- Munesarudzo yekubatsiridza, kurega kubatsiridza kana kumira kubatsira muzvidzidzo zvino chero paneipi nguva yamunoda. Hapana kumanikidza kana zvimwe zvakashata zvingaitwa kukurwasai nekuda kwesarudzo yamungaita.
- Kubatsira kwenyu ndekwekuti zvidzidzo zvino zvibudirire uye hakuna mubhadharo wemari kana zvimwewo ungazotevera.

- Ndapota ratidzai netiki muzvibhokisi zvakaratidzwa kuti makasununguka here kana kuti hamuna kusununguka kupinda muhurukuro dzino dzichazenge dzichirekodhwa dzichishandisa zvombo zvekurekodhesa:

Rudzi rwezvombo	**Ndakasununguka**	**Handina kusununguka**
Zvombo zvekunzwa nazvo		
Zvombo zvekunzwa nekuona		
Kutorwa mifananidzo		
Kubuditsa mifananidzo yawanda		

Kana paine zvimwe zvamungada kuziva, makasununguka kundibata pa:

Email: mahundi.placky@gmail.com Cell: +263712750604 or +263782080695.

Mudzidzisi wangu ndiDoctor Kirthee Pillay vachibatsirana na Doctor Nicola Wiles. Vanowanikwa pachikoro cheAgricultural, Earth and Environmental Sciences, pa univhesiti ye KwaZulu-Natal irimuScottsville, Pietermaritzburg munyika yeSouth Africa.

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PhD Supervisor
pillayk@ukzn.ac.zawilesn@ukzn.ac.za
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Doctor Nicky Wiles
PhD Co-Supervisor

Kana makasununguka kubatira muzvidzidzo zvino, ndaikumbira kuti munyore muchizadzisa zvindima zvakasiyiwa pazasi uye nekusaina.

CHITSIDZO

Ini…… (Zita rizere) ndanzwisisa zvose zvirimuzvinyorwa zvino uye mamirire ezvidzidzo zvino. Ndinobvuma kuva mumwe vevabatsiridzi muhurukuro dzino ndichinzwisisa kuti zvichabuda muhurukuro ino zvakachengetedzwa uye mazita evabatidzi haachazoshambadzwi. Ndinonzwisisa zvakare kuti ndakasununguka kubuda mukubatsiridza muhurukuro dzino chero panguva ipi zvayo kana ndafunga kuita saizvozvo, ndisina kana kutya kuti pane zvakashata zvingaitwa kwandiri.

SAINAI PAZASI **DHETI**

…… ……

Tinotenda

APPENDIX Q: NUTRITION EDUCATION PAMPHLET FOR PREGNANT WOMEN

Strategies for addressing Iron Deficiency Anaemia

A combination of consistent consumption of iron and vitamin C-rich foods is effective in alleviating IDA among pregnant women. Diets also need to be diversified. Other strategies for reducing IDA include fortification, biofortification of food, as well as nutrition education. Side effects associated with iron supplements are nausea, heartburn, dizziness, diarrhoea, constipation and fatigue. These usually disappear with time, or can be reduced by taking iron supplements with food or with plenty of water.

Iron rich foods


Liver


Beef


Broccoli


Strawberries


Spinach


Oranges


Pumpkin leaves


Breakfast cereals

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Department of Dietetics and Human Nutrition
Pietermaritzburg Campus
mahundi.placky@gmail.com (215074342) 2020

IMPORTANCE OF IRON SUPPLEMENTS

For healthy maternal and paediatric outcomes

IMPORTANCE OF IRON SUPPLEMENTS TO PREGNANT WOMEN

IMPORTANCE OF IRON SUPPLEMENTS IN PREGNANCY

Iron supplementation in pregnancy is a very effective strategy in reducing Iron Deficiency Anaemia (IDA). The iron supplements are usually given free of charge at local clinics. Iron supplements help to increase maternal and fetal blood volumes, increase oxygen flow, and delivery to body tissues. They also reduce infections and complications at delivery. The World Health Organization (WHO) recommends to every pregnant woman 60 mg of elemental iron from beginning of second trimester to six weeks post delivery. This helps to boost iron from the diet in order to meet the increased physiologic needs of pregnancy. In developing countries, such as Zimbabwe, the prevalence of anaemia is high because diets are not usually varied. Therefore, iron supplementation is one affordable strategy to reduce maternal mortality and morbidity rates.

Inhibitors to Iron absorption: Calcium; Phytic acids; Polyphenols; Oxalic acid; Zinc supplements.

Dose: 60mg of Iron (Ferrous Sulphate) One (1) tablet per day

START: BEGINNING OF 2ND TRIMESTER (Latest)

STOP: SIX (6) WEEKS POST-DELIVERY

BENEFITS OF IRON SUPPLEMENTS

1. To increase blood volume (30-50%)
2. To deliver oxygen to body tissues
3. To reduce complications and infection at delivery
4. To prevent premature delivery and low birth weight infants
5. To enhance mental cognitive development of infants
6. For efficient energy metabolism
7. Prevents maternal mortality & morbidity

SIGNS AND SYMPTOMS OF IDA

1. Paleness of skin
2. Cold hands & feet; poor temperature regulation
1. Shortness of breath or rapid heartbeat
2. Fatigue/tiredness; reduced work capacity
3. Brittle & spoon shaped nails; hair loss
4. Headaches & light headedness
5. Crave non-food substances, e.g. clay (Pica)
6. Restlessness
7. Poor concentration
8. Sore tongue and sore corners of mouth

EATING FOODS RICH IN IRON AND VITAMIN C TOGETHER IMPROVES ABSORPTION OF IRON

Examples of iron rich foods

1. Liver (Chiropa)
2. Red Meat (e.g. Beef)
3. Poultry (Huku, Hanga, Matoki)
4. Blackjack (Nhungumira/Tsine/ Guku)
5. Offals (Maguru, Matumbu, Itsvo, Rwatata)
6. Spinach
7. Pulses e.g. beans (Bhinzi), peas

Examples of Vitamin C rich foods

1. Oranges (Maranjisi)
2. Naartjies (Manachisi)
3. Grapes (Mazambiringa)
4. Lemons (Mandimu)
5. Fruit juices (100%)
6. Strawberries
7. Green vegetables e.g. tsunga, rape, covo, lettuce, broccoli

IMPORTANCE OF IRON SUPPLEMENTS TO PREGNANT WOMEN