EVALUATION OF OUTCOME OF NUTRITION EDUCATION ON KNOWLEDGE, ATTITUDE, AND PRACTICE OF IRON DEFICIENCY ANAEMIA AMONG PREGNANT WOMEN IN NILGIRIS DISTRICT, TAMIL NADU

A THESIS SUBMITTED TO

THE UNIVERSITY OF TRANS-DISCIPLINARY HEALTH SCIENCES AND TECHNOLOGY

FOR THE PARTIAL FULFILLMENT OF THE AWARD OF THE DEGREE OF M.Sc. LIFE SCIENCES (AYURVEDA BIOLOGY)

BY

DR. SANDRA DAS

UNDER THE GUIDANCE OF

DR. PRAKASH BN

Associate Professor, Centre for Community Health,
Clinical Research and Education
TDU, # 74/2, Jarakabande Kaval, Attur post,
Via Yelahanka, Bengaluru – 560 064

NOVEMBER 2022 - JUNE 2023

THE UNIVERSITY OF TRANS-DISCIPLINARY HEALTH SCIENCES AND TECHNOLOGY
Private University Established in Karnataka by ACT 35 of 2013
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BENGALURU - 560064

DECLARATION BY THE CANDIDATE

I declare that this thesis "**Evaluation of outcome of nutrition education on Knowledge, Attitude, and Practice of Iron deficiency anaemia among pregnant women in Nilgiris district Tamil Nadu**" submitted for the award of Master of Science to THE UNIVERSITY OF TRANS-DISCIPLINARY HEALTH SCIENCES AND TECHNOLOGY, Bengaluru, is my original work, conducted under the supervision of Dr. Prakash BN. I confirm that no part of the work reported herein has been submitted for a degree or examination at any other university. References, funding, and material obtained from other sources have been duly acknowledged, and no part of this dissertation has been plagiarised.

Place: Bengaluru **Signature of the Candidate**

Date: 15.06.2023

Name of candidate: Dr. Sandra Das
Reg. No.: 2021MSCAB11

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Private University Established in Karnataka by ACT 35 of 2013
BENGALURU - 560064

CERTIFICATE FROM THESIS SUPERVISOR/S

This is to certify that the work incorporated in this thesis **"Evaluation of outcome of nutrition education on Knowledge, Attitude and Practice of Iron deficiency anaemia among pregnant women in Nilgiris district, Tamil Nadu"** submitted by Dr. Sandra Das was carried out under my supervision. No part of this thesis has been submitted for a degree or examination at any other university. References, help and material obtained from other sources have been duly acknowledged. I confirm the originality of the work and that there is no plagiarism in any part of the thesis.

Name, Designation	Role	Signature & Date
Dr. Prakash. BN Associate Professor, Centre for Community Health, Clinical Research and Education	**Supervisor**	

ACKNOWLEDGEMENT

I would like to extend my sincere gratitude to the people and institutions listed below who made a significant contribution to the completion of this thesis:

Prior to anything else, I want to express my sincere gratitude to my supervisor, Dr. BN Prakash, for his outstanding direction, unwavering support, and priceless insights throughout the entire research process. His knowledge, support, and mentorship have been crucial in helping me refine my research and improve my academic abilities. I consider myself extremely fortunate to have had his advice and ongoing support.

I am incredibly appreciative of my supportive family's unwavering love, unending support, and unwavering faith in my abilities. They have consistently encouraged and strengthened me, giving me the fortitude to face obstacles and work towards my academic objectives.

I am deeply indebted to the ASHA workers, VHOs (Village Health Organizers), Anganwadi workers, and MO of Kattabettu PHC for their invaluable assistance, cooperation, and collaboration during the data collection phase of this study. Their dedication, expertise, and willingness to share their insights have significantly contributed to the successful implementation of this research.

I want to thank the MSc program's class coordinators Dr. Megha and Dr. Vishnu Prasad for their direction, assistance, and coordination. My educational experience has been significantly improved by their dedication to fostering a positive learning environment and offering helpful resources and opportunities for academic growth.

I am grateful to the participants of this study for their willingness to share their knowledge, experiences, and time. Their contributions have been instrumental in shaping the findings of this research and have added depth and richness to the study. I would also like to express my appreciation to the RIST project for the support in providing funding that has been crucial for the successful completion of this thesis. Finally, I would like to express my gratitude to all my friends and coworkers who have supported me, given me guidance, and helped me with the research. Your help has been extremely valuable. In conclusion, without the assistance and contributions of the people and organizations mentioned above, this thesis would not have been able to be finished. This thesis has only been possible because of their confidence in my abilities, their direction, and their readiness to lend a helping hand.

Thank you all for your unwavering support, encouragement, and collaboration. I am truly grateful for the impact each one of you has had on my academic journey and the successful completion of this thesis.

DEDICATION

I dedicate this dissertation with utmost gratitude and deep appreciation to my exceptional supervisor, Dr. BN Prakash. His unwavering guidance, expert knowledge, and tireless commitment have been instrumental in shaping the trajectory of this research work. Throughout this academic journey, his mentorship has been invaluable in refining my research skills, expanding my understanding of the subject matter, and honing my analytical abilities.

I consider myself extremely fortunate to have had the opportunity to work under his direction. He has continuously pushed me to strive for excellence and go beyond the limits of my abilities with their unwavering support, tolerance, and constructive criticism. His astute advice and unfailing support have helped me advance, giving me faith in my skills and igniting my passion for research.

I am immensely grateful for the countless hours he has dedicated to providing valuable insights, fostering critical thinking, and nurturing intellectual curiosity. His mentorship has not only shaped this research endeavor but has also had a profound impact on my overall academic and personal growth.

Additionally, I would like to express my gratitude for his availability, approachability, and willingness to offer assistance even at the busiest times. He has been constant sources of inspiration and motivation because of his unwavering dedication to my academic advancement and belief in my potential.

I am deeply indebted to my supervisor for his unwavering dedication, his relentless pursuit of excellence, and their unwavering commitment to the advancement of knowledge. His guidance and support have been transformative, and this dissertation is a testament to his mentorship and expertise.

I would like to express my sincere gratitude to my supervisor for his unwavering support, academic guidance, and unwavering belief in my capabilities. His advice and mentoring have been crucial in forming both this study and me as a researcher. I want to express my gratitude for your exceptional commitment, mentorship, and inspiration.

SUMMARY

The most prevalent nutritional deficiency-related issue that many pregnant women experience worldwide is iron deficiency anaemia (IDA), which is a serious health concern. Given that it is associated with a lack of the proper knowledge, attitude, and practice (KAP) on anaemia, it may be preventable. The aim of this study was to evaluate the outcome of a nutrition education program on change in the KAP on IDA of pregnant women in Nilgiris, Tamil Nadu. A prospective, interventional, single-arm, pre-post study was conducted involving 41 pregnant women in Nilgiris district. Socio-demographic, economic status data and KAP on IDA were collected using a semi structured questionnaire through Epicollect5 android application. Six weeks of nutrition education was conducted with the participants. The result revealed that the participants had limited adequate knowledge (31.7%), positive perception (40.2%) and healthy practices (42.1) about anaemia. Nutrition education intervention significantly improved knowledge scores (91.6%, $p \leq 0.05$), with a notable increase in understanding of anaemia causes, consequences, and preventive measures. Attitudes (72%, $p \leq 0.05$) and Practice (47.6% $p \leq 0.05$) towards anaemia prevention and treatment also showed improvement. It can be concluded that structured nutritional educational intervention effectively enhances knowledge, attitude, and practice regarding IDA among pregnant women, thereby potentially contribute to improve health outcomes for both mothers and infants. Further research is recommended to assess the long-term sustainability and effectiveness of the intervention, as well as its impact on anaemia prevalence rates in the study population.

The study underscores the significance of incorporating nutrition education into healthcare policies and practices to address the burden of anaemia among pregnant women effectively.

PERSONAL REFLECTION

During the course of conducting this study, I had the opportunity to learn and apply a wide range of research techniques and methodologies. I learnt to conduct community studies in rural settings by applying standard methodologies starting from protocol development, requirements of approval, implementation of research study in the rural community, communication in the local language, data analysis etc. Additionally, I familiarized myself with various tools and software such as Mendeley, Epicollect5 app, and Epi Info, which proved invaluable for data management and analysis.

Developing questionnaires for baseline and endline data collection was a crucial aspect of the research process. I gained hands-on experience in designing and structuring questionnaires to capture relevant information. This involved selecting appropriate question formats, ensuring clarity and coherence of the questions, and incorporating relevant scales or response options.

Through the development of these questionnaires, I deepened my understanding of the key concepts and factors related to iron deficiency anaemia and its management. It allowed me to critically evaluate the existing literature, identify relevant variables, and formulate questions that would capture the necessary information to assess the impact of the intervention accurately. This process honed my skills in survey design, questionnaire development, and the importance of clarity and relevance in data collection instruments.

Furthermore, I had the privilege of obtaining a Good Clinical Practice (GCP) certificate from the National Institute on Drug Abuse (NIDA), (https://gcp.nidatraining.org/certification) which provided me with a comprehensive understanding of clinical research, design, ethical aspects, protocols, and requirement of. This certification not only added credibility to my work but also instilled in me a sense of responsibility and adherence to ethical standards in research.

Developing the study protocol and creating study materials were pivotal experiences that enriched my understanding of the research process. It allowed me to delve into the intricacies of study design, data collection tools, and implementation strategies. These tasks challenged me to think critically, plan meticulously, and consider potential limitations and ethical considerations. The whole process equipped me to get the approvals of the Scientific Advisory Committee, Institutional Ethics Committee and CTRI registration.

One of the most valuable aspects of this research journey was the development of my social skills, particularly in communicating and interacting with people. Through engaging with study participants, healthcare professionals, and colleagues, I honed my ability to effectively communicate research objectives, explain the study procedures in simple local language, and address any concerns or questions. These interactions not only facilitated the smooth execution of the study but also enhanced my interpersonal skills and ability to collaborate with diverse individuals.

Overall, this research journey has been a transformative experience that has not only expanded my knowledge in the field of nutrition and anaemia but also equipped me with essential research skills and personal growth. I am grateful for the opportunity to have acquired new techniques, enhanced my social and communication skills, obtained a GCP certificate, and contributed to the development of study materials. These experiences have undoubtedly prepared me for future research endeavors and have solidified my passion for making meaningful contributions to the field of public health.

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1) INTRODUCTION

Anaemia is a medical condition characterized by an insufficient number of red blood cells or a deficiency of haemoglobin within them. Red blood cells and haemoglobin play vital roles in the transportation of oxygen throughout the body. When there is a deficiency of either red blood cells or haemoglobin, the blood's capacity to deliver oxygen to the body's tissues becomes compromised. This can result in various symptoms, including fatigue, weakness, dizziness, and shortness of breath, among others. The ideal haemoglobin concentration required to meet physiological needs varies depending on factors such as age, sex, elevation of habitation, smoking habits, and pregnancy status. Inadequate or malformed red blood cells, insufficient haemoglobin levels, or a combination of both contribute to the development of anaemia. One of the most prevalent causes of anaemia is nutritional deficiencies, with iron deficiency being particularly common (WHO, 2023).

1.1) Iron Deficiency Anaemia

Iron deficiency anaemia (IDA) arises when the body experiences insufficient levels of iron, which is an essential component for the production of haemoglobin. Haemoglobin, found within red blood cells, is responsible for binding and transporting oxygen throughout the body. When there is a lack of iron, the body's ability to produce an adequate amount of haemoglobin is compromised, leading to the development of IDA. Our diets provide the body with the majority of its iron needs. But one of the most frequent causes of IDA is insufficient dietary iron intake. Some people may not consume enough iron-rich foods in their diets, such as red meat, poultry, fish, legumes, and leafy green vegetables, which are essential dietary sources of iron. A lack of the iron required to produce haemoglobin can occur if these iron-rich foods are not consumed in sufficient amounts. Additionally, issues with iron absorption can contribute to IDA. Even if an individual consumes an adequate amount of dietary iron, certain conditions or factors can hinder its absorption in the body. Conditions like celiac disease, inflammatory bowel disease, or surgical removal of parts of the digestive tract may impair the absorption of iron, leading to a deficiency over time. Another significant cause of iron deficiency anaemia is blood loss, which can result in iron depletion. Menstruation, especially heavy or prolonged menstrual bleeding, can lead to significant iron loss in women. Similarly, bleeding from the gastrointestinal tract due to conditions such as peptic ulcers, colorectal cancer, or gastrointestinal disorders can cause chronic blood loss and subsequent iron deficiency. Iron deficiency anaemia can also be caused by specific medical conditions. For instance, kidney failure can impact the body's capacity to make and regulate erythropoietin, a hormone crucial for promoting the production of red blood cells. Inflammation, which is frequently linked to long-term conditions like systemic lupus

erythematosus or rheumatoid arthritis, can impair the metabolism and utilization of iron, resulting in an iron deficiency. (Abu-Baker et al., 2021; Mahanta et al., 2015)

1.2) Anaemia in Women

Anaemia has a profound effect on a woman's ability to procreate and on the health of her unborn child, with serious repercussions. Due to the combination of increased iron requirements during pregnancy and menstrual iron loss, women are more likely than men to develop anaemia. A sufficient supply of iron is required for both the mother and the growing fetus because the requirements for iron during pregnancy are roughly twice as high as those in the non-pregnant state. Anaemia has been estimated to be the cause of about 20% of maternal fatalities worldwide (Sunuwar et al., 2019). This emphasizes how serious the condition is and how it affects maternal health. An estimated 50% of all maternal deaths are caused by anaemia, which is a significant contributor to the problem (Parker et al., 2012). These figures highlight the urgent need for efficient interventions to manage and prevent anaemia in pregnant women. Several studies have identified anaemia as a risk factor for adverse outcomes during pregnancy and childbirth (Kulkarni, 2015; Mahanta et al., 2015; Parker et al., 2012; Sinha et al., 2021). Anaemia increases the likelihood of intrauterine fetal death, premature birth, low birth weight, and other adverse neonatal outcomes. Inadequate oxygen delivery to the fetus due to reduced hemoglobin levels can impair fetal growth and development, leading to complications and negative outcomes. Intrauterine fetal death refers to the unfortunate occurrence of fetal death within the uterus before the onset of labor. Research has shown that anaemia increases the risk of intrauterine fetal death, underscoring the importance of addressing and managing anaemia during pregnancy to safeguard fetal well-being. Women with anaemia are more likely to experience premature birth, which is the delivery of a child before the completion of 37 weeks of gestation. The link between anaemia and premature birth emphasizes the significance of early anaemia detection and treatment to reduce the risk of preterm delivery and the complications that go along with it. Maternal anaemia is closely related to low birth weight, which is defined as a birth weight of less than 2,500 grams. Inadequate iron levels in the mother can lead to restricted fetal growth, resulting in a lower birth weight. Comprehensive anaemia prevention and management strategies during pregnancy are essential because low birth weight babies are more likely to experience a range of health problems and developmental difficulties. These findings underscore the critical role of addressing and managing anaemia in pregnant women (Anuradha guptha et al., 2013; Kulkarni, 2015; Mahanta et al., 2015; Parker et al., 2012; Sari et al., 2022; Sinha et al., 2021).

