KNOWLEDGE AND PERCEPTION OF ORAL IRON INTAKE AMONG PREGNANT WOMEN AT HOSPITAL UNIVERSITI SAINS MALAYSIA

By
DR. NURULHUDA BINTI ABD KADIR

Advanced Medical and Dental Institute
Universiti Sains Malaysia

Dissertation submitted in partial fulfilment of
the requirement for the degree of
MASTER OF MEDICINE
(TRANSFUSION MEDICINE)

May 2021

KNOWLEDGE AND PERCEPTION OF ORAL IRON INTAKE AMONG PREGNANT WOMEN AT HOSPITAL UNIVERSITI SAINS MALAYSIA

By

DR. NURULHUDA BINTI ABD KADIR

Advanced Medical and Dental Institute

Universiti Sains Malaysia

Dissertation submitted in partial fulfilment of

the requirement for the degree of

MASTER OF MEDICINE

(TRANSFUSION MEDICINE)

May 2021

DISCLAIMER

I hereby certify that the work in this dissertation is my own except for the quotations and summaries, which have been duly acknowledged. I declare that I have no financial of interest in the instruments or materials used in this study.

Date: 17 May 2021

_____

DR. NURULHUDA BINTI ABD KADIR

ACKNOWLEDGEMENT

Alhamdulillah all praises to Allah SWT, peace and blessings be upon the Prophet Muhammad SAW, his family members and his companions. My greatest gratitude goes to the Almighty, for HIS grace and blessings for me to complete this dissertation.

My deepest gratitude goes to my beloved husband, Farish Hafeez Shaharuddin and also for my children Muhammad Faris Hakim, Nur Farha Humaira and Nur Fathia Alzahra who have been my pillar of strength and for supporting me at all cost. Special appreciation to my parents, Abd Kadir Ariffin and Fauziah Radin Salim, my parents in law, Shofiah Yaacob and Shaharuddin Mohyuddin, and my sisters and brothers for their endless support and encouragement to keep me strong throughout this programme.

I would like to take this opportunity to express my heartfelt gratitude to my supervisors, Dr Ahzad Hadi Ahmad, Dr Nur Arzuar Abd Rahim and Dr Ernest Mangantig and Associate Professor Dr Nik Ahmad Zuki Nik Lah for their continuous guidance. My appreciation to the staffs of the Department of Obstetrics and Gynaecology, Hospital USM for assistance in my study.

I also would like to extend my gratitude to my colleagues of Transfusion Medicine master program for their enormous help and support. Thank you.

TABLE OF CONTENTS

LIST OF TABLES

MANUSCRIPT TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

Abbreviations

CFA	Confirmatory Factor Analysis
CI	Confidence Interval
CVI	Content Validity Index
EFA	Exploratory Factor Analysis
Hb	Haemoglobin
ICC	Intraclass Correlation Coefficient
IDA	Iron Deficiency Anaemia
IRT	Item Response Theory
JEPeM	Jawatankuasa Etika Penyelidikan (Manusia)
PBM	Patient Blood Management
REF	Reference
SD	Standard Deviation
SPSS	Statistical Package For The Social Sciences
USM	Universiti Sains Malaysia
WHO	World Health Organization

LIST OF APPENDICES

ABSTRAK

PENGENALAN: Pematuhan terhadap pengambilan suplemen zat besi adalah penting bagi mengurangkan kadar anemia semasa kehamilan. Pengetahuan dan persepsi mengenai pengambilan suplemen zat besi boleh mempengaruhi kepatuhan terhadap pengambilan suplemen zat besi. Oleh itu, kajian ini bertujuan untuk menilai tahap pengetahuan dan persepsi mengenai pengambilan suplemen zat besi di kalangan wanita hamil di Hospital Universiti Sains Malaysia.

KAEDAH: Ini adalah kajian rentas silang yang dilakukan dikalangan 410 wanita hamil yang hadir di Klinik Obstetrik, Hospital Universiti Sains Malaysia diantara 1 Oktober 2019 sehingga 27 Februari 2020. Kajian ini menggunakan borang soal selidik yang telah divalidasi dimana ia mengandungi 54 soalan yang merangkumi profil sosiodemografi, sejarah obstetrik, perincian pengambilan suplemen zat besi, pengetahuan, dan persepsi mengenai pengambilan suplemen zat besi. Skor pengetahuan dikategorikan kepada baik atau lemah berdasarkan kebolehjawapan terhadap pengetahuan teras mengenai pengambilan suplemen zat besi. Skor persepsi pula tidak dikategorikan kepada baik atau lemah, tetapi, setiap soalan telah dianalisa secara individu.

