Dietary Iron Status of Adult Women and Its Relationship with Menstrual Health

BY

M.SASHMITHA

(20PFN021)

THESIS SUBMITTED TO

AVINASHILINGAM INSTITUTE FOR HOME SCIENCE AND HIGHER EDUCATION FOR WOMEN

COIMBATORE -641043

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN FOOD SCIENCE AND NUTRITION

MAY 2022

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27/05/2022

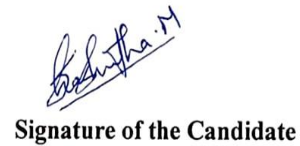
Signature of the Supervisor

27/5/22

Signature of the Head of the Department

DECLARATION

I hereby declare that the dissertation entitled " **Dietary Iron Status of Adult Women and Its Relationship with Menstrual Health**", submitted to the Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, in partial fulfillment of the requirement for the award of the **Degree of Master of Science in Food Science and Nutrition** is a record of original research work done by me under the supervision and guidance of **Dr.(Mrs.) S.Thilakavathy,M.Sc.,M.Phil.,Ph.D**, Assistant Professor(SG), Department of Food Science and Nutrition, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore and that it has not formed the basis for the award of any Degree/ Diploma/ Associateship /Fellowship or similar title to any candidate of any other University and it represents entirely an independent work on the part of the Candidate.



Signature of the Supervisor 27/5/2022

Signature of the Candidate

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INTRODUCTION

I. INTRODUCTION

Health is very important for all irrespective of gender. It is the key to a life of long active years. The proverb "health is wealth" cannot be underestimated. Health and fitness can be achieved by taking good care of the body and consuming nutritious food. Good health of the body and mind helps a person to sustain the day-to-day activities to achieve success in life.(Ali *et al.,* 2017)

Health is not only fundamental but also it is an indicator of a society 's overall development. Women 's health is of prime importance as it contributes to better – educated and industrious societies, and helps in economic growth and development. Women 's optimal health is essential for the health and well – being of subsequent generations. Health of women should be maintained optimum as health issues should not be a hindrance to women 's way to achievement. Women are the backbone of the family. Healthy women correlate to healthy future generations. The true development of a country depends upon the health status of its women and how a country safeguards and promotes the health of its women population. (Onarheim *et al.,*2016).Women 's health has been the topic of growing concern and interest in the last few decades. (Siristatidis *et al.*, 2021).

The health of women is influenced by various interconnected factors. The interconnected factors that affect the health of a women are biological , social and cultural factors. Various studies report that women are more prone to sickness and disabilities throughout the life cycle. There are various factors that determine the health concerns of women like illiteracy , inadequate health service, reproductive years, social and cultural influences, gender discrimination, domestic violence, low levels of education , less employment opportunities , poor environmental hygiene, early marriage , early child bearing , unsafe abortion , malnutrition and poverty. Adequate nutrition is thus essential to maintain the health of any individual , especially women. The various disorders associated with women due to inadequate nutrition are iron and iodine deficiency disorders, anaemia, underweight , impaired menstrual cycle and osteoporosis. Among this anaemia is the major cause of mortality and morbidity among women of reproductive age.(Kowsalya and Manoharan.,2017)

Anaemia is defined as a state in which the concentration of the blood haemoglobin decreases. It is marked by either by the insufficiency of red blood cells or the decreased ability of the oxygen carrying capacity of the red blood cells. Anaemia is a nutritional deficiency disease that is found to affect population of both developed and developing countries. The

physiological requirements of haemoglobin concentration , number of red blood cells and the oxygen carrying capacity of red blood cells varies according to the age, sex , altitude and during pregnancy. (Kishore *et al*.,2020)

Chaparro *et al*.,2019 reported that anaemia affects a third of world 's population. Anaemia has various etiological factors and is a complex disease. Anaemia may develop due to imbalance in erythrocyte production due to ineffective or lack of erythropoietic activity. Nutritional deficiencies , inflammation, genetic haemoglobin disorders and those that cause excessive loss of blood like haemolysis and blood loss or both can contribute to the lack of erythropoietic activity.

Anaemia prevails as a major health problem in women of less developed countries. It is a common disorder that affects about thirty percentage of women of reproductive age and forty percentage of children. It is indicated as the contributor to various health consequences.(Safiri *et al.,*2021).

Iron deficiency and iron deficiency anaemia is highly prevalent among women. Anaemia is found to cause adverse health consequences and is also found to affect the physical and mental wellbeing of women. Anaemia remains to be highly prevalent among women of reproductive age but it still remains as an underdiagnosed and undertreated condition. Pregnant women, postpartum women and women with high menstrual bleeding are found to be more vulnerable to anaemia.(Mirza *et al.*,2018).

The impact of iron deficiency as a cause of anaemia differs from region to region. Iron deficiency is the most common cause of anaemia globally. Iron – deficiency also has major impact on future generations as iron – deficiency anaemia increases the susceptibility to preterm labour , low birth weight , infant mortality and foretells iron deficiency in infants after 4 months of age. The iron deficiency anaemia accounts for 50 percent cases of anaemia. Low dietary iron intake and poor biological availability of iron in phytate and fiber – rich Indian diet are other contributing factors to iron deficiency. The prevalence of anaemia among Indian women has remained higher than 45 % since 1990 and there is found to be a strong correlation between anaemia and iron deficiency. (Mehrotra *et al* ., 2018)

It is important to prevent anaemia in women of reproductive age and comprehensive approaches should be undertaken. These approaches are needed to improve the haematological status and improve maternal and child health outcomes. The reproductive age is characterised by the occurrence of menstrual cycle. (Finkelstein *et al* ., 2020) Menstrual cycle in women is an important phase of life. The menstrual cycle is the time from the first day of a female 's

period to the day before their next period. The length of the menstrual cycle differs, but in average it consists 28 days. The menstrual cycle is characterised by four stages the menstrual phase , follicular phase, ovulation phase and luteal phase. Menstrual cycle is considered as normal when the menses occurs every 23 – 32 days , with the luteal phase lasting for 9 – 17 days and the follicular phase for 10 – 20 days. The variation in cycle length is determined by genetic factors.(Allen *et al* ., 2017).