1.3) Prevalence of Anaemia

According to the National Family Health Survey 5 (NFHS-5), the prevalence of anaemia among non-pregnant women aged 15-49 years is 57.2%. This indicates that more than half of non-pregnant women in this age group are affected by anaemia. In comparison, the previous survey, NFHS-4, reported a prevalence rate of 53.2% among non-pregnant women, showing a slight increase in anaemia prevalence over time. According to NFHS-4 data, anaemia is reported to be 50.4% common among pregnant women aged 15 to 49 (Table 1.1). However, the prevalence increased by 1.8% in the more recent NFHS-5 survey, reaching 52.2% among pregnant women. These statistics emphasize the ongoing problem of anaemia among pregnant women and the demand for supportive interventions and solutions (MoHFW, 2021).

Table 1.1: Prevalence of anaemia

Sl. No.	Indicators	NFHS-4 (2015-16)	NFHS-5 (2019-21)
1	Non-pregnant women age 15-49 years who are anaemic (<12.0 g/dl) (%)	53.2	57.2
2	Pregnant women age 15-49 years who are anaemic (<11.0 g/dl) (%)	50.4	52.2
3	All women age 15-49 years who are anaemic (%)	53.1	57

The World Health Organization (WHO) provides guidelines for categorizing the severity of anaemia during pregnancy based on hemoglobin (Hb) levels (WHO, 2023). Hemoglobin levels less than 11.0 g/dL are considered indicative of anaemia during pregnancy (Table 1.2). Anaemia during pregnancy can be further classified into three severity levels (Okia et al., 2019).

Table 1.2: Anaemia category in pregnant women (WHO criteria)

Sl. No.	Category	Hb range
1	Mild anaemia	9.0 to 10.9 g/dL.
2	Moderate anaemia	7.0 to 8.9 g/dL.
3	Severe anaemia	< 7.0 g/dL.

These severity levels help to assess the impact and seriousness of anaemia during pregnancy, guiding appropriate management strategies and interventions.

1.4) WHO Strategies for Anaemia Management

Diet diversification, food fortification, and supplementation are three key recommendations by the World Health Organization (WHO) to combat anaemia in the Indian population (WHO, 2023). Implementing these recommendations requires effective nutrition education targeted towards the anaemic population.

a) **Diet diversification**: Promoting diet diversification involves encouraging individuals to consume a variety of nutrient-rich foods. In the context of anaemia, it is essential to emphasize the inclusion of iron-rich foods in the diet. This includes promoting the consumption of foods such as lean meats, poultry, fish, legumes, nuts, seeds, fortified cereals, and leafy green vegetables, which are excellent sources of dietary iron. Nutrition education plays a vital role in creating awareness about the importance of a diversified diet and providing practical guidance on incorporating these foods into daily meals.

b) **Food fortification**: Food fortification involves the addition of specific nutrients, such as iron, to commonly consumed food products. Fortification can be implemented in staple foods like rice, wheat flour, salt, and cooking oils. Iron-fortified foods provide an opportunity to increase iron intake among the population, including individuals who may have limited access to a diverse range of food sources. Nutrition education plays a crucial role in creating awareness about the benefits of consuming fortified foods and informing individuals about the availability and utilization of such products in their daily diet.

c) **Supplementation**: Supplementation involves the provision of iron or iron-containing supplements to individuals at risk of or diagnosed with anaemia. Pregnant women, in particular, often require iron supplementation to meet the increased demands during pregnancy. Supplementation programs may also target other vulnerable groups, such as young children and women of reproductive age. Effective nutrition education is essential to ensure proper understanding of the supplementation guidelines, including dosage, timing, and potential side effects. It can also address common misconceptions and encourage adherence to the supplementation regimen.(Anuradha guptha et al., 2013)

1.5) Nutrition Education

Effective implementation of these three recommendations depends heavily on nutrition education. It can encourage the use of fortified foods, increase awareness of the value of a balanced and varied diet, and inform people about specific food sources that are high in iron. Nutrition education can also address dietary preferences, cultural beliefs, and obstacles to accessing and consuming nutrient-rich

foods. It equips people with the knowledge and practical skills they need to make wise decisions, which leads to better dietary habits and, in turn, helps prevent and manage anaemia. By integrating nutrition education into public health programs, healthcare systems, and community interventions, the three recommendations of diet diversification, food fortification, and supplementation can be effectively communicated, understood, and implemented, leading to a significant reduction in anaemia prevalence and improved health outcomes.

1.6) Anaemia Mukth Bharath

The government of India has implemented several programs and initiatives to address the issue of anaemia, recognizing its significant impact on public health. Among these initiatives, "Anaemia Mukth Bharath" (AMB) stands out as a comprehensive program aimed at achieving an anaemia-free nation and improving the overall well-being of the population.

AMB is an initiative in India spearheaded by the government which aims to combat anaemia and create an "Anaemia-Free India." The program's main goal is to put comprehensive prevention and control measures in place for anaemia in a variety of population groups, especially women and children.

A) **Objective**: The primary objective of "Anaemia Mukth Bharath" is to reduce the prevalence of anaemia in India and improve the overall health and well-being of the population, especially women and children. The initiative aims to create awareness, provide effective interventions, and monitor progress in combating anaemia.

B) **Target Population**: The initiative specifically targets populations that are more prone to anaemia, such as pregnant women, lactating mothers, infants, kids, and adolescents. It acknowledges the need for various approaches and interventions that are tailored to the particular demands of each group.

C) **Key Strategies and Interventions**: "Anaemia Mukth Bharath" adopts a multi-sectoral approach involving healthcare providers, community workers, and government agencies to implement the following strategies and interventions:

   a) Iron and Folic Acid Supplementation: The program promotes the regular and timely provision of iron and folic acid supplements to pregnant women and other vulnerable groups to meet their increased iron requirements.

   b) Antenatal Care: It stresses the value of routine antenatal examinations and encourages expectant mothers to go to prenatal care clinics where they can get crucial health advice, iron and folic acid supplements, and haemoglobin levels checks.

c) Dietary Diversity and Nutrition Education: The initiative focuses on promoting dietary diversity and improving nutrition education. It encourages individuals, especially women, to consume a balanced diet that includes iron-rich foods and educates them on meal planning, food preparation, and the benefits of proper nutrition.

d) Food fortification: "Anaemia Mukth Bharath" supports and encourages the addition of vital micronutrients, such as iron, to common foods like rice, wheat flour, salt, and cooking oils. Foods that have been fortified offer the populace an additional source of nutrients, assisting in the treatment of anaemia.

e) Behavior Change Communication: The program employs various communication channels, including mass media campaigns, community mobilization, and interpersonal communication, to raise awareness about anaemia, its causes, prevention, and available services. It aims to bring about positive behavior change related to diet, health-seeking behavior, and adherence to interventions.

D) **Monitoring and Evaluation**: The "Anaemia Mukth Bharath" initiative emphasizes the importance of robust monitoring and evaluation systems to track progress, measure the impact of interventions, and make informed decisions for program improvement. Regular assessment of haemoglobin levels, health indicators, and program coverage helps identify gaps and guide targeted interventions.

E) **Collaboration and Partnership**: The initiative acknowledges the importance of working together and forming partnerships with other stakeholders, including NGOs, healthcare providers, and government agencies. To ensure a coordinated and successful response to anaemia, it encourages the active participation of numerous sectors.

The initiative "Anaemia Mukth Bharath" is crucial in addressing the high prevalence of anaemia in India. The initiative aims to significantly lower anaemia rates, improve population health generally, and contribute to the goal of a healthier and anaemia-free India by implementing comprehensive strategies, increasing awareness, and offering targeted interventions(AMB, 2019).

1.7) Literature Review: Nutrition Education and Anaemia

It has been observed in earlier studies that nutrition education to anaemic patients has played significant role in improving their knowledge, attitude and practice towards anaemia and its management (Sunuwar et al., 2019; Upadhyay S et al., 2011). For instance, a study conducted among 363 adolescent school-going female students in Jordan found that those who received one month of nutrition education intervention (n=194) showed significantly higher total scores in knowledge,

attitude, and practice compared to the control group (n=169). The difference in scores between the intervention and control groups was statistically significant ($p<0.05$) (Abu-Baker et al., 2021). Similarly, a randomized control trial (RCT) conducted in the Gaza Strip, Palestine, involved 89 girls aged 15-19 years. The intervention group attended nutrition education lectures for three months, while the control group did not receive any specific intervention. The results of the pre-post-test assessment showed significant improvements in knowledge scores ($p < 0.001$), positive attitude scores ($p < 0.001$), and the adoption of desired practices ($p < 0.002$) in the intervention group (Ghosh et al., 2022). This indicates that the nutrition education intervention had a positive impact on their knowledge, attitude, and practice regarding anaemia and its management (Ghosh et al., 2022; Jalambo et al., 2017).

In a study conducted in Ghana, nutrition education was implemented as an intervention targeting pregnant women over a period of 10 weeks. The results indicated a significant improvement in the haemoglobin levels ($p = 0.002$) of the women in the intervention group compared to the control group (Sunuwar et al., 2019). This suggests that the nutrition education intervention positively influenced their iron status. Additionally, the intervention group showed a substantial increase in maternal nutritional knowledge scores ($p < 0.001$) related to anaemia and iron-rich foods. Similar to this, a study carried out in a rural hill region of India's Uttarakhand State sought to assess the influence of various media formats (Print media group: n=59, Multimedia group: n=53, Control group: n=111) on women's nutritional knowledge and haemoglobin status. The results showed that both the print media group and the multimedia group had significantly higher nutrition knowledge scores than the control group. This indicates that the participants' nutritional knowledge was positively impacted by their exposure to educational materials in various media formats (Upadhyay S et al., 2011).

These studies demonstrate how nutrition education interventions can raise haemoglobin levels and increase dietary knowledge in the targeted populations. Pregnant women and women living in rural areas can learn important information about anaemia, foods high in iron, and general nutrition by providing education through a variety of media channels, including print and multimedia. These results highlight the significance of utilizing a variety of accessible educational approaches to disseminate knowledge and enable people to make knowledgeable decisions about their nutritional practices.

1.8) Purpose of the study

Building upon the existing evidence from previous studies, the purpose of the present study is to assess the outcome of a nutrition education intervention on the knowledge, attitude, and practice (KAP) of

pregnant women regarding iron deficiency anaemia in the Nilgiris district of Tamil Nadu, India. The findings of previous research have demonstrated the positive effects of nutrition education interventions on various aspects related to anaemia, such as haemoglobin levels, nutritional knowledge, and adoption of healthy practices. However, it is important to recognize that the effectiveness of interventions can vary across different populations and contexts. Therefore, conducting a study in a specific region, such as the Nilgiris district in Tamil Nadu, might provide valuable insights into the local dynamics and enable a tailored approach to addressing the issue of iron deficiency anaemia among pregnant women.

The objective of this study was to evaluate the outcome of the nutrition education intervention on the KAP of pregnant women by assessing the participants' knowledge on iron deficiency anaemia, its causes, consequences, and management strategies. Additionally, it also explored their attitudes towards anaemia, including perceptions, beliefs, and cultural factors that may influence their practices related to iron-rich foods and supplements. With this study, a comprehensive understanding of the impact of nutrition education on the KAP of pregnant women in the Nilgiris district was obtained. The findings of the study might contribute to the existing body of knowledge on effective strategies to combat iron deficiency anaemia in this specific population. Moreover, the study would inform the development of targeted interventions and recommendations for improving the nutritional status and overall well-being of pregnant women in the region. It is important to note that the present study was conducted within a specific timeframe, utilizing appropriate research methodologies, data collection instruments, and analysis techniques to ensure the reliability and validity of the findings.

Overall, this study holds significant potential to contribute to the field of nutrition and public health by providing evidence-based insights into the effectiveness of nutrition education interventions in improving the KAP of pregnant women regarding iron deficiency anaemia in the Nilgiris district of Tamil Nadu.