KEPUTUSAN: Daripada 410 borang soal selidik yang diedarkan, 389 borang telah diterima dan lengkap untuk dianalisa. Majoriti (90.7%) wanita hamil mempunyai pengetahuan yang lemah, dan hanya 9.3% mempunyai pengetahuan yang baik. Kurang daripada 50% wanita hamil mengetahui bahawa suplemen zat besi harus diambil sehingga

enam minggu selepas bersalin. Hanya 36.8% mengetahui bahawa susu tidak membantu penyerapan zat besi dan hanya 10% yang mengetahui bahawa sakit perut adalah salah satu kesan sampingan suplemen zat besi. Kurang daripada satu pertiga mengetahui bahawa tauhu dan ubi kentang mempunyai kandungan zat besi yang tinggi. Umur, tahap pendidikan, usia kandungan, sejarah pengambilan suplemen zat besi dan tahap kepatuhan terhadap pengambilan suplemen zat besi (tertinggal pil zat besi lebih daripada tujuh hari) telah mempengaruhi secara signifikan tahap pengetahuan mengenai pengambilan pil zat besi ($p \leq 0.05$). Didapati wanita hamil sangat bersetuju atau bersetuju bahawa suplemen zat besi perlu diambil pada awal kehamilan (10.5%) dan oleh wanita hamil yang anemia (15%) sahaja. Selain dari itu, 24.7% dari wanita hamil sangat bersetuju atau bersetuju bahawa pengambilan suplemen zat besi boleh dihentikan sekiranya paras sel darah merah sudah mencapai tahap normal. Pengetahuan mengenai paras sel darah merah berkait secara signifikan dengan tahap skor persepsi ($p \leq 0.05$).

KESIMPULAN: Pengetahuan yang lemah dan persepsi yang salah mengenai pengambilan suplemen zat besi telah dikenal pasti di kalangan wanita hamil di dalam kajian ini. Oleh itu, program bimbingan dan pendidikan yang berkesan mengenai pengambilan suplemen besi harus dilaksanakan untuk meningkatkan kesedaran di kalangan wanita hamil.

Kata kunci: *Wanita Hamil, Suplemen zat besi, Anemia, Pengetahuan, Persepsi*

ABSTRACT

Knowledge and Perception of Oral Iron Intake among Pregnant Women at Hospital Universiti Sains Malaysia

Background: Adherence to oral iron therapy is the primary factor in reducing the incidence of anaemia in pregnancy. Knowledge and perception of oral iron intake have been shown to affect compliance with oral iron therapy. Therefore, the purpose of this study was to assess the knowledge and perception of oral iron intake among pregnant women at Hospital Universiti Sains Malaysia.

Methods: This was a cross-sectional study conducted among 410 pregnant women attending the Obstetrics Clinic, Hospital Universiti Sains Malaysia from 1st October 2019 until 27th February 2020. The study used a structured, and validated questionnaire consisting of 54 items including sociodemographic profile, obstetrics and iron supplementation details, knowledge and perception of oral iron consumption. The knowledge score was categorised as good or poor, depending on the response to the core knowledge items. The perception score was not categorised into good or poor, but the items were analysed individually.

Results: Of the 410 distributed questionnaires, 389 were accepted for further analysis. The majority (90.7%) had poor knowledge, and only 9.3% of pregnant women had good

knowledge. Less than 50% were aware that oral iron supplements should be resumed up to six weeks postpartum. Merely 36.8% knew that milk would not help in iron absorption, and only 10% knew that abdominal pain is one of the side effects of oral iron supplements. Less than one-third knew that tofu and potatoes have high iron content. Age, educational level, maternal gravidity, history of oral iron intake and compliance status (missed iron pills more than seven days) were significantly associated with knowledge score ($p \leq 0.05$). A proportion of the respondents strongly agreed or agreed that oral iron supplements should be taken during early pregnancy (10.5%) and by anaemic pregnant women (15%) only. Besides, 24.7% of the pregnant women strongly agreed or agreed that oral iron supplements could be stopped if the haemoglobin concentration achieves normal range. One variable which is aware of their haemoglobin level was significantly associated with the perception score ($p \leq 0.05$).

Conclusion: Poor knowledge and misperception of oral iron intake in pregnant women have been established. Effective counselling and educational programmes on oral iron supplementation should be initiated to improve awareness among pregnant women.

Keywords: *Pregnant Women, Oral Iron supplements, Anaemia, Knowledge, Perception*

CHAPTER 1

INTRODUCTION

1.1 Overview

This chapter covers the outline of the knowledge and perception of oral iron intake among pregnant women at Hospital Universiti Sains Malaysia. This chapter also highlights the research justifications and research questions.

1.2 Background of Study

Anaemia in pregnancy is an important public health issue, particularly in developing countries (WHO, 2015). Anaemia in pregnancy is defined by the World Health Organization (WHO) as a haemoglobin concentration below 11.0 g/dL in the first and third trimester and below 10.5 g/dL in the second trimester (Milman N. *et al*., 2007). Iron deficiency anaemia (IDA) is the most common cause of anaemia across the globe (WHO, 2015). Iron deficiency, even in the absence of IDA, negatively impacts maternal health, foetus and infants such as maternal fatigue, reduced cognitive function, increased risk of low birth weight baby and preterm delivery (Zhang Y. *et al*., 2016). Oral iron supplementation is the most common strategy used to control IDA in developing countries (Reveiz L. *et al*. 2011). The WHO also advocates prophylactic oral iron and folic acid supplementation for all pregnant women, particularly in areas with a high prevalence of anaemia (WHO, 2016). An oral iron supplement is inexpensive, convenient to consume and readily available, making it a preferred treatment option.