2) MATERIALS AND METHODS

2.1) Study area

The word "Nilgiris" is derived from the words "Neelam" (blue) and "giri" (hill or mountain). The Silappadikaram contains the earliest record of this name. There is a theory that the Nilgiris name should have been given by the inhabitants of the plains at the base of the hills due to the recurring violet blooms of the "kurinji" flower. The Nilgiris, one of the oldest mountain ranges, is situated where Tamil Nadu, Kerala, and Karnataka converge. The three hill stations in this district are Ooty, known as the "Queen of Hill Stations," Coonoor, and Kotagiri. With a population of 7,35,394 people, 3,75,251 of whom are women, it is a portion of the western ghats. Scheduled Castes and Scheduled Tribes accounted for 32.08% and 4.46% of the population, respectively (The government of Tamil Nadu, 2023). Toda, Kota, Kurumbas, Irulur, Paniyan and Kattunayakan are the six primitive tribes recognized by government and residing in Nilgiris. The six taluks that make up the Nilgiris District are Udhagamandalam, Kundah, Coonoor, Kotagiri, Gudalur, and Pandalur. These taluks are divided into two municipalities, Wellington Contonment and Aruvankadu Township, as well as four Panchayat Unions: Udhagamandalam, Coonoor, Kotagiri, and Gudalur. There are 15 Revenue Firkas and 88 Revenue Villages in the District. In this district, there are three revenue divisions: Udhagai, Coonoor, and Gudalur. In this District, there are 11 Town Panchayat and 35 Village Panchayat (The government of Tamil Nadu, 2023). In the Nilgiris District, Kotagiri, also known as Kothagiri, is a taluk and a panchayat town. The "Kota" tribes have traditionally lived in the Nilgiris Hills. "Mountain of the Kotas" is the literal meaning of the name "Kota-giri."

In Nilgiris, 44.2% of women of age 15-49 years are anaemic according to NFHS 5 report and **30.5% of pregnant women age 15-49 years are anaemic** (NFHS-4)(MoHFW, 2021).

The study was conducted among pregnant women in 6 selected villages under Kattabattu PHC of Kotagiri taluk in Nilgiris district, Tamil Nadu.

Image 2.1: The map of Nilgiris district

2.2) Study design

This is a prospective, interventional design with a single-arm pre-post assessment. It is having a mixed-methods approach, incorporating both qualitative and quantitative research methods to comprehensively evaluate the impact of a nutrition education intervention on the knowledge, attitude, and practice of iron deficiency anemia (IDA) among pregnant women in the Nilgiris district, Tamil Nadu.

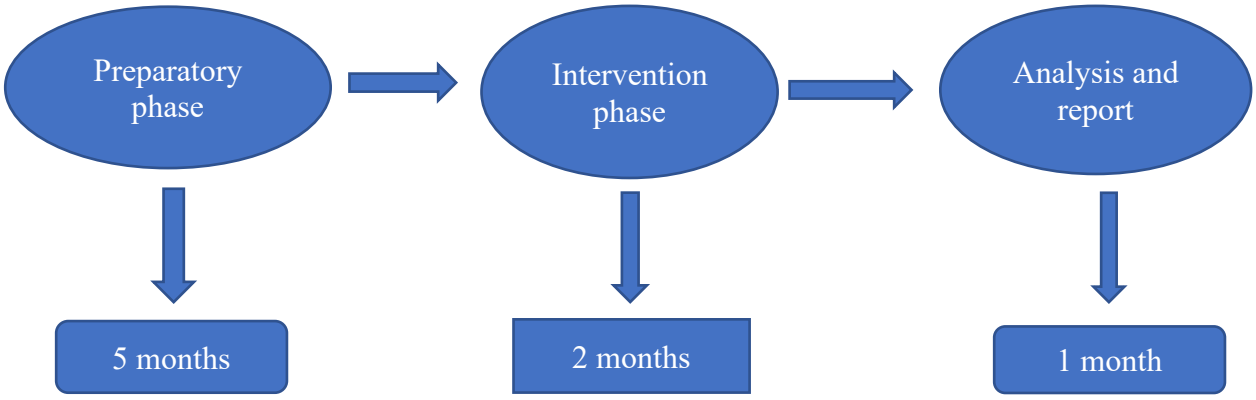
2.3) Study duration

The eight-month duration of the entire study (November 2022 to June 2023) was chosen to evaluate how the nutrition education intervention affected pregnant women's knowledge, attitudes, and practices regarding iron deficiency anaemia.

A series of interactive sessions and counselling sessions were held throughout the two-month nutritional educational intervention period to improve the participants' understanding of iron deficiency anaemia and encourage healthier eating habits. The remaining five months of the study were dedicated to the pre-intervention and post-intervention data collection phases, which included baseline assessments, follow-up surveys, and evaluation of the sustained effects of the education program.

Based on prior research findings, the two-month length of the nutritional educational intervention was carefully chosen to give the participants enough time to absorb the information presented and implement the suggested dietary changes. Throughout the two-month period, frequent monitoring and feedback sessions were held to address any concerns or questions the pregnant women had in order to ensure the success of the nutritional education intervention.

Figure 2.1: Study process



2.4) Selection criteria

2.4.1) Inclusion criteria

i) Pregnant women of first and second trimester.

ii) Participants who are going to stay in the same village during the intervention period.

iii) Willing to provide written informed consent.

2.4.2) Exclusion criteria

Pregnant women who are in their third trimester was exempted from the study as they can't participate in the whole intervention period due to their nearby delivery date.

2.4.3) Withdrawal criteria

The participation in this study was purely voluntary and the participants had the right to withdraw from this study at any time during the course of the study without giving any reasons.

2.5) Sampling method

The population of this study included pregnant women who are in either first or second trimester living in six chosen villages near the Kattabattu Primary Health Centre (PHC), which is a part of the Nilgiris district's Kotagiri taluk. These villages were chosen because they offered a good representation of the local population and were convenient to collect data from.

Purposive sampling technique was used to select the pregnant women who met the inclusion criteria and exclusion criteria. The utilization of purposive sampling and the involvement of key healthcare professionals and local NGOs in the survey process strengthened the validity and reliability of the study findings, as it allowed for the inclusion of pregnant women who were representative of the selected villages and who could provide valuable insights into the research topic.

2.6) Sample size

Considering that this study was a pilot study, no formal sample size calculation was performed. 44 **pregnant women** who met the inclusion criteria within the study were chosen as a sample using a purposive sampling technique.

Since the study was designed as a pilot study, the focus was primarily on assessing the feasibility, methodology, and preliminary outcomes of the intervention. Therefore, the sample size of 44 pregnant women was chosen as a reasonable number to provide initial insights into the impact of the nutrition

education intervention on the knowledge, attitude, and practice of iron deficiency anemia among pregnant women.

The purposive selection of 44 pregnant women allowed for a targeted and focused examination of the intervention's effects within the limited scope of the pilot study. The sample size was determined based on practical considerations such as available resources, time constraints, and the anticipated ability to collect and analyze data effectively.

By carrying out the pilot study with this sample size, important knowledge could be gathered to guide the design and execution of potential future larger-scale studies. Before conducting a more in-depth study, the results and experiences from the pilot study may help to improve research techniques, identify obstacles, and inform changes to the intervention.

2.7) Ethical consideration

The study protocol (Appendix: 6.1) was prepared and obtained approval from the Scientific Advisory Sub Committee of TDU and Institutional Ethics Committee of TDU (Appendix: 6.2). The data collection began after obtaining approval from the Institutional Ethics Committee of TDU (Protocol number: TDU/IEC/13E/2023/PR50). Data were collected between April and May 2023. In the first meeting, the purpose and procedures of the study were explained, and the pregnant women were assured of voluntary participation, confidentiality of all provided data, and the ability to withdraw at any time, Informed consents were obtained from the participants before data collection.

2.8) Data collection

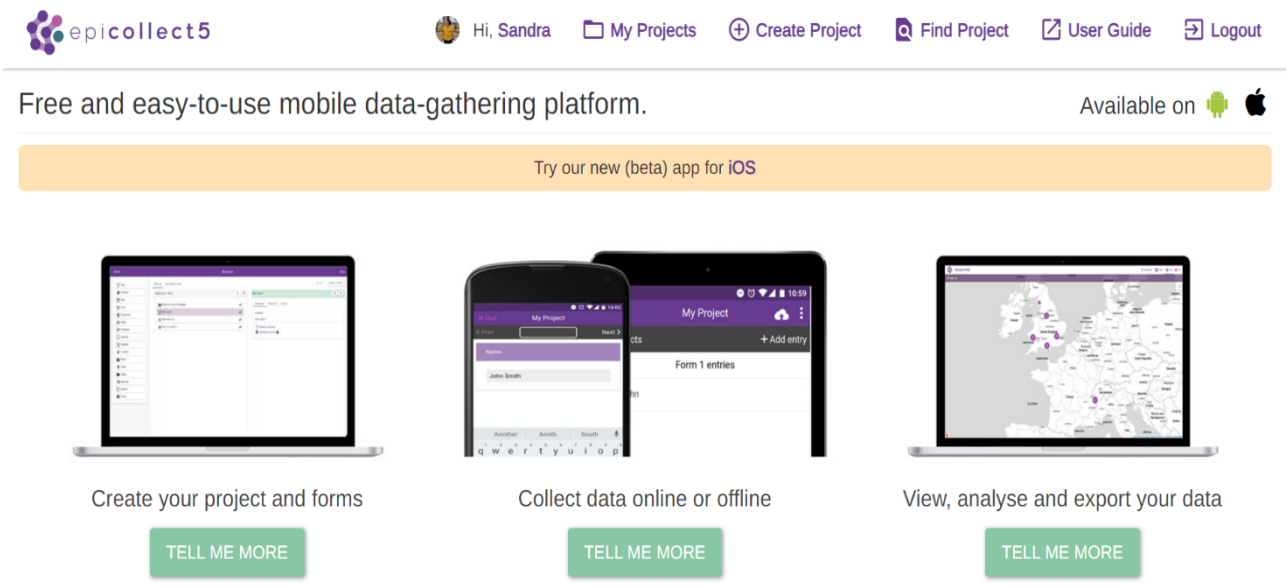
2.8.1) Baseline survey**:** At the commencement of the study, a comprehensive baseline survey was conducted to gather essential participant information and assess their knowledge, attitudes, and practices regarding anaemia and its management. This survey aimed to establish a benchmark against which the impact of the nutrition education intervention could be evaluated. A wide range of topics, including sociodemographic characteristics like age, education, occupation, and income, were covered in the baseline questionnaire with reference to Kuppuswamy's scale (Mohd Saleem, 2019). These elements shed light on the participants' backgrounds and allow for the investigation of potential relationships between socio-demographic factors and knowledge, attitude and practices related to anaemia.

Furthermore, the baseline survey included questions related to pregnancy history, capturing important details such as the number of previous pregnancies, birth outcomes, and any previous experiences with anaemia during pregnancy. This information helps in understanding the participants' prior exposure to anaemia and its management, which can influence their current knowledge and practices.

A semi-structured questionnaire was used to evaluate the participants' knowledge, attitudes, and practices regarding anaemia and its management. This carefully crafted questionnaire addresses important facets of anaemia, such as its causes, symptoms, effects, prevention, and treatment. Since the questionnaire was semi-structured, it was flexible to delve deeper into participants' responses, ensuring a thorough understanding of their knowledge, attitudes, and practices.

Epicollect5, an Android app, was used to facilitate effective data management and collection. The user-friendly interface of this app made data entry and synchronization simple, removing the need for manual data entry and lowering the likelihood of transcription errors. Epicollect5 was used, which simplified data collection and improved data accuracy and integrity. (https://five.epicollect.net/project/ida).

Image 2.2: Image of Epicollect 5 app



2.8.2) Follow up**:** Throughout the 6-week intervention period, regular follow-up assessments were conducted to monitor the participants' progress and evaluate the impact of the nutrition education intervention. These follow-up assessments aimed to capture changes in participants' haemoglobin levels and their adoption of locally available iron-rich foods in their diets.

Monthly monitoring was performed, during which the participants' medical records, specifically their Antenatal Care (ANC) cards, were checked to record any changes in their haemoglobin levels. The ANC cards serve as valuable sources of information, containing vital records of prenatal check-ups, laboratory test results, and other relevant medical data. By monitoring the participants' haemoglobin levels over time, the effectiveness of the nutrition education intervention in addressing iron deficiency anaemia (IDA) could be assessed.

In addition to monitoring haemoglobin levels, participants were also observed for their adaptation of locally available iron-rich foods in their diets. The intervention likely included education on identifying and incorporating nutritious, iron-rich foods that are easily accessible within the local community. By encouraging participants to adopt such dietary changes, the intervention aimed to improve their iron intake and mitigate the risk of IDA.

It's important to remember that the study's participants' health and wellbeing came first. During the follow-up assessments, if any participant displayed symptoms or signs of severe anaemia, they were advised to visit their obstetrician or a local hospital for a more thorough, standardized diagnosis and treatment. This referral made sure that participants with severe anaemia received prompt, specialized medical care that went above and beyond the intervention of the study.

By incorporating regular follow-up assessments, monitoring haemoglobin levels, tracking dietary changes, and facilitating appropriate healthcare referrals, the study aimed to comprehensively evaluate the impact of the nutrition education intervention on the participants' knowledge, attitudes, practices, and ultimately, their management of iron deficiency anaemia during pregnancy.