Even though oral iron supplements are freely distributed to all pregnant women as part of antenatal care programs, the prevalence of anaemia among pregnant women in developing countries has not been successfully reduced (Milman N., 2015). Poor compliance to oral iron supplementation is believed to be a contributing factor for ineffective supplementation programs (Milman N., 2015). The knowledge and perception of the pregnant women about oral iron consumption have been shown to influence compliance towards oral iron supplementation (Lacerta P. *et al*., 2011; Titaley C.R. *et al*., 2017; Triharini M. *et al*., 2018). Furthermore, several works of literature reported poor knowledge and some misperceptions about oral iron therapy among pregnant women (Ghimire N. *et al*., 2013; Sonkar V.K. *et al*., 2017; Titaley C.R. *et al*., 2017; Triharini M. *et al*., 2018). Hence, this study explores the knowledge and perception of oral iron consumption among pregnant women at Hospital Universiti Sains Malaysia (USM).

1.3 Literature Review

1.3.1 Prevalence of Anaemia in Pregnancy

Anaemia is a global phenomenon affecting low-, middle- and high-income countries. Women of reproductive age are particularly involved in which 38.2% of pregnant women and 29.4% of non-pregnant women are having anaemia worldwide (WHO, 2015). Developing countries have a higher prevalence of anaemia in pregnant women in which the highest prevalence is in South-East Asia, Eastern Mediterranean and African Regions (WHO, 2015). In Malaysia, the prevalence rates of anaemia in pregnant women ranged between 33% (Soh K.L. *et al*., 2015) to 43.6% (Mahdy Z.A. *et al*., 2017) and therefore indicated a moderate to severe public health problem (McLean E. *et al*., 2009).

Table 1.1: Anaemia in women viewed as a public health problem (McLean E. *et al*., 2009).

Prevalence of anaemia %	Public health significance
≤4.9	No problem
5.0-19.9	Mild problem
20.0-39.9	Moderate problem
≥40	Severe problem

1.3.2 IDA among Pregnant Women

The most common cause of anaemia worldwide is iron deficiency which constitutes about 50% of the anaemia cases (WHO, 2015). Iron deficiency is ascertained by the presence of a low serum ferritin <15-30 μg/L and often a low serum transferrin saturation <20% (Milman N. *et al*., 2007). A study done in Malaysia's urban area reported that 47.7% of the anaemia in pregnancy cases were due to IDA (Mahdy Z.A. *et al*., 2017). The similar study also found that 19.1% of pregnant women without anaemia were also iron deficient (Mahdy Z.A. *et al*., 2017). These findings suggest that iron deficiency remain a significant issue among pregnant women in Malaysia; thus, immediate and effective remedial measures are crucial in tackling the problem. Pregnant women are at a higher risk of developing IDA due to the substantial increase in iron demand during pregnancy to support foetal-placental growth and the expansion of the maternal red cell mass and plasma volume (Fisher A.L. & Nemeth E., 2017). Besides, iron losses may also occur through blood loss during delivery, leading to postpartum IDA (Milman N., 2006).

1.3.3 Impacts of IDA towards Mother and Foetus

Iron deficiency state, even in the absence of IDA, is associated with various detrimental effects to mother and foetus. These include preterm birth, foetal growth restriction, low Apgar scores and infection in foetus and infant. While in mother, IDA during pregnancy is associated with maternal fatigue, emotional disruption, reduced cognitive and immune function and impaired tolerance to massive bleeding during delivery which may increase risk of blood transfusion in the postpartum period (Haider B.A. *et al*., 2013; Zhang Y. *et al*., 2016). Analysis of postpartum haemorrhage cases revealed that pregnant women with anaemia have a higher risk of requiring blood transfusion (58.5%) compared to pregnant women without anaemia (17.8%) (Flores C.J. *et al*., 2017).

1.3.4 Treatment Options of IDA

During pregnancy, the recommended dietary allowances (RDAs) for iron have increased from 18 mg/d for non-pregnant women to 27 mg/d throughout pregnancy due to substantial increase in iron requirement during pregnancy (FAO/WHO, 2002). A study among British pregnant women showed that only 4% of the pregnant women had a dietary iron intake of more than the recommended dietary intake (Alwan N.A. *et al*., 2011). Additionally, study done to assess pregnant women's nutritional habit before and during pregnancy demonstrated that majority of the pregnant women do not change their diet significantly when they become pregnant which predispose them to get IDA (Milman N., 2015). Due to the increased iron demand during pregnancy, nutritional support alone may be insufficient to correct the IDA. Oral or parenteral iron is more effective to replace the depleted iron stores. Oral iron is the preferred first-line treatment for iron deficiency. It is

cheap, effective, and will correct anaemia in most pregnant women, especially if the treatment started early (Peña-Rosas J.P. *et al*., 2012).

Parenteral iron offers a quicker response and shorter treatment duration. Still, its administration is more invasive, expensive, and associated with the risk of anaphylaxis with iron dextran formulations (Auerbach M. *et al*., 2010). Blood transfusion is reserved for severe anaemia cases. It has several known risks namely transmission of infectious agents, transfusion reactions, ABO mismatch, alloimmunisation, transfusion-related acute lung injury, transfusion-associated circulatory overload, immunomodulation etc. (Sahu S. *et al*., 2014). The increasing awareness about blood transfusion safety has led to an implementation of patient blood management (PBM) concepts to maximise erythropoiesis, reduce blood loss, and enhance tolerance for anaemia with the ultimate goal of improving patient outcomes (Shander A. *et al*., 2016). The management of anaemia and iron deficiency in the peripartum period is a part of PBM in obstetrics. All pregnant women with gestational anaemia will be identified and treated to ensure sufficient haemoglobin level and adequate iron stores throughout pregnancy and the postpartum period.

1.3.5 Compliance with Oral Iron Supplementation

The WHO strongly advocates all pregnant women to take daily oral iron and folic acid supplementation with 30 mg to 60 mg of elemental iron as prophylaxis. In those with confirmed IDA, a higher dose of elemental iron (120 mg) is recommended until haemoglobin (Hb) concentration increases to normal level (Hb 11.0 g/dL or higher) (WHO, 2016). Currently, many antenatal care programs disseminated free iron supplements to pregnant women to reduce IDA incidence (Milman N., 2015). Even

though oral iron supplements are freely distributed to all pregnant women, poor adherence to oral iron supplementation remains one of the reasons for the partial success of the programs (Milman N., 2015). A study done among pregnant women in Malaysia reported that 50.8% of the participants were non-compliant to oral iron supplementation with the main reasons for non-compliance were forgetfulness (33.9%), side effects of the pills (11.9%) and misconception regarding the big size of babies (5.1%) (Thirukkanesh S. *et al*., 2010). Another study done in Ethiopia revealed that only 20.4% out of 628 pregnant women were compliant to oral iron therapy in which maternal age, educational status, knowledge of anaemia and iron supplementation, and the history of anaemia during pregnancy were significantly associated with compliance to oral iron therapy ($p < 0.05$) (Taye B. *et al*., 2015).

1.3.6 Knowledge and Perception of Oral Iron Supplementation

Knowledge and perception of oral iron supplementation vary among developing countries. In Albania, researchers found that only 39.6% of pregnant women had good awareness of oral iron supplementation in which only one-third of them were aware that oral iron supplement could prevent anaemia. In a similar study, 35.6% believed that consuming iron tablets may affect the mother and baby (Kraja E. *et al*., 2013). In Nepal, a study reported that majority of the respondents (56%) had poor knowledge (Sarju S.R. *et al*., 2014), while another study in Iran revealed that most of the pregnant women (75.9%) were aware of the importance of oral iron supplements during pregnancy. Still, only 43.3% consume iron supplements correctly (Moradi F. *et al*., 2007). Additionally, a study in South India showed that 35% of the pregnant women had negative beliefs about oral iron supplementation in which they believed that baby might become dark (22%) and grow very big (8%) (Gowri D. *et al*., 2017). Another study done among pregnant women

in Indonesia revealed that half of the respondents believed that regular iron supplementation could lead to high blood pressure (Triharini M. *et al*., 2018). In Malaysia, a survey conducted in Kuala Terengganu demonstrated that only 58.3% of pregnant women have good knowledge of oral iron consumption (Theng C.E. *et al*., 2017). Overall, most of the studies which conducted in developing countries where IDA is prevalence showed that the knowledge level regarding oral iron consumption is still low among pregnant women and there are some misperceptions on the benefits of oral iron supplements.

1.4 Research Justification

In Malaysia, the prevalence of iron deficiency anaemia among pregnant women is still high (Mahdy Z.A. *et al*., 2017) and remains a significant public health problem even though oral iron supplements are freely given to all pregnant women (Milman N., 2015). Poor compliance to oral iron supplementation is one of the factors that contribute to the high prevalence of IDA among pregnant women in Malaysia (Thirukkanesh S. *et al*., 2010; Nik Rosmawati N.H. *et al*., 2012). Therefore, it is interesting to explore why pregnant women are poor compliance with oral iron therapy. There are several studies done to assess the knowledge and perception of pregnant women about oral iron consumption, but the majority of these studies were done in India and other developing countries (Kraja E. *et al*., 2013; Sarju S.R. *et al*., 2014; Titaley C.R. *et al*., 2017; Gowri D. *et al*., 2017). In Malaysia, a survey of knowledge and perception of oral iron consumption among pregnant women is still limited and not well explored. The previous studies done in Malaysia were mainly assessing the understanding of anaemia and its general prevention (Adznam S.N.H *et al*., 2018; Bah F. *et al.*, 2020). Only one study was found evaluating the knowledge and attitude of pregnant women towards oral iron

supplementation, but the study tool used was not properly validated (Theng C.E. *et al.*, 2017). Besides, there was no local study evaluating pregnant women's perception of oral iron consumption. Therefore, this study will be done to fill the knowledge gap.