2.8.3) Endline survey: An endline survey of the participants was conducted after the 6-week intervention period to evaluate the result of the nutrition education intervention on their understanding of iron deficiency anaemia (IDA) and practices for managing it.

The endline survey aimed to evaluate the effectiveness of the nutrition education intervention by comparing the participants' knowledge, attitudes, and practices before and after the intervention. It provided an opportunity to measure any changes or improvements in their understanding of IDA, its causes, symptoms, consequences, prevention, and treatment.

During the endline survey, a semi-structured questionnaire was used to collect the required data. This questionnaire was carefully created to cover a variety of IDA-related topics, such as participant knowledge of the condition, their attitudes towards adopting iron-rich diets, and their routines for treating and preventing IDA.

To ensure efficient data collection and management, the Epicollect5 app was utilized for administering the endline survey.

2.9 Nutrition education program

The intervention package (Appendix: 6.3) consisted of nutrition education and anaemia-related knowledge. PowerPoint presentations and videos were used to present the educational material. The nutrition education component focused on the importance of nutrition during pregnancy. Participants received education on the significance of consuming a well-balanced diet that met their increased nutritional needs during this critical period. Information was provided on the specific nutrients required for a healthy pregnancy, including iron, which played a vital role in preventing anaemia. Participants learned about the sources of locally available iron-rich foods and were encouraged to incorporate them into their daily meals.

Image 2.3: Providing nutrition education to the participants

2.9.1) Nutrition education: The nutrition education component covered topics related to iron absorption. Participants learned about the factors that could enhance or inhibit iron absorption in the body. Practical information was provided on how to maximize iron absorption, such as consuming iron-rich foods alongside sources of vitamin C, and avoiding substances that hindered iron absorption, such as tea or coffee. This knowledge empowered participants to optimize the nutritional value of their meals and enhance the effectiveness of their dietary iron intake.

2.9.2) Anaemia and its consequences:

This lecture contained accurate, updated, acceptable, and simple information about the definition of IDA, manifestations, risk factors, consequences, epidemiological description etc.

Emphasis was placed on the connection between iron and haemoglobin, highlighting how iron deficiency could impair the production of healthy red blood cells and compromise the oxygen-carrying capacity of the blood. Participants were provided with knowledge specific to anaemia in pregnancy, as this was a critical period when iron requirements were significantly higher. They learned about the potential consequences of untreated anaemia during pregnancy, including increased risks of preterm birth, low birth weight, and maternal complications.

The delivery of the intervention took place over a period of 6 weeks, with weekly sessions conducted in the local language, Tamil. Information, Education, and Communication materials, such as flipcharts, brochures, and video clips, were utilized to enhance the participants' learning experience. These

materials presented key messages, visual aids, and practical tips related to nutrition education and the prevention and management of iron deficiency anaemia.

By providing nutrition education and anaemia-related knowledge, the intervention package equipped pregnant women with the necessary tools and knowledge to make informed choices about their diet and effectively manage anaemia during pregnancy. This comprehensive approach addressed both the nutritional aspect and the specific concerns related to iron deficiency anaemia, ensuring a holistic and empowering intervention for the participants.

2.10) Intervention plan

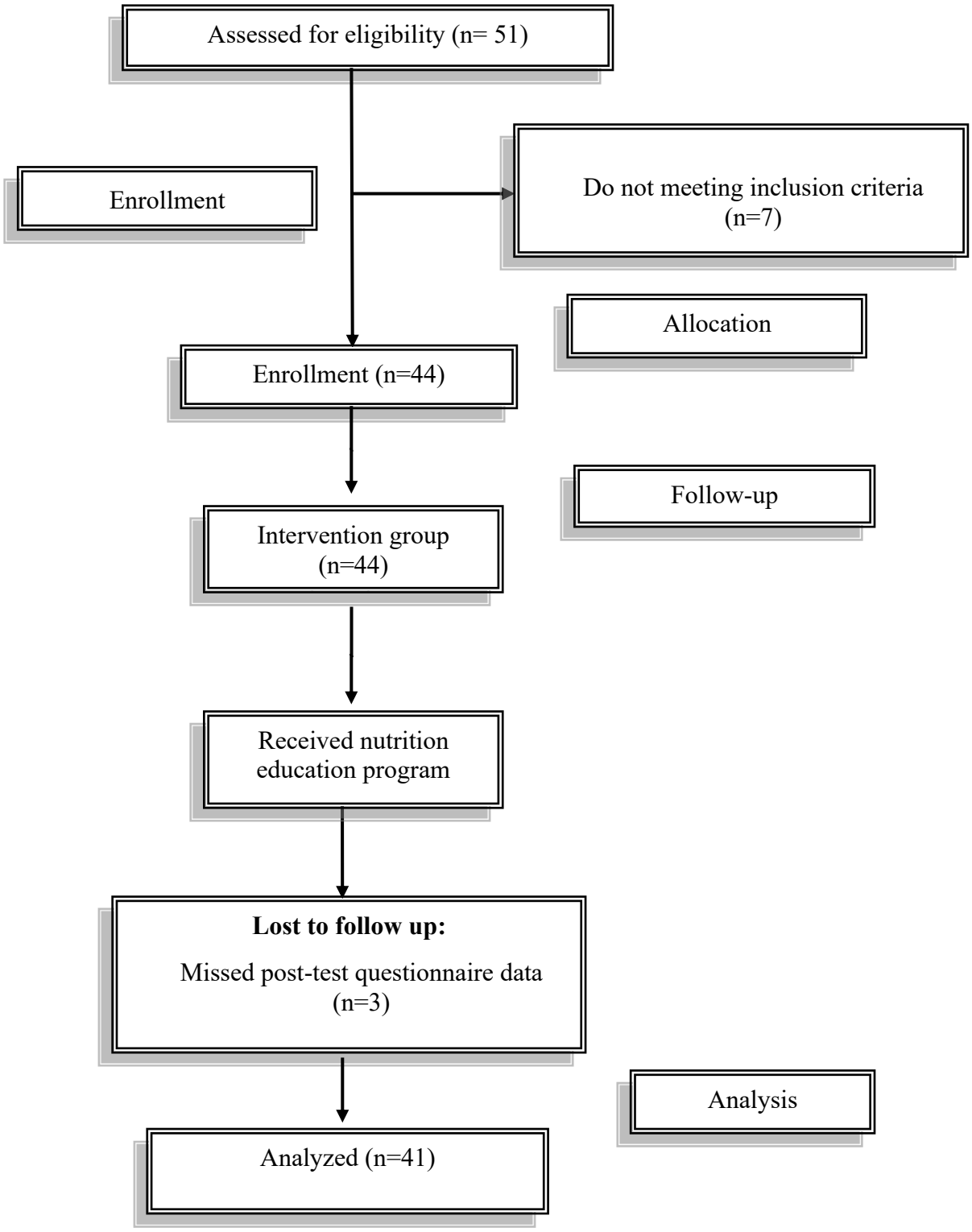
Week 1	3rd week of April	Anaemia: What, causes, signs and symptoms, types (Overview of IDA and its management)
Week 2	4th week of April	IDA: Prevalence, IDA-prone population, iron-haemoglobin connection
Week 3	1st week of May	Anaemia in pregnancy and standard care
Week 4	2ndweek of May	Iron rich plant-based food (vegetables, fruits etc.) and Iron rich animal foods
Week 5	3rd week of May	Meals that are iron rich
Week 6	4th week of May	Enhancers and Inhibitors for iron absorption

Image 2.4: Group photo with some of the participants

2.11) Data analysis

Data analysis was performed using Microsoft Excel. Descriptive statistics - means, standard deviations, percentages, and frequencies were used to describe the participant's characteristics. A paired sample t-test was used for a pretest and posttest comparison of the study variables.

Figure 2.2: Study profile



3) RESULTS AND DISCUSSION

3.1) Baseline Characteristics of Pregnant Women

3.1.1) Sociodemographic Characteristics

The study included a total of 41 pregnant women in the Nilgiris district, Tamil Nadu. The majority of participants fell into the age group of 20-25 (63.4%), followed by 25-30 (24.4%), with smaller proportions in other age categories. In terms of education, the majority had a graduate degree (53.7%), while smaller proportions held higher secondary certificates (19.5%), high school certificates (14.6%), or post-graduate/professional degrees (4.9%). The majority of participants were unemployed (70.7%), with some being semi-skilled workers (14.6%) or engaged in other occupations. Regarding geography, most participants resided in rural areas (78%), and the remaining were from semi-urban areas (22%). The sample encompassed various castes, with 14.6% belonging to ST, 39% to SC, and 46.3% to OBC. Among the participants, 61% came from joint families, while 39% belonged to nuclear families. A significant proportion of the participants (87.8%) were classified as below the poverty line (Table 3.1.1) and (Table 3.1.2).

3.1.2) Obstetric history

All 41 pregnant women had a pregnancy card, indicating good access to antenatal care. In terms of haemoglobin (Hb) levels, 17.1% had Hb levels below 11 gm/dl which indicate they are anaemic. The majority of the women were in the second trimester (73.2%) of their pregnancy. Regarding the obstetric history, the most common status was G1P1L0A0 and G1P0L0A0 (21.3%), indicating the number of gravidae, parity, living children, and abortions. There were varying proportions of women with different obstetric histories. The majority did not have a history of premature delivery, anaemia in previous delivery, or a previous C-section. Most women (90.2%) were taking iron folic acid tablets during their current pregnancy (Table 3.2)

Table 3.1.1: Participants' demographic information (n = 41)

Components	n	(%)
Age		
18-20	1	2.4
20-25	26	63.4
25-30	10	24.4
30-35	3	7.3
>35	1	2.4
Education		
Middle school certificate	3	7.3
High school certificate	6	14.6
Higher secondary certificate	8	19.5
Graduate degree	22	53.7
Post graduate or professional degree	2	4.9
Occupation		
Unemployed	29	70.7
Semi-skilled worker	6	14.6
Skilled worker	2	4.9
Arithmetic skill jobs	1	2.4
Semi professional	3	7.3
Geography		
Rural area	32	78.0
Semi Urban area	9	22.0
Caste		
ST	6	14.6
SC	16	39.0
OBC	19	46.3
Type of family		
Joint	25	61.0
Nuclear	16	39.0

Table 3.1.2: Participants' socioeconomic information (n = 41)

Economic category	n	(%)
Below poverty	36	87.8
Above poverty	5	12.2
Type of house		
Semi pucca	32	78.0
Pucca	9	22.0
Own house		
No	9	22.0
Yes	32	78.0
Separate room for kitchen		
No	3	7.3
Yes	38	92.7
Fuel use for cooking		
Wood	12	29.3
LPG	29	70.7
Agricultural land		
No land	39	95.1
< 2 acres /unknown acreage	2	4.9
Own any livestock		
No	39	95.1
Yes	2	4.9
Source of lighting		
Electricity	40	97.6
Solar	1	2.4
Source of drinking water		
Public well	1	2.4
Public tap	18	43.9
Shared well	1	2.4
Shared tap	7	17.1
Own well	6	14.6
Own tap	8	19.5
Toilet facility		
No facility available	1	2.4
Own pit toilet	32	78.0
Own flush toilet	8	19.5

Table 3.2: Participants' obstetric history (n = 41)

Pregnancy history	n	(%)
Have pregnancy card		
Yes	41	100.0
Hb in g/dl		
<11	7	17.1
11 to 13	24	58.5
>13	7	17.1
Not taken	3	7.3
Trimester		
First trimester	11	26.8
Second trimester	30	73.2
GPLA Status		
G1P0L0A0	12	29.3
G1P1L0A0	12	29.3
G2P1L0A0	1	2.4
G2P1L1A0	9	22.0
G2P2L1A0	6	14.6
G4P2L2A1	1	2.4
History of premature delivery		
Yes	2	4.9
No	15	36.6
NA	24	58.5
History of anaemia in previous delivery		
Yes	2	4.9
No	15	36.6
NA	24	58.5
Type of previous childbirth		
C- section	1	2.4
Vaginal delivery	16	39.0
NA	24	58.5
Taking Iron folic acid tablet		
Yes	37	90.2
No	4	9.8

3.1.3) Level of knowledge, attitude, and practice regarding IDA

Regarding knowledge, only 31.7% of all participants reported adequate overall knowledge about IDA. For example, 82.9% were unaware about the causes of anaemia, only 9.8% of participants knows food that increases iron absorption and none of them knows the food which decreases iron absorption. The knowledge about how to diagnose anaemia and the consequences of IDA in pregnancy is 36.6% and 34.1% respectively. However, most know about easily absorbed iron rich foods (52.2%). (Table 3.3)

Regarding attitude, 41.5% of all participants reported an overall positive perception toward IDA. 70.4% like the taste of iron rich food or meal and 50% believed that IDA is a serious problem. However, only 43.1% of participants were confident in preparing foods with iron rich ingredients. (Table 3.4)

Regarding practice, 42.2% of all participants reported overall healthy practices related to IDA. For example,93.2% reported consumption of at least one iron rich food daily, and 84.1% reported that they usually consumed Vitamin-C rich fruits. Despite this, no one was consuming it correctly during the meal. In the same manner,29.5% reported the consumption of caffeine either in the form of coffee or tea; only 38.7% consumed this correctly two hours after the meal. Furthermore, usage of home remedies on locally available plants to prevent and treat anaemia were 22.7% and 27.3% respectively. (Table 3.5)

Table 3.3: Participants' responses on knowledge part in the KAP questionnaire (n = 41)