This study is different from previous works as it mainly explores on the knowledge and perception of oral iron consumption. The benefits of oral iron supplements, the correct way of taking the vitamin, factors that may influence iron absorption as well as the misperception and negative beliefs of oral iron therapy were assessed using a validated and reliable questionnaire. By analysing the knowledge and perception of oral iron consumption among pregnant women in Malaysia, this study would provide information on the current knowledge and perception of oral iron consumption among pregnant women in Malaysia to improve the supplementation program for pregnant women. It is believed that the findings of this study would be of great input for health authorities, policymakers, and researchers for designing strategies to improve the adherence level towards oral iron supplementation with the ultimate aim is to reduce the burden of anaemia among pregnant women in Malaysia.

1.5 Research Questions

1.5.1 What is the knowledge level of oral iron consumption among pregnant women?

1.5.2 What is the perception of pregnant women towards oral iron consumption?

1.5.3 What are the factors associated with knowledge score of oral iron consumption?

1.5.4 What are the factors related to the perception score of oral iron consumption?

CHAPTER 2

OBJECTIVES

2.1 General Objective

To study the knowledge and perception of pregnant women towards oral iron consumption.

2.2 Specific Objectives

2.2.1 To determine the level of knowledge of pregnant women of oral iron consumption

2.2.2 To determine the level of perception of the pregnant woman of oral iron consumption

2.2.3 To determine the association between sociodemographic profile, pregnancy characteristics and iron supplementation details with the level of knowledge of oral iron consumption

2.2.4 To determine the association between sociodemographic profile, pregnancy characteristics and iron supplementation details with the level of perception of oral iron consumption

2.3 Alternative Hypotheses

H_{A1}: There is a low level of knowledge regarding oral iron consumption among pregnant women

H_{A2}: There is a low level of perception regarding oral iron consumption among pregnant women

H_{A3}: There is a significant relationship between sociodemographic profile, pregnancy characteristics and iron supplementation details with the level of knowledge of oral iron consumption

H_{A4}: There is a significant relationship between sociodemographic profile, pregnancy characteristics and iron supplementation details with the level of perception of oral iron consumption

2.4 Null Hypotheses

H_{01}: There is a high level of knowledge regarding oral iron consumption among pregnant women

H_{02}: There is a high level of perception regarding oral iron consumption among pregnant women

H_{03}: There is no significant relationship between sociodemographic profile, pregnancy characteristics and iron supplementation details with the level of knowledge of oral iron consumption

H_{04}: There is no significant relationship between sociodemographic profile, pregnancy characteristics and iron supplementation details with the level of perception of oral iron consumption

CHAPTER 3

METHODOLOGY

3.1 Study Background

This is a questionnaire-based study to assess knowledge and perception of oral iron consumption among pregnant women at Hospital USM. This study consisted of two phases: development and validation of research questionnaire in Phase I and distribution of the validated questionnaires to conduct actual research in Phase II. Both validation and actual studies were conducted among pregnant women at Obstetrics Clinic, Hospital USM.

3.2 Phase I (Questionnaire Development and Validation)

3.2.1 Development of Questionnaire

The questionnaire had been developed based on the previous studies (Sarju S.R. *et al*., 2014; Ashraful A. *et al*., 2015; Nivedita K. *et al*., 2016; Gowri D. *et al*., 2017; Sonkar V.K. *et al*., 2017; Adznam S.N.H. *et al*., 2018; Triharini M. *et al*., 2018) on knowledge and perception of anaemia and oral iron consumption as well as brochures about dietary iron advice and iron supplementation produced by Ministry of Health Malaysia. A discussion with obstetricians was conducted to obtain their expert opinion on the important items to be included in the questionnaire. Ten pregnant women were interviewed to explore their knowledge about oral iron supplement intake. During the interview, the perception aspects were also explored to assess their views on the importance of oral iron therapy during pregnancy and their negative beliefs about an iron supplement. The information from the literature and interviews were used by a panel of

experts consisting of an Obstetrician and Gynaecologist, a Family Medicine Specialist, a Haematopathologist, a Transfusion Medicine Specialist and a Paediatrician to create the relevant constructs in the questionnaire. The questionnaire was developed in the Malay language.

3.2.2 Validation of Questionnaire

The questionnaire's validation involved several processes: content validity, face validity, and conducting pilot studies.