Sl. No.	Item	Answer	Before (n)	%	After (n)	%
1	Know about anaemia	**Know**	**12**	**29.3**	**37**	**90.2**
		Partially know	**14**	**34.1**	**4**	**9.8**
		Don't know	15	36.6	0	-
2	Causes of anaemia	**Know**	**6**	**14.6**	**33**	**80.5**
		Partially know	**1**	**2.4**	**8**	**19.5**
		Don't know	34	82.9	0	-
3	How to diagnose anaemia	**Yes**	**15**	**36.6**	**41**	**100.0**
		No	26	63.4	0	-
4	Iron rich food easily absorbed	**Yes**	**20**	**48.8**	**40**	**97.6**
		No	21	51.2	1	2.4
5	Food that increases iron absorption	**Yes**	**4**	**9.8**	**26**	**63.4**
		No	37	90.2	15	36.6
6	Food that decreases iron absorption	**Yes**	**0**	**-**	**32**	**78.0**
		No	41	100.0	9	22.0
7	Consequences of IDA for pregnant women	**Yes**	**14**	**34.1**	**41**	**100.0**
		No	27	65.9	0	-
8	Home remedies based on locally available plants to prevent anaemia	**Yes**	**15**	**36.6**	**41**	**100.0**
		No	26	63.4	0	-
9	Home remedies based on locally available plants to treat anaemia	**Yes**	**16**	**39.0**	**35**	**85.4**
		No	25	61.0	6	14.6

*Adequate knowledge marked bold

Table 3.4: Participants' responses on attitude part in the KAP questionnaire (n = 41)

Sl. No.	Item	Answer	Before (n)	%	After (n)	%
1	How serious do you think IDA in pregnancy is	Not serious	2	4.9	0	-
		Don't know	19	46.3	0	-
		Serious	**20**	**48.8**	**41**	**100.0**
2	How confident do you feel about preparing meals with iron rich ingredients	**Confident**	**18**	**43.9**	**26**	**63.4**
		Don't know	17	41.5	12	29.3
		Not confident	6	14.6	3	7.3
3	How much do you like the taste of iron rich food/ meal	Dislike	6	14.6	8	19.5
		Not sure	7	17.1	4	9.8
		Like	**28**	**68.3**	**29**	**70.7**
4	Approach when family members show anaemia	Follow Home remedy	2	4.9	1	2.4
		Consult Allopathy Doctor	39	95.1	18	43.9
		Follow Home remedy, Consult Allopathy Doctor	**0**	-	**22**	**53.7**

*Positive perception marked bold

Table 3.5: Participants' responses on practice part in the KAP questionnaire (n = 41)

Sl. No.	Item	Answer	Before (n)	%	After (n)	%
1	Intake of at least one iron rich food daily	No	3	7.3	3	7.3
		Yes	**38**	**92.7**	**38**	**92.7**
2	Usual consumption of Vitamin C rich fruits	No	7	17.1	3	7.3
		Yes	**34**	**82.9**	**38**	**92.7**
	If yes, Timing of intake	Before meal	2	5.9	2	5.3
		During meal	**0**	**-**	**6**	**15.8**
		After meal	28	82.4	24	63.2
		Others	1	2.9	3	7.9
		Don't know	3	8.8	3	7.9
3	Usual consumption of Tea/Coffee	**No**	**12**	**29.3**	**13**	**31.7**
		Yes	29	70.7	28	68.3
	If yes, Timing of intake	2 hours before meal	11	37.9	12	42.9
		During meal	2	6.9	1	3.6
		Direct after meal	1	3.4	1	3.6
		2 hours after meal	**12**	**41.4**	**14**	**50.0**
		No timing	3	10.3	0	-
4	Use home remedies based on locally available plants to prevent anaemia	**Yes**	**9**	**22.0**	**13**	**31.7**
		No	32	78.0	28	68.3
5	Use home remedies based on locally available plants to treat anaemia	**Yes**	**11**	**26.8**	**14**	**34.1**
		No	30	73.2	27	65.9

*Healthy practices marked bold

3.2) Outcome of nutritional education on KAP of pregnant women in IDA

The pre-study (31.7%) and post-study (91.6%) phases showed a significant increase in knowledge scores (t = -5.61, df = 10.0, p=0.0001). The statistically significant difference in mean knowledge scores showed that knowledge significantly increased following the intervention.

From the pre-study (40.2%) to the post-study (72.0) phase, the attitude scores moderately improved (t = -2.5, df = 3.0, p = 0.042). Even though the p-value was significant, the results may not be generalizable due to the small (df) for attitude.

From the pre-study (42.1) to the post-study (47.6) phase, there was a discernible change in the practise scores (t = -3.9, df = 6.0, p = 0.004). There was a p-value significant, indicating a significant improvement in practices following the intervention (Graph 3.1).

Graph 3.1: KAP on IDA

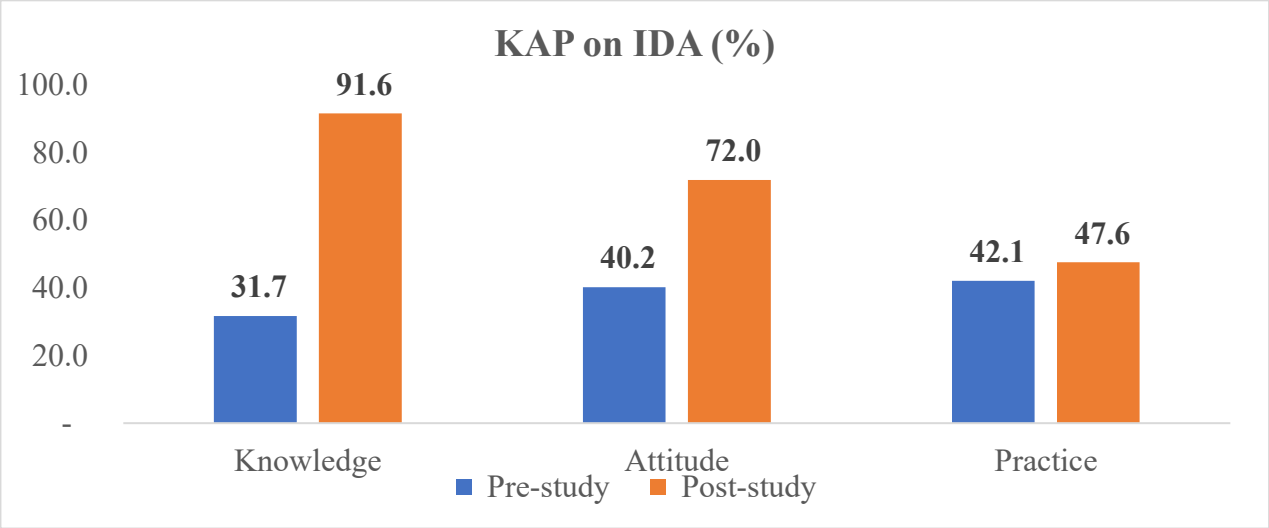


Table 3.6: Paired Sample t-Test before and after nutrition education program (n = 41)

Pre-test – post-tests	t	df	p
Total knowledge score	-5.61	10.0	0.0001
Total attitude score	-2.5	3.0	0.042
Total practice score	-3.9	6.0	0.004

3.3) Discussion

This study assessed the knowledge attitude and practice of IDA among pregnant women. The results revealed that before intervention more than half the participants didn't have adequate knowledge regarding anaemia. Previous studies also reported similar results (Monika S et al., 2019) (Sunuwar et al., 2019). This study results highlighted the need to extensively educate women especially pregnant women about IDA. This study also revealed that less than half the participants engaged in healthy practices or had a positive attitude related to IDA.

We hypothesized that implementing a nutrition education program effectively improves knowledge, attitude and practice regarding IDA among pregnant women. This hypothesis was supported as the participant's, post intervention, significantly improved in these aspects compared to pre-study. Prior evidence demonstrated that implementing a structured and comprehensive educational program is an effective strategy for improving knowledge, attitude and practice among women even if it is a short duration (Abu-Baker et al., 2021; Jalambo et al., 2017; Kulkarni, 2015). For example, studies in Jordan conducted one month of educational intervention and showed significant score improvements from pretest to posttests (Abu-Baker et al., 2021). Additionally, studies in India used educational interventions for 7 to more than 10 days and found a significant improvement in test results (Gopal & Chand, 2017). Thus, these findings added to prior evidence that supports the implementation of educational programs among pregnant women. This study offers important details about the advantages of educational intervention as a workable remedy.

3.3.1) Limitations of this study

Despite important and significant findings, this study has some limitations. Firstly, the study was conducted over a short period of time, which may limit the ability to capture long-term effects or changes. Secondly, the absence of a control group makes it difficult to determine the specific impact of the intervention, as there was no basis for comparison. Additionally, the study had a relatively small sample size, which may restrict the generalizability of the findings to a larger population. Furthermore, it should be noted that the participants in the study were predominantly educated (90%), which may limit the generalizability of the results to less educated populations. Lastly, the presence of interviewer bias cannot be ruled out, as the data collection involved direct interviews with the participants. These limitations should be considered when interpreting the results and future studies should address these aspects to provide a more comprehensive understanding of the topic.

4) CONCLUSION

- Iron deficiency anaemia is a major health problem among pregnant women
- Their knowledge, attitude, and practice in this regard need to be improved, and educational intervention is a successful way to do this.
- At baseline, the study found that participants knew little about anaemia and its causes, but following the nutrition education intervention, knowledge and attitude scores significantly improved.
- Even though knowledge and attitude scores significantly improved, the change in practice scores was only moderate, indicating the need for additional interventions and support to turn knowledge into action.
- Further research is recommended to explore long-term effects and sustainability of the intervention, as well as the potential impact on anaemia prevalence rates in the study population.

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6) APPENDIX

6.1) Study protocol

Institutional Ethics Committee for Human Research
Application for Ethical Review of Research Protocol

To
The Member Secretary
Scientific Advisory Sub Committee (SASC)
The University of Trans-Disciplinary Health Sciences and Technology
Bengaluru

Date: 18-04-2023

Full name of Principal investigator	**Dr. Sandra Das**
Designation	Intern, M.Sc. Life Sciences in Ayurveda Biology (course at TDU) *
Complete postal address	The University of Trans-Disciplinary Health sciences and Technology; # 74/2, Jarakabande Kaval, Attur post, Via Yelahanka, Bengaluru – 560064, Karnataka
Mobile number	8547129650
E mail	sandra.d@tdu.edu.in

Site of study	Kotagiri thaluk, Nilgiris district, Tamil Nadu
Title of project	Evaluation of outcome of nutrition education on Knowledge, Attitude and Practice of Iron deficiency anaemia among pregnant women in Nilgiris district Tamil Nadu

Sl. no	**Name**	**Signature**
Principal Investigator	Dr. Sandra Das	
Supervisor	Dr. Prakash BN	

Type of study: local/ national/ international	local
type of trial: multi center/ single center	Single center

*** This is a part of my M.Sc. dissertation project work.**

PROTOCOL NAME
Evaluation of outcome of nutrition education on Knowledge, Attitude and Practice of Iron deficiency anaemia among pregnant women in Nilgiris district Tamil Nadu

PROTOCOL NUMBER: **TDU/IEC/13E/2023/PR50**

PROTOCOL VERSION DATE: Version1 dated 23-03-2023

Name and title of the investigator(s) and supervisor responsible for the study with address and phone number(s):

1. **Dr. Sandra Das – Principal investigator**

   Intern, M.Sc. Life Sciences in Ayurveda Biology,
   TDU, # 74/2, Jarakabande Kaval, Attur post, Via Yelahanka, Bengaluru – 560064, Karnataka

2. **Dr. Prakash BN – Supervisor**

   Associate Professor, Centre for Community Health, Clinical Research and Education
   TDU, # 74/2, Jarakabande Kaval, Attur post, Via Yelahanka, Bengaluru – 560064,

Name and address of the person authorized to sign the protocol and amendments:
Dr. Prakash B.N., The University of Trans-Disciplinary Health sciences and Technology

Roles and responsibilities of the investigators:

Sl. No.	Name	Role	Responsibilities
1	Dr. Sandra Das	Principal investigator	• Protocol development • Designing prerequisites of study like questionnaires, educational materials for awareness programs. • Conducting nutritional awareness program on IDA. • Monitoring data and data analysis.
2	Dr. Prakash BN	Supervisor	• Protocol development, ensuring that the study is conducted as per the design. • Monitoring data and data analysis.

INTRODUCTION

Iron deficiency anaemia:

Anaemia is a condition when there are not enough red blood cells or there is not enough haemoglobin in them. The capacity of the blood to transfer oxygen to the body's tissues will be reduced if you have too few or malformed red blood cells, not enough haemoglobin, or both. Haemoglobin is required to carry oxygen. This leads to signs including exhaustion, weakness, light-headedness, and shortness of breath, among others. Age, sex, elevation of habitation, smoking habits, and pregnancy status all affect the ideal haemoglobin concentration required to meet physiologic needs. The most common causes of anaemia include nutritional deficiencies, particularly iron deficiency(1).

When the body lacks enough iron, which is required for the production of haemoglobin, iron deficiency anaemia (IDA) develops. As our diet is the primary source of iron, inadequate dietary intake of iron, issues with iron absorption, blood loss that causes iron loss, and other medical illnesses, such as kidney failure and inflammation, etc., are the main causes of iron deficiency anaemia. (Abu-Baker et al., 2021).

The effects of anaemia on a woman's ability to produce and have children are severe, and this has serious consequences. Due to menstrual iron loss and the high iron requirements of a developing foetus during pregnancy, which are roughly twice as high as those in the non-pregnant state, women are more likely than men to have iron deficiency. Worldwide, it is estimated that about 20 per cent of maternal deaths are caused by anaemia; in addition, anaemia contributes partly to 50 percent of all maternal deaths(Parker et al., 2012). Several studies have identified anaemia as a risk factor for intrauterine foetal death, premature birth, low birth weight and other adverse neonatal outcomes(3–7).

According to National Family Health Survey 5 (NFHS-5), non- pregnant women age 15-49 years who are anaemic is 57.2% whereas it was 53.2% as reported in NFHS-4. Pregnant women age 15-49 years who are anaemic is 52.2% (NFHS – 4) which has increased by 1.8% as mentioned in NFHS – 5(MoHFW, 2021). Tamil Nadu 30.5% of pregnant women were anaemic according to NFHS-4 data(9). According to WHO, Hemoglobin levels less than 11.0 g/dL are considered anaemia during pregnancy, and it can be categorised into three severity levels: mild anaemia (Hb levels 9 to 10.9 g/dL), moderate anaemia (Hb levels 7 to 8.9 g/dL), and severe anaemia (Hb levels less than 7 g/dL).

Diet diversification, food fortification and supplementation are three specific recommendations by WHO for Indian population to fight against Anaemia(Anuradha guptha et al., 2013). Nutrition education to the anaemic population is one of the key strategies to implement these three recommendations.

It has been observed in earlier studies that nutrition education to anaemic patients have played significant role in improving their knowledge, attitude and practice towards anaemia and its management. The study conducted among 363 adolescent school going female students in Jordan showed significantly ($p \leq 0.05$) higher total scores of knowledge, attitude and practice in the intervention group (n=194) than compared to the control group (n=169), with one month nutrition education as an intervention(Abu-Baker et al., 2021). In the same manner, a randomized control trial (RCT) conducted in Gaza strip, Palestine, involving 89 girls aged 15–

19 years has shown pre-post-test results indicating significant improvement in knowledge (p <0.001) and positive attitude scores (p <0.001), and adoption of desired practice (p <0.002) in the intervention group who attended nutrition education lectures for three months (Ghosh et al., 2022; Jalambo et al., 2017).

A study in Ghana that adopted nutrition education as an intervention focused on pregnant women for 10 weeks showed a significant improvement in haemoglobin level (p=0.002) in the intervention group compared to control group. The change in the maternal nutritional knowledge score (p<0.001) on anaemia and iron rich foods was also high in the intervention group(Sunuwar et al., 2019). Similarly, a study conducted for the impact of the use of single vs. combination of media on nutritional knowledge and haemoglobin status of women in a rural hill area in Uttarakhand State, India having print media group (n = 59), multimedia group (n = 53) and control group (n = 111) showed significant rise in the print media group and the multimedia group in nutrition knowledge as compared to control group(Upadhyay S et al., 2011).

Considering the findings of these studies, the present study proposes to evaluate the outcome of a nutrition education among pregnant women on improving the KAP on iron deficiency anaemia in Nilgiris district of Tamil Nadu.

STUDY OBJECTIVE

To evaluate the outcome of a nutrition education program on change in the KAP on IDA of pregnant women in Nilgiris, Tamil Nadu.

METHODOLOGY

Study area

The Nilgiris, one of the oldest mountain ranges, is situated where Tamil Nadu, Kerala, and Karnataka converge. With a population of 7,35,394 people, 3,75,251 of whom are women, it is a portion of the western ghats. Scheduled Castes and Scheduled Tribes accounted for 32.08% and 4.46% of the population, respectively(The government of Tamil Nadu, 2023). Toda, Kota, Kurumbas, Irulur, Paniyan and Kattunayakan are the six primitive tribes recognized by government and residing in Nilgiris. In Nilgiris, 44.2% of women of age 15-49 years are anaemic according to NFHS 5 report and **30.5% of pregnant women age 15-49 years are anaemic** (NFHS-4) (MoHFW, 2021).

The study will be conducted among pregnant women in 5 selected villages under Kattabattu PHC of Kotagiri taluk in Nilgiris district, Tamil Nadu. Detailed list of villages is given in Annexure-1.

Study design

This is a prospective, interventional, (single arm) pre-post study. The study will include mixed methods employing qualitative and quantitative research methods.

Quantitative data of demography, socio economic status, education, occupation, pregnant history and qualitative data of knowledge, attitude and practice of IDA will be documented using a semi structured questionnaire. Questionnaire is attached as Annexure-2.

Study duration

The study will have a total duration of seven months from preparation to end of the study. The nutrition education intervention will be for 2 months.

Selection criteria

Inclusion criteria:

- Pregnant women of first and second trimester.
- Participants who are going to stay in the same village during the intervention period.
- Willing to provide written informed consent.

Exclusion criteria:

Pregnant women who are in their third trimester will be exempted from the study as they can't participate in the whole intervention period due to their nearby delivery date.

Withdrawal criteria:

The participation in this study is purely voluntary and the participants have the right to withdraw from this study at any time during the course of the study without giving any reasons.

Sampling method

The sampling unit for the study will be the pregnant women residing in the selected five villages of Kattabattu PHC, Kotagiri taluk in Nilgiris district. **Purposive sampling** method will be used to identify the pregnant women for the survey.

The survey will be conducted by the PI with the help of Village Health Nurses, ASHA workers from the identified villages and local NGO.

Sample size

As this is a **pilot study**, sample size has not been calculated. **40 pregnant women** will be purposively selected for the study in the selected study area.

Data Collection

Baseline survey: At study entry, a baseline questionnaire will record participants information (like socio demographic status); pregnancy history; knowledge, attitude and practice on anaemia and its management. The data will be collected through a semi structured questionnaire (Annexure-2) using an android app - Epicollect5 (https://five.epicollect.net/project/ida)

Follow up: During the intervention of 8 weeks, the participants will be monitored and record the changes in their haemoglobin by checking their medical records (ANC card). Participants will also be monitored for the adaptation of locally available iron rich foods in their diet. If any participants show the signs of severe anaemia, they will refer to local health facilities or their obstetrician for further standard diagnosis and health care**.**

Endline survey: At the end of eight weeks of intervention, endline survey will be done among the participants to know the outcome of nutrition education on the knowledge, attitude and practice regarding Iron deficiency anaemia and its management, using a semi-structured questionnaire through Epicollect5 app.

Intervention

The intervention package consists of nutrition education and anaemia related knowledge.

Nutrition education: This consists of topics on importance of nutrition food during pregnancy; Information on the locally available plants/foods which are having high iron content and the foods which increases and decreases iron absorption.

Anaemia and its consequences: Knowledge on general information on anaemia, its causes, the signs and symptoms, prevalence of IDA, Iron-haemoglobin connection, anaemia in pregnancy will be shared with the participants.

The participants will receive training on nutrition education and prevention and management of Iron Deficiency Anaemia over a period of **8 weeks (weekly once)** through Information, Education and Communication materials in Tamil language using flipchart (Annexure – 4) brochure, audio and video clippings.

Intervention (for 8 weeks)

1st week	Anaemia: What, causes, signs and symptoms, types (Overview of IDA and its management)
2nd week	IDA: Prevalence, IDA-prone population, iron-haemoglobin connection
3rd week	Anaemia in pregnancy and standard care
4th week	Iron rich plant-based food (vegetables, fruits etc.)
5th week	Iron rich animal foods
6th week	Meals that are iron rich
7th week	Enhancers for iron absorption
8th week	Inhibitors for iron absorption

Statistical plan

Statistical methods: Data collected through surveys will be entered in excel worksheets and paired "t" will be used to see the change in KAP of an individual woman. Or Chi-square tests will be used to explore relationships between KAP levels and women's characteristics and also among their K – A – P levels using Epi info or SPSS software**.** All the statistical analysis will be represented in mean ± standard deviation or percentage. Baseline and endline data will be compared using paired t-test or Wilcoxon signed rank t-test. 80% of compliance will be considered for analysis.

ETHICAL CONSIDERATION:

Prior informed consent: Prior to commencing the study, IEC (Institutional Ethics Committee) approval will be sought for the study protocol, informed consent forms and other relevant documents. Confidentiality of the patients will be maintained. IEC will be informed about study updates as indicate by the committee. Prior informed consent will be obtained from the participant before collecting the data. A format of the same is given in Annexure-3.

If any amendment is needed to update protocol during the study, IEC will be notified first. Approval will be sought prior to implementing significant changes. IEC will be informed by the PI upon completion of the study and the study report will be submitted to IEC in accordance with agreed timelines**.**

EXPECTED OUTCOME

The expected outcome from this study are

- A baseline report on KAP on iron deficiency anaemia by pregnant women in Nilgiris district.
- Outcome of training program on KAP on iron deficiency anaemia and its management by the pregnant women.

The primary data from this study will help us to develop project proposals and to implement long term health education programs and design appropriate health care intervention programs. This also helps us to sensitize local health authorities on the local health issues, thus leading to proper health care and health system planning.

FINANCE

As this is a part of MSc dissertation work, there is no specific funding support for the study. However, local, incidental expenses will be covered under the Rural India Support Trust (RIST) project.

PUBLICATION PLAN

The findings of the study will be published in M.Sc. dissertation, peer reviewed journals, or popular articles (Tamil & English) or book chapter. Local communities will receive the information on health care management methods in local language for Iron deficiency anaemia.

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ANNEXURE

Annexure 1: List of villages selected for the study

1. Happy valley
2. Donnington
3. Aggal
4. Naduhatty
5. Hadathurai
6. Darmono

Annexure 2: KAP questionnaire on Iron Deficiency Anaemia

Purpose of the questionnaire: To know knowledge, attitude and practice of iron deficiency anaemia among pregnant women in Nilgiris district.
Components of the questionnaire:

- Participant information
- Pregnancy related information
- Knowledge, attitude and practice related to iron deficiency anaemia

Target group: Pregnant women in the selected villages of Nilgiris district.

A) Participant information

1. Date of the survey:
2. Participant ID:
3. Name of the participant:
4. Age:
5. Address:
6. Education:
7. Occupation:
8. Name of village and panchayath:
9. Mobile number:
10. Nature of geography:
    a. Rural area
    b. Semi urban area
    c. Urban
11. Caste / tribe (specify)
    a. SC
    b. ST
    c. OBC
    d. General category
    e. Others (specify)

    If ST

- Todas
- Kota
- Kurumba
- Irula
- Paniya
- Kattunayakans
- Any other, specify

12. Type of family
    a. Joint family
    b. Nuclear

13. Which economic category do you belong to according to Govt. categorization?

    a. Above poverty level
    b. Below poverty level
    c. Antyodaya Anna Yojana (Family cards)
    d. Others

14. Type of house

    a. Pucca
    b. Semi-pucca
    c. Katcha

15. Do you have any own house

    a. Yes
    b. No

16. Do you have a separate room for kitchen

    a. Yes
    b. No

17. What type of fuel does your household mainly use for cooking?

    a. Wood
    b. Crop residues
    c. Dung cakes
    d. Coal/coke/lignite
    e. Charcoal
    f. Kerosine
    g. LPG
    h. Bio gas
    i. Electricity

18. How much agriculture land does this household own?

    a. 5 acres or more
    b. 2- 4.9 acres
    c. < 2 acres /unknown
    d. No land

    18.1 Out of this land how much is irrigated

        a. All

b. Some
c. None
d. Don't know

19. Does this household own any livestock?
    a. Yes
    b. No
20. What is the main source of lighting for your household
    a. Electricity
    b. Kerosene
    c. Gas
    d. Candle/oil
21. What is the main source of drinking water for members of your household?
22. What kind of toilet facility does your household have?
    a. Own flush toilet
    b. Shared flush toilet
    c. Public flush toilet
    d. Own pit toilet
    e. Shared pit toilet
    f. Public pit toilet
23. Does the household own any one of the following
    a. A bed
    b. A pressor cooker
    c. A chair
    d. A cot
    e. A table
    f. A clock
    g. A wrist watch
    h. A radio
    i. A tailoring machine
    j. A mobile phone
    k. A fridge
    l. A TV
    m. A two-wheeler
    n. A car

B) Information about pregnancy

1. Do you have pregnancy card?
    a. Yes
    b. No

1.1. Height (in cm)

1.2. Weight (in kg)

1.3. Hb (in gm/dl)

2. Trimester

   a. First trimester
   b. Second trimester
   c. Third trimester

3. Expected date of delivery

4. GPLA status

5. History of premature delivery

   a. Yes
   b. No
   c. NA

6. Any history of anaemia in previous pregnancy

   a. Yes
   b. No
   c. NA

7. Type of previous childbirth

   a. Vaginal delivery
   b. Assisted vaginal delivery
   c. C-section
   d. Others?? If other, namely____

8. Have you ever been taken iron + folic acid supplementation in your recent pregnancy

   a. Yes
   b. No

8.1. If yes, name of the medicine and dosage

KAP regarding iron deficiency anaemia

1. Have heard about iron deficiency anaemia/Raktasogai.

   a. Yes
   b. No

2. If yes, what are the signs and symptoms of IDA

   a. Weakness/fatigue
   b. Pallor
   c. Unusual rapid heartbeat
   d. Shortness of breath

e. Difficulty in concentration
f. Headache
g. If any other specify…….