3.2.2.1 Content Validity

The questionnaire's content validity was assessed by another panel of experts, including an Obstetrician and Gynaecologist, a Family Medicine Specialist, a Clinical Haematologist and a Haematopathologist to determine the clarity, relevance, simplicity and ambiguity of each item. The level of agreement between the experts was assigned as a content validity index (CVI). The items with a score of less than 0.8 were either rephrased or deleted.

3.2.2.2 Face Validity

To assess the questionnaire's face validity, the questionnaire was pre-tested among 30 pregnant women at the Obstetrics Clinic, Hospital USM. An open-ended discussion was included to assess their understanding of the items and the readability, clarity and ambiguity of the questionnaire. The results obtained were used in the revision of the questionnaire.

The revised questionnaire has two sections which are knowledge and perception sections. The knowledge section consists of 22 items including knowledge of iron requirement during pregnancy (two-items), effects of anaemia on the mother and foetus (two-items), foods with high iron content (five-items), benefits of iron supplements (two-items), daily iron supplements consumption (four-items), factors that influence iron absorption (four-items) and side effects of iron supplements (three-items). The perception section comprises 16 items exploring negative beliefs about iron supplements. This questionnaire was then subjected to pilot/validation studies.

3.2.2.3 Conducting Pilot/Validation Studies

The validation study consisted of two parts. Validation Study 1 included item response theory (IRT) and exploratory factor analysis (EFA). Validation Study 2 which involved repeat IRT and confirmatory factor analysis (CFA) conducted to further evaluate and confirm the psychometric properties of the questionnaire.

3.2.2.3.1 Validation Study Location

Both Validation Study 1 and 2 were conducted at Obstetrics Clinic, Hospital USM. This hospital was chosen because it is one of the largest hospitals in Kelantan State, with various sub-speciality services and serves a high influx of patients.

3.2.2.3.2 Study Population

Validation Study 1 involved 124 pregnant women attended Obstetrics Clinic, Hospital USM from 1st June 2019 until 31st July 2019. Validation Study 2 was conducted from 1st

August 2019 to 30th September 2019 and also involved 124 pregnant women who did not participate in Validation Study 1.

3.2.2.3.3 Subject Criteria

Inclusion Criteria

- All pregnant women who came for an antenatal visit at Obstetrics clinic Hospital USM within the study period
- Able to understand the Malay language.

Exclusion Criteria

- Patient who has any known mental disorder
- Non-Malaysian citizen
- Patient who is illiterate

3.2.2.3.4 Sample Size

The minimum sample size of 1:3 ratio is required for EFA to produce a construct with relatively high factor loadings (Cattell R.B., 1978; Bujang M.A. *et al*., 2012). The sample size for EFA was calculated according to a 1:6 ratio for the 16 items in the perception section. Thus, the sample size required with an additional 30% non-response rate was 124. For test-retest reliability, the sample size was calculated using STATA 14.0 in which a minimum sample size required was 50. The minimum sample size for the IRT analysis

follows the sample size for EFA as no definitive sample size for IRT is known, although a previous study recommends 100 to 500 samples (Edelen M.O. & Reeve B.B., 2007). Conversely, 50 participants were invited for a test–retest analysis after two weeks of using the same questionnaire.

3.2.2.3.5 Sampling Method and Subject Recruitment

The participants were recruited according to systematic random sampling in which every third registered patient was invited to participate in this validation study. Only those who were not involved in Validation Study 1 were recruited to take part in Validation study 2.

3.2.2.3.6 Pilot/Validation Study Data Collection Method

Pregnant women attended Obstetrics Clinic Hospital USM for an antenatal visit within the stated period and meet the inclusion criteria were approached by the researcher and recruited into the study. The selected participants were explained regarding the objectives of the study, inclusion and exclusion criteria, procedure and expected benefits to participants. Pregnant women who gave written informed consent were given the questionnaire form, which took approximately 20 minutes to complete. The questionnaire would not identify the participants personally. The questionnaires were returned to the researcher on the same day at the end of the session and stickers were pasted on the pregnant women's antenatal book to indicate that they participated in our study and to avoid redundancy of participation.

3.2.2.3.7 Statistical Analysis

Statistical analysis for Validation Study 1: IRT and EFA

The statistical analysis was performed using R software version 4.0.2. R package *ltm* was used to perform the two-parameter logistic item response theory (2-PL IRT) analysis for the knowledge section, which consisted of unidimensional items with dichotomous responses (Rizopoulos D., 2006). The pre-defined acceptable values for difficulty index were between –3 to +3, and the acceptable values for the discrimination index were 0.35 to 2.5 (Baker F.B., 2001). The chi-square goodness-of-fit per item was used to assess the item fit individually. The assumption of unidimensionality was checked by modified parallel analysis (Baker F.B., 2001; Drasgow F. & Lissak R., 1983).