3. Do you know causes of IDA

a. Yes
b. No

4. If yes, what are the causes

a. Lack of dietary iron
b. Sickness/infection
c. Heavy menstrual bleeding
d. Food diversity is changed over a period of time
e. Monetary problems in buying healthy food
f. If any other specify……

5. Do you know how to diagnose anaemia
a. Yes
b. No
6. If yes, what are the methods of diagnosis
7. Do you know iron rich food easily absorbed

a. Yes
b. No
7.1. If yes, which are they

8. Do you know food that increases iron absorption

a. Yes
b. No

9. If yes, which are they?

10. Do you know food that decreases iron absorption

a. Yes
b. No

11. If yes, which are they?

12. Do you know about the consequences of iron deficiency anaemia for pregnant women

a. Yes
b. No

13. How serious do you think iron deficiency anaemia is

a. Not serious
b. Serious
c. Not sure

14. How confident do you feel about preparing meals with iron rich ingredients

a. Not confident
b. May be
c. Confident

15. How much do you like the taste of an iron rich food item or meal
    a. Like
    b. Dislike
    c. Not sure

16. What is your approach for when any of your family members show symptoms of anaemia?

    a. Follow Home remedy
    b. Consult Folk healers
    c. Consult Allopathy Doctor (Government Hospital /private clinics)
    d. Consult Siddha Doctor (Government Hospital / private clinics)
    e. Others (please mention) ……

17. Reason for approaching the concerned health care provider?

    a. Affordable
    b. Easy access
    c. It is best treatment for IDA
    d. I have health coverage card
    e. Family physician
    f. Others specify…….

18. Do you take of at least one iron rich food daily

    a. Yes
    b. No

19. Do you usually consume Vitamin C rich fruits

    a. Yes
    b. No

20. If yes, timing of intake

    a. Before meal
    b. During meal
    c. After meal
    d. Other
    e. Don’t know

21. Usual consumption of tea/ coffee

    a. Yes
    b. No

22. if yes, timing of intake

    a. 2 hours before meal
    b. Direct before meal
    c. During meal
    d. Direct after meal
    e. 2 hours after meal
    f. No timing
    g. Don’t know

23. Do you know home remedies based on locally available plants to prevent anaemia

    a. Yes
    b. No

24. Do you use home remedies based on locally available plants to prevent anaemia

    a. Yes
    b. No

25. If yes, what do you prepare and how?

26. Do you know home remedies based on locally available plants to treat anaemia

    a. Yes
    b. No

27. Do you use home remedies based on locally available plants to treat anaemia

    a. Yes
    b. No

28. If yes, what do you prepare and how?

29. Photo of the participant

30. Collected by

Annexure 3: Information for participants and prior informed consent

- **Title of the study:** Evaluation of outcome of nutrition education on Knowledge, Attitude and Practice of Iron deficiency anaemia among pregnant women in Nilgiris district Tamil Nadu
- **Purpose of this study**: The purpose of the study is to update knowledge on iron deficiency anaemia among pregnant women in selected villages of Nilgiris district, Tamil Nadu
- **Study procedure:**
    1. Pregnant women from selected villages can participate in the KAP survey
    2. This survey may take about 20-30 minutes
    3. During the survey the participants will be asked about general information, socio economic status, pregnancy related information and knowledge, attitude and practice regarding iron deficiency anaemia.
- **Benefit to participant:** pregnant women who participate in this study will get an opportunity to learn about the locally available fruits and vegetables that contain iron and also the importance of taking iron rich meal during pregnancy.
- **Maintenance of confidentiality of records**: The participants have the right to confidentiality regarding the privacy of their personal information. The information from this study will not be revealed the identity of any individual or household in any publications.
- **Freedom to withdraw from the study at any time**: The participation in this study is purely voluntary and the participants have the right to withdraw from this study at any time during the course of the study without giving any reasons.
- **Name, address and contact details of the investigators:**

Name	Address	Phone number
Dr. Sandra Das	TDU, 74/2 Post Attur via Yelahanka Jarakabande Kaval, Bangaluru, Karnataka 560064	8547129650

பங்கேற்பாளர்களுக்கான தகவல்

- **ஆய்வின் தலைப்பு:** தமிழ்நாட்டில் நீலகிரி மாவட்டத்தில் கர்ப்பிணிப் பெண்களிடையே இரும்புச்சத்து குறைபாடு இரத்த சோகைக்கான அறிவு, அணுகுமுறை மற்றும் நடைமுறை பற்றிய ஊட்டச்சத்து கல்வியின் விளைவுகளின் மதிப்பீடு

- **இந்த ஆய்வின் நோக்கம்:** தமிழ்நாடு, நீலகிரி மாவட்டத்தில் தேர்ந்தெடுக்கப்பட்ட கிராமங்களில் கர்ப்பிணிப் பெண்களிடையே இரும்புச்சத்து குறைபாடு இரத்த சோகை குறித்த அறிவை புதுப்பிப்பதே ஆய்வின் நோக்கம்.

- **படிப்பு நடைமுறை:**

1. தேர்ந்தெடுக்கப்பட்ட கிராமங்களைச் சேர்ந்த கர்ப்பிணிப் பெண்கள் கேஏபி கணக்கெடுப்பில் பங்கேற்கலாம்
2. இந்த கணக்கெடுப்பு சுமார் 20-30 நிமிடங்கள் ஆகலாம்
3. ஆய்வின் போது பங்கேற்பாளர்களிடம் பொதுவான தகவல்கள், சமூக பொருளாதார நிலை, கர்ப்பம் தொடர்பான தகவல்கள் மற்றும் இரும்புச்சத்து குறைபாடு இரத்த சோகை தொடர்பான அறிவு, அணுகுமுறை மற்றும் நடைமுறை பற்றி கேட்கப்படும்.

- **பங்கேற்பாளருக்கான நன்மை:** இந்த ஆய்வில் பங்கேற்கும் கர்ப்பிணிப் பெண்களுக்கு இரும்புச்சத்து உள்ள உள்ளூர் பழங்கள் மற்றும் காய்கறிகள் மற்றும் கர்ப்ப காலத்தில் இரும்புச்சத்து நிறைந்த உணவை உட்கொள்வதன் முக்கியத்துவத்தைப் பற்றி அறிய வாய்ப்பு கிடைக்கும்.

- **பதிவுகளின் ரகசியத்தன்மையைப் பராமரித்தல்:** பங்கேற்பாளர்கள் தங்கள் தனிப்பட்ட தகவலின் தனியுரிமையைப் பற்றிய ரகசியத்தன்மைக்கு உரிமை உண்டு. இந்த ஆய்வின் தகவல்கள் எந்தவொரு தனி நபர் அல்லது குடும்பத்தின் அடையாளத்தை எந்த வெளியீடுகளிலும் வெளிப்படுத்தாது.

- **எந்த நேரத்திலும் ஆய்வில் இருந்து விலகுவதற்கான சுதந்திரம்:** இந்த ஆய்வில் பங்கேற்பது முற்றிலும் தன்னார்வமானது மற்றும் பங்கேற்பாளர்கள் எந்த காரணமும் தெரிவிக்காமல் ஆய்வின் போது எந்த நேரத்திலும் இந்த ஆய்வில் இருந்து விலகுவதற்கு உரிமை உண்டு.

- **புலனாய்வாளர்களின் பெயர், முகவரி மற்றும் தொடர்பு விவரங்கள்:**

பெயர்	முகவரி	தொலைபேசி எண்
டாக்டர் சாண்ட்ரா தாஸ்	TDU, 74/2 போஸ்ட் ஆத்தூர் வழியாக யெலஹங்கா ஜரகபந்தே காவல், பெங்களூரு, கர்நாடகா 560064	8547129650

INFORMED CONSENT LETTER **Date:**

Project title:

Evaluation of the outcome of nutrition education on Knowledge, Attitude and Practice of Iron deficiency anaemia among pregnant women in Nilgiris district, Tamil Nadu

I, Mrs./Ms. ---------- wife/daughter of ---------- fully understand the objectives of the aforesaid study. I have been informed in detail about the procedures of the study through the 'Information Sheet' supplied to me well before my initiation to the study.

I am convinced that it will be useful in enhancing the knowledge and will help to improve the quality of the life by using local herbal resources for Iron deficiency anaemia.

I am willing to participate in the survey to share my knowledge, attitude and practice on iron deficiency anaemia.

I understand that my participation in this study is voluntary and that I have the right to refuse or withdraw my consent at any time during its tenure by informing the investigator. I also understand that my identity will not be revealed to third parties or to the media (electronic or otherwise). I shall not restrict the use of any data or result obtained from this study, provided such usage is only for scientific purpose.

The contents of this Informed Consent Letter have been explained to me to my satisfaction in the language I am conversant with. Hence, I am signing this document of my free volition, thus consenting to participate in the study.

Signature of the investigator: Signature of the participant:

Name of the investigator: Name and Address:

Signature of witness:

Name and Address:

தகவலறிந்த ஒப்புதல் கடிதம் தேதி:

திட்டத்தின் தலைப்பு:
தமிழ்நாடு, நீலகிரி மாவட்டத்தில் கர்ப்பிணிப் பெண்களிடையே இரும்புச்சத்து குறைபாடு இரத்த சோகைக்கான அறிவு, அணுகுமுறை மற்றும் நடைமுறை பற்றிய ஊட்டச்சத்து கல்வியின் விளைவுகளின் மதிப்பீடு

நான், திருமதி/திருமதி. ---------- மனைவி/ மகள் ---------- ---------- மேற்கூறிய படிப்பின் நோக்கங்களை முழுமையாக புரிந்து கொள்ள வேண்டும். நான் படிப்பைத் தொடங்குவதற்கு முன்பே எனக்கு வழங்கப்பட்ட 'தகவல் தாள்' மூலம் படிப்பின் நடைமுறைகள் பற்றி விரிவாக எனக்குத் தெரிவிக்கப்பட்டுள்ளது.

இது அறிவை மேம்படுத்துவதில் பயனுள்ளதாக இருக்கும் மற்றும் இரும்புச்சத்து குறைபாடு இரத்த சோகைக்கு உள்ளூர் மூலிகை வளங்களைப் பயன்படுத்துவதன் மூலம் வாழ்க்கைத் தரத்தை மேம்படுத்த உதவும் என்று நான் நம்புகிறேன்.

இரும்புச்சத்து குறைபாடு இரத்த சோகை குறித்த எனது அறிவு, அணுகுமுறை மற்றும் பயிற்சியைப் பகிர்ந்து கொள்வதற்காக கணக்கெடுப்பில் பங்கேற்க நான் தயாராக இருக்கிறேன்.

இந்த ஆய்வில் நான் பங்கேற்பது தன்னார்வமானது என்பதையும், ஆய்வாளரிடம் தெரிவிப்பதன் மூலம் அதன் பதவிக்காலத்தில் எந்த நேரத்திலும் எனது ஒப்புதலை மறுக்கவோ அல்லது திரும்பப் பெறவோ எனக்கு உரிமை உள்ளது என்பதையும் புரிந்துகொள்கிறேன். எனது அடையாளம் மூன்றாம் தரப்பினருக்கோ அல்லது ஊடகங்களுக்கோ (மின்னணு அல்லது வேறு) வெளிப்படுத்தப்படாது என்பதையும் நான் புரிந்துகொள்கிறேன். இந்த ஆய்வில் இருந்து பெறப்பட்ட தரவு அல்லது முடிவுகளின் பயன்பாட்டை நான் கட்டுப்படுத்த மாட்டேன், அத்தகைய பயன்பாடு அறிவியல் நோக்கத்திற்காக மட்டுமே.

இந்த தகவலறிந்த ஒப்புதல் கடிதத்தின் உள்ளடக்கங்கள் நான் அறிந்த மொழியில் எனக்கு திருப்தி அளிக்கும் வகையில் விளக்கப்பட்டுள்ளன. எனவே, எனது விருப்பத்தின் பேரில் இந்த ஆவணத்தில் கையொப்பமிடுகிறேன், எனவே ஆய்வில் பங்கேற்க ஒப்புக்கொள்கிறேன்.