R package *psych* was used to perform the EFA for the perception section, which consisted of ordinal responses. The Kaiser–Meyer–Olkin measure of sampling adequacy (KMO) and Bartlett's test of the sphericity were utilised to evaluate the adequacy and suitability of the samples for factor analysis. A KMO value above 0.5 and a significant Bartlett's test ($p < .001$) indicates that the data are suitable for factor analysis (Field A., 2005). The EFA was performed using the principal axis factoring extraction method with oblimin rotation. The number of extracted factors were determined by scree plot inspection and eigenvalues > 1. The pre-defined acceptable factor loading value was > 0.4 (Stevens J.P., 2009). For internal consistency reliability, the acceptable Cronbach's alpha coefficient value was > 0.7 (Devellis R.F., 2012). For the reliability of each individual item, items with a corrected-item total correlation value of < 0.3 were removed. The ICC was employed to evaluate the level of test-retest reliability in this study. An ICC value

between 0.4 to 0.75 was considered acceptable, and such a value ≥ 0.75 is excellent (Rosner B., 2006).

Statistical analysis for Validation Study 2: Repeat IRT and CFA

R software version 4.0.2 was also used for the data analysis. The 2-PL IRT analysis, as explained in Validation Study 1 were repeated for the knowledge section. R package *lavaan* was used to perform CFA for the perception section. The model fitness was assessed according to the following indices with their respective cut-off values: X^2 *p*-value > 0.05; robust comparative fit index (CFI) and Tucker-Lewis fit index (TLI) ≥ 0.95; and robust root mean square error of approximation (RMSEA) and standardized root mean square residual (SRMR) ≤ 0.08 (Brown T.A., 2015; Schreiber J.B. *et al*., 2006). R package *semTools* was used to assess the composite reliability based on the Raykov's rho, with an acceptable value of ≥ 0.7 (Jorgensen T.D. *et al*., 2016; Raykov T., 2001).

3.2.2.3.8 Finalization of Research Questionnaire

The questionnaire was finalized according to the results of the validation study. The final questionnaire consists of four sections and 54 questions: (i) sociodemographic profile (8 items), (ii) obstetric characteristics and iron supplementation details (15 items), (iii) knowledge of oral iron consumption (18 items) (one item regarding the timing of oral iron intake was excluded from the validated questionnaire due to availability of the new type of iron supplement which best taken with meals), (iv) perception of oral iron consumption (13 items). The knowledge response was rated based on a three-point scale (True/False/Don't know). One mark was given for each 'Correct' answer, and zero marks were given for 'Wrong' or 'Don't know' answers. The knowledge rating ranged from 0 -

18. Based on the expert opinion of a senior obstetrician, nine items out of 18 were listed as the core items for determining the extent of knowledge of oral iron intake in pregnant women. Respondents who answered correctly to all of the core items were deemed to have good knowledge. For items in the perception section, the responses were based on a 5-point Likert scale (strongly agree/ agree/ unsure/ disagree/ strongly disagree). The range of perception score was between 13 - 65. This final questionnaire was distributed to conduct actual research.

3.3 Phase II (Conducting an Actual Research)

3.3.1 Study Design

Cross-sectional study using self-administered and validated questionnaires.

3.3.2 Study Location

This study was conducted at the Obstetrics Clinic, Hospital USM. Hospital USM is the main teaching hospitals for the undergraduate and postgraduate students of USM. With a total of 723 beds, it is one of the largest hospitals in Kelantan and referral centres for district hospitals in Kelantan. Due to the availability of complete medical facilities and various sub-speciality treatments offered, Hospital USM has a high influx of patients from different places surrounding Kelantan, including urban and rural areas. Thus, it is expected that they have different social backgrounds and cultural beliefs.

3.3.3 Study Population

3.3.3.1 Reference population: Pregnant women who live in Kelantan and neighbouring states

3.3.3.2 Source population: Pregnant women who registered and received treatment at Hospital USM

3.3.3.3 Target population: Pregnant women who attended Obstetrics Clinic, Hospital USM

3.3.3.4 Sampling Frame: Pregnant women who attended Obstetrics Clinic, Hospital USM during study duration (1st October 2019 until 27th February 2020)

3.3.4 Subject Criteria

3.3.4.1 Inclusion Criteria

- All pregnant women who came for an antenatal visit at Obstetrics clinic Hospital USM within the study period (1st October 2019 until 27th February 2020)
- Able to understand the Malay language.

3.3.4.2 Exclusion Criteria

- Patient who has any known mental disorder
- Non-Malaysian citizen
- Patient who is illiterate

3.3.5 Sample Size

The sample size estimation was done in accordance with objectives.

Objective 1:

To assess the knowledge of pregnant women of oral iron consumption

The objective's estimated sample size was based on 5% precision and 95% confidence level, using single proportion calculation where 40% of the population had adequate knowledge (Sonkar V.K. *et al*., 2017).

Single proportion: $n=(z/\Delta)^2 p(-p)$

n = sample size

z = z statistic for a level of confidence = 1.96 (95% confidence interval)

p = expected prevalence or proportion (in proportion of one; if 100%, p = 1)

Δ = precision (in proportion of one; if 5%, $\Delta = 0.05$)

Where,

$n = (1.96/0.05)^2 \times 0.4 (1- 0.4)$

n = 368 + 10% non-response rate = 405

A minimum sample size of 405 was needed for this objective.

Objective 2:

To determine the perception of pregnant women of oral iron supplementation

The estimated sample size for this objective was based on 5% precision and 95% confidence level, using single proportion calculation where 79.7% of the population had positive perception (Triharini M. *et al*., 2018).

Single proportion: $n=(z/\Delta)^2 p(1-p)$

n = sample size

z = z statistic for a level of confidence = 1.96 (95% confidence interval)

p = expected prevalence or proportion (in proportion of one; if 100%, p = 1)

Δ = precision (in proportion of one; if 5%, $\Delta = 0.05$)

$n = (1.96/0.05)^2 \times 0.8 (1-0.8)$

n = 245 + 10% non-response rate = 269

A minimum sample size of 269 was needed for this objective.

Objective 3:

<u>To determine the association between associated factors of pregnant women and knowledge score of oral iron consumption</u>

The estimated sample size for this objective was calculated based on comparing two proportion formula. The calculation is based on a study by Ghimire N. *et al*., 2013 in which 50.8% of pregnant women with age below 30 years and 33.3% of pregnant women with age 30 years and above had adequate knowledge, respectively (Ghimire N. *et al*., 2013).

Two proportions:

$n=[[p_1(1-p_1) + p_2(1- p_2)]/ (p_1- p_2)] (Z_\alpha + Z_\beta)^2$

n=sample size

p_1= proportion of the associated factor among high risk group

p_2= proportion of the associated factor among low risk group

Z_α= 1.96 for α=0.05 (two tailed) or 2.58 for α=0.01 (two tailed)

Z_β= 0.84 for 80% power or 1.28 for 90% power

Where,

N=calculated sample size

p_1=proportion of pregnant women aged below 30 years with adequate knowledge= 0.51 (Ghimire *et al*., 2013)

p_2= proportion of pregnant women aged 30 and above with adequate knowledge= 0.33 (Ghimire *et al*., 2013)

Z_α= 1.96 for α=0.05 (two tailed)

Z_β= 0.84 for 80% power

$n= [[0.51 (1-0.51) + 0.33 (1-0.33)] /(0.51-0.33)] \times (1.96+0.84)^2$

n=20 + 10% drop out

n=22, 22 x 2 = 44

A minimum sample size of 44 was needed for this objective.

Objective 4:

To determine the association between associated factors of pregnant women and perception score of oral iron consumption

There was a lack of study investigating the association between associated factors of pregnant women and perception score of oral iron supplementation to the best of my knowledge. Hence, sample size for objective four was not calculated due to lack of a reference from the literature.

The largest sample size was from **Objective 1, n=405.** Hence, the minimum sample size required was 405.

3.3.6 Sampling Method and Subject Recruitment

The sampling method used was systematic random sampling in which every second registered pregnant women at Obstetrics Clinic, Hospital USM was recruited.

3.3.7 Research Tool

The research tool used in this study was a self-administered, structured and validated questionnaire which was developed in the Malay language. The development and validation of the questionnaire were extensively described in Phase I of the study. The questionnaire consisted of 54 questions which were divided into four sections: (i) sociodemographic profile (ii) obstetric characteristics and iron supplementation details (iii) knowledge and (iv) perception of oral iron supplementation. The research tool is attached in Appendix I.

3.3.8 Data Collection Method

Pregnant women attended Obstetrics Clinic Hospital USM for an antenatal visit within the stated date and meet the inclusion criteria were approached by the researcher or research assistant and recruited into the study. Those who were illiterate, non-Malaysian citizen and/or had any mental disorder were excluded from this study. The selected participants were explained regarding the objectives of the study, inclusion and exclusion criteria, procedure and expected benefits to participants. Pregnant women who understood the Malay language and gave written informed consent were given the questionnaire. Participants were allowed to ask the researcher or research assistant if there was any unclear question. The name of the participants would not be cited in the questionnaire to ensure anonymity. On average, each questionnaire took approximately 20 minutes to complete. The questionnaires were returned to the researcher or research assistant on the same day at the end of the session and stickers were pasted on the pregnant women's antenatal book to indicate that they participated in our study and to avoid redundancy of participation. The participants were allowed to withdraw from the study at any point during the session, and they had been assured that failing to return the questionnaire would not affect their treatment and antenatal care.

3.3.9 Statistical Analysis

Data entry and analysis were performed using International Business Machine corporation (IBM) Statistical Package for the Social Sciences (SPSS) version 26.0 (SPSS, Chicago, IL). The sociodemographic profile, pregnancy characteristics, iron supplementation details, knowledge and perception of the pregnant women were analysed and presented as descriptive data. The data were presented as frequency (percentage) for