ஆய்வாளரின் கையொப்பம்: பங்கேற்பாளரின் கையொப்பம்:

விசாரணையாளரின் பெயர்: பெயர் மற்றும் முகவரி:

சாட்சி கையெழுத்து:

பெயர் மற்றும் முகவரி:

APPENDIX

6.2) IEC approval letter

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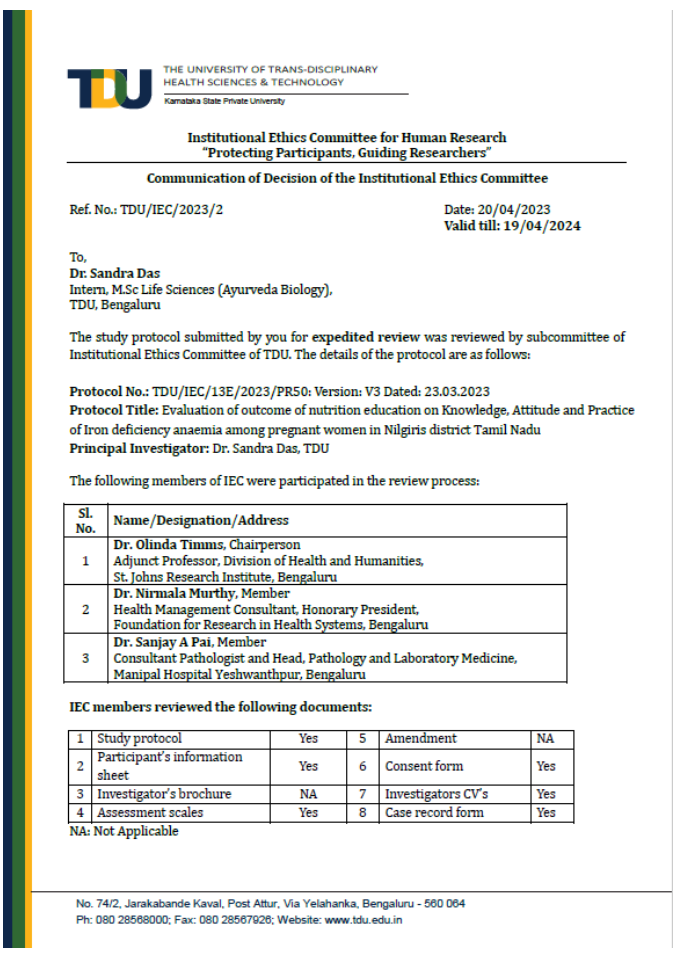


THE UNIVERSITY OF TRANS-DISCIPLINARY HEALTH SCIENCES & TECHNOLOGY
Karnataka State Private University

Institutional Ethics Committee for Human Research
"Protecting Participants, Guiding Researchers"

Communication of Decision of the Institutional Ethics Committee

Ref. No.: TDU/IEC/2023/2

Date: 20/04/2023
Valid till: 19/04/2024

To,
Dr. Sandra Das
Intern, M.Sc Life Sciences (Ayurveda Biology),
TDU, Bengaluru

The study protocol submitted by you for **expedited review** was reviewed by subcommittee of Institutional Ethics Committee of TDU. The details of the protocol are as follows:

Protocol No.: TDU/IEC/13E/2023/PR50: Version: V3 Dated: 23.03.2023
Protocol Title: Evaluation of outcome of nutrition education on Knowledge, Attitude and Practice of Iron deficiency anaemia among pregnant women in Nilgiris district Tamil Nadu
Principal Investigator: Dr. Sandra Das, TDU

The following members of IEC were participated in the review process:

Sl. No.	Name/Designation/Address
1	**Dr. Olinda Timms**, Chairperson Adjunct Professor, Division of Health and Humanities, St. Johns Research Institute, Bengaluru
2	**Dr. Nirmala Murthy**, Member Health Management Consultant, Honorary President, Foundation for Research in Health Systems, Bengaluru
3	**Dr. Sanjay A Pai**, Member Consultant Pathologist and Head, Pathology and Laboratory Medicine, Manipal Hospital Yeshwanthpur, Bengaluru

IEC members reviewed the following documents:

1	Study protocol	Yes	5	Amendment	NA
2	Participant's information sheet	Yes	6	Consent form	Yes
3	Investigator's brochure	NA	7	Investigators CV's	Yes
4	Assessment scales	Yes	8	Case record form	Yes

NA: Not Applicable

No. 74/2, Jarakabande Kaval, Post Attur, Via Yelahanka, Bengaluru - 560 064
Ph: 080 28568000; Fax: 080 28567926; Website: www.tdu.edu.in

THE UNIVERSITY OF TRANS-DISCIPLINARY HEALTH SCIENCES & TECHNOLOGY
Karnataka State Private University

Protocol was discussed and reviewed in detail. IEC has **approved** this protocol after certain modifications were made.

The committee approves the study to be conducted in the presented form. The approval is valid for **one year**. The investigator must take re-approval after one year if the study is not initiated. The investigator is requested to submit periodic **progress report** on or before **30th June and 31st December** of every year till the completion of the study. IEC must be informed about any change, modification or deviation from the protocol. Approval for amendment, changes must be obtained prior to implementation. The exact alteration/amendment should be specified and indicated where the amendment occurred in the orginal project. (Page no. clause no. etc.).

Investigators should conduct the study as per the recommendation by ICMR, 2017, GCP and other regulatory guidelines. IEC members have the right to monitor the study with prior intimation.

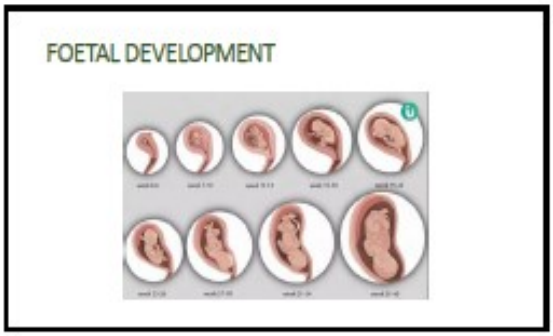
With Best Wishes,

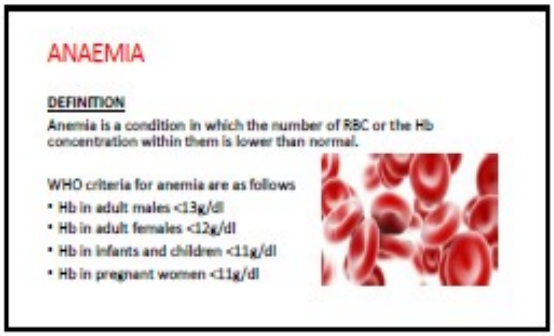
Signature of the Chairperson,
Institutional Ethics Committee
Name: Dr. Olinda Timms
Date: 20th April 2023

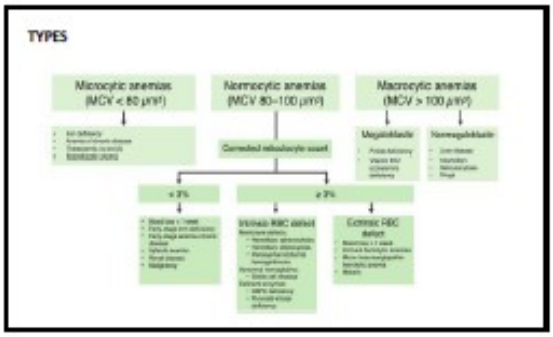
APPENDIX

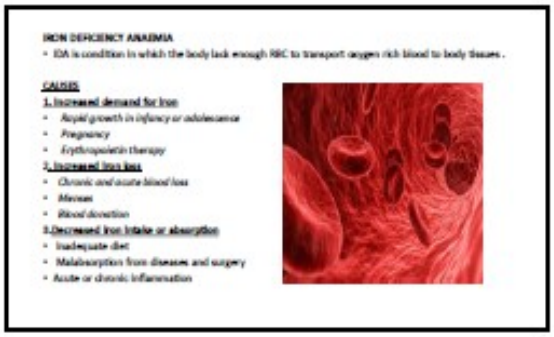
6.3) Intervention package

During intervention, the IEC material in the local language was used.





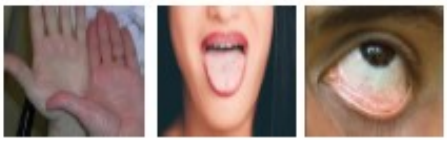




SYMPTOMS

Symptoms that can be assessed through one's eye:

- Paleness in palmar creases
- Paleness in tongue colour in IDA
- Paleness of eyes in IDA



- Brittle nails in IDA
- Koilonychia- spoon nails
- Angular stomatitis

Few peculiar desires of people with IDA:

1. PICA- People with PICA compulsively eat non food items with no nutritional value. Example: mud, ant hill mud, paper, paint etc.
2. Desire to eat sour food items

IDA PREVALENCE

- Children:35-45%
- Pregnant:45-60%

IDA PRONE POPULATION

- Reproductive age females
- Pregnant women
- Elderly
- Low income
- Under weight
- Iron or vitamin c poor diet

IRON- HAEMOGLOBIN CONNECTION

- Lower than normal number of RBC in body in IDA
- 70% body's iron is in RBC
- Iron is an essential element for blood production
- Daily requirement of iron

❑Adult male=17mg/day
❑Adult female=21mg/day
❑Adolescent male or female= 27mg/day

ANAEMIA IN PREGNANCY

- Commonest medical disorder in pregnancy.
- In developing countries- 40-70% of pregnant women are anaemic.
- It is responsible for significant high maternal and fetal mortality rate worldwide.

Anaemia in pregnancy is defined as haemoglobin concentration is less than 11gm/dl

CLASSIFICATION

- Mild: 9-10.9gm/dl
- Moderate: 7.8-9gm/dl
- Severe: <7gm/dl
- Very severe: <4gm/dl

IRON REQUIREMENTS IN PREGNANCY

During pregnancy approximately 1500 mg iron is needed for;

- Increase in maternal haemoglobin (400-500mg)
- The fetus and placenta (300-400mg)
- Replacement of daily lose through urine, stool and skin (250mg)
- Replacement of blood lost at delivery (200mg)
- Lactation (1mg/day)

IRON AND FOLIC ACID REQUIREMENTS IN PREGNANCY

- Elemental iron- 30-40mg
- Folic acid- 0.4mg

It is recommended for pregnant women to prevent maternal anaemia, puerperal sepsis, low birth weight and preterm birth of babies

EFFECTS OF ANAEMIA ON MOTHER

- Reduced resistance to infection
- Reduced ability to withstand postpartum haemorrhage
- Strain of even an uncomplicated labour may cause cardiac failure
- Preterm labour
- Fatigue
- Potential threat to life

EFFECTS TO BABY

- Intra uterine hypoxia and growth retardation
- Pre maturity
- Low birth weight
- Anaemia a few months after due to poor store
- Increased risk of perinatal morbidity and mortality

MANAGEMENT

- Avoidance of frequent child births
- Supplementary iron therapy
- Diet modification
- Early detection of falling haemoglobin level

IRON RICH PLANT BASED FOODS

- Some plant-based foods that are rich in iron, such as lentils, chickpeas, spinach, and raisins, can be good sources of iron for vegetarians and vegans.
- The bioavailability of iron from these foods can be increased by combining them with foods that are high in vitamin C, such as citrus fruits, tomatoes, and bell peppers.

- Iron-rich leafy greens, such as methi or fenugreek leaves or spinach, in your diet can help boost iron levels.

- Incorporating iron-rich foods like whole grains, such as jowar and bajra, into your diet can help prevent iron deficiency.

- Iron-rich whole grains, such as brown rice, can help boost iron levels in the body.

- Iron-rich fruits like guava and figs can help boost iron levels in the body.

- Including iron-rich legumes, such as chickpeas and kidney beans, in your diet can help prevent iron deficiency anemia.


- Iron-rich legumes, such as lentils and peas, can help prevent iron deficiency.


- Iron-rich root vegetables like sweet potatoes and carrots can help boost iron levels in the body.


- Iron-rich dried fruits, such as raisins and dried apricots, can help boost iron levels in the body.


- Including iron-rich plant-based foods in every meal, such as soybean and tofu, can help prevent iron deficiency


- Including iron-rich nuts and seeds in your diet, such as pumpkin and sunflower seeds, can help prevent iron deficiency anemia


- Including iron-rich nuts, such as almonds and cashews, and seeds, such as chia and flax, in your diet can help prevent iron deficiency anaemia


IRON RICH ANIMAL FOODS

MEAT AND EGG

- Beef
- Lamb
- Turkey
- Chicken



- Pork
- Dried beef
- Liver
- Eggs (any style)




SEA FOODS

- Shrimp
- Clams
- Scallops
- Oysters
- Tuna
- Sardines
- Haddock
- Mackerel



MEALS THAT ARE IRON RICH

- **Breakfast**: A bowl of idli (steamed rice cakes) served with a side of sambar (lentil soup) and a glass of fresh tomato juice. The idli and sambar provide non-heme iron, while the tomato juice helps to enhance the absorption of iron.


- **Lunch**: A plate of steamed rice with a side of rasam (spicy lentil soup) and a bowl of mixed vegetable curry. The rasam and mixed vegetable curry provide additional iron from lentils and leafy greens


- **Dinner:** A bowl of kitchari (rice and lentil porridge) with a side of brinjal (eggplant) curry and a glass of buttermilk. The kitchari and brinjal curry are good sources of iron, and the buttermilk can help to enhance the absorption of iron



- **Breakfast:** A bowl of millet porridge made with iron-rich foxtail millet, served with a side of sautéed amaranth leaves and a glass of fresh tender coconut water. The millet porridge and amaranth leaves provide non-heme iron, while the tender coconut water helps to enhance the absorption of iron



- **Lunch:** A plate of steamed rice with a side of avarekalu (hyacinth bean) curry and a bowl of mixed vegetable stir-fry. The avarekalu and mixed vegetables provide additional iron from legumes and leafy greens.



- **Dinner:** A bowl of horse gram soup with a side of yam curry and a glass of buttermilk. Horse gram and yam are good sources of iron, and the buttermilk can help to enhance the absorption of iron.



ENHANCERS FOR IRON ABSORPTION

- Consuming iron-rich plant-based foods with foods high in vitamin C, such as amla or Indian gooseberry, can enhance iron absorption.

- Cooking food in iron pots can add extra iron to your meals

- Drinking enough water is important for proper iron absorption, so be sure to stay hydrated throughout the day

- Including iron-rich foods in every meal, such as fortified rice, can help prevent iron deficiency anemia

- Iron supplements can be a helpful addition to your diet if you have low iron levels, but be sure to speak with a doctor before starting any supplement

INHIBITORS FOR IRON ABSORPTION

- Eating iron-rich foods along with calcium-rich foods, such as milk and curd, can reduce iron absorption, so it's best to have them at separate meals

- Drinking tea and coffee between meals can decrease iron absorption, so it's best to have them at separate times from iron-rich foods

APPENDIX

6.4) Photographs from the field

Image 1: Assessing eligibility of a pregnant woman for the study with the help of VHNs and ASHA workers

Image 2: Kattabettu PHC in Nilgiris district of Tamil Nadu

Image 3: Explaining about the study before signing consent form

Image 4: Participant reading the information sheet

Image 5: Participants signing the consent form

Image 6: Proving nutrition education to the participants

Image 7

Image 8

Image 9: Group photo with participant and ASHA worker

Image 10: Interaction with participant during endline data collection