Rafique and Al- Sheikh ., 2018 conducted a cross sectional study to identify the prevalence of various menstrual problems in young females and found that 91 % of them were suffering from some kind of menstrual problems. The various menstrual problems that were reported are irregular menstruation , abnormal vaginal bleeding , amenorrhea, menorrhagia, dysmenorrhoea and premenstrual symptoms. The young females also reported high perceived stress. It was seen that a large population of reproductive age women suffered from menstruation related health issues. Menstrual problems impose a huge economic burden among the female population. Dysmenorrhea was noted as the most prevalent among the menstrual disorders and has the potential to cause women to become bed ridden. The other menstrual problem that can affect women 's normal life is premenstrual syndrome. Menstrual disorders like menorrhagia, abnormal uterine bleeding and polymenorrhagia contribute to 12 % of gynaecology referrals and are associated with high chance of being treated with surgical intervention. The cause of menstrual problems can be attributed to many factors like age , ethnicity, family history, physical activity and dietary habits. It has been reported that 4.1 % of South Indian women experience longer menstrual periods.

The relationship between iron deficiency anaemia and menstruation is that menstrual blood loss is the most common cause of iron deficiency and iron – deficiency anaemia. Women with heavy menstrual bleeding are at higher risk of developing iron deficiency anaemia. The non – haematological manifestations observed among the women of reproductive age with iron deficiency are hair loss, brittle nails , concavity of nails, koilonychia, thinning and flattening of nail , angular cheilitis characterised by ulcerations or fissures at the corners of the mouth and intense fatigue. The prevalence of iron deficiency and iron deficiency anaemia among women is high. Inspite of this, the degree of awareness among them is less. The health consequences of anaemia on the menstruating women are vast and is found to have an impact on the physical health, psychological health and affect the overall wellbeing of women. (Fernandez – Jimenez *et al*., 2020). Kocaoz *et al*., 2019 investigated the prevalence and impact of heavy menstrual bleeding on anaemia , fatigue and the quality of life in women of reproductive age. The prevalence of heavy menstrual bleeding in women of reproductive age

was 37.9 %. Heavy menstrual bleeding is highly prevalent among women and is found to decrease the haemoglobin and serum ferritin levels in the body , which further leads to anaemia. This shows that there is a link between anaemia and menstrual abnormalities. Heavy menstrual bleeding has an impact on anaemia.

It is important to prevent and resolve the health problems caused by heavy menstrual bleeding by effective measure. There are various factors that have an impact on the maintenance of reproductive health. The major factor among them is health literacy. Health literacy has a significant impact on the behaviour change that is conducive to better reproductive health. Health literacy is also found to enhance reproductive knowledge.(Kilfoyle *et al*.,2016)

Health and nutrition literacy can be improved by health and nutrition education. It is the most effective method to inculcate the importance of health and nutrition related practices to adult women. Nutrition education to promote sustainable healthy eating behaviour is a well-established intervention. The impact of nutrition education to bring about a positive change in the nutrition related behaviour of individuals is well known. The positive associations between education and diet quality (favourable dietary intake patterns) have also been reported in several other survey on women. Nutrition education is one of the most efficient methods to improve the knowledge of the women regarding the importance of making healthier choices in eating. (Khoigani.,*et al* 2018)

The optimal health of women is very essential as it contributes to physical , mental and emotional wellbeing. The global burden of diseases among women has changed significantly over the past decades. Iron deficiency and anaemia are the global health problem. It is also a major cause of morbidity in women. Menstrual blood loss leads to iron deficiency. Iron deficiency has notable effects on the quality of life of women which leads to tiredness , reduced work capacity and poor exercise performance. The burden of anaemia and iron deficiency which the women population are living with, shows the limitation of the prevailing strategies to recognise , prevent and treat the condition. The advantageous factor in understanding the potential relationship between inadequate iron status and menstrual health is, it paves the way for a healthier generation of women population and improves the reproductive health of women. (Benson *et al*.,2021).

This present study carried out to find out the dietary iron status of adult women of age 20 -25 years and the impact of inadequate iron status on menstrual health. This study helps to throw light on the dietary iron status of women belonging to the age group 20 to 25 years and study

the dietary consumption pattern of women. This study also aims to study the various menstrual problems that the women undergo and to find the interrelationship between inadequate iron status and menstrual health. Though there are many studies done on the types of anaemia and iron deficiency lesser studies are done regarding the relationship of dietary iron status and its impact on menstrual health. The study can contribute to better dietary practices and enhance the intake of iron rich foods and also helps in self-evaluation of the menstrual health and hygienic practices that can promote better health and hygiene status among the female population in their reproductive phase of life.

Hence the study entitled "Dietary Iron Status of Adult Women and Its Relationship with Menstrual Health" was conducted with the following objectives:

- To assess the dietary iron status of adult women in the age group of 20 – 25 years.
- To analyse the relationship between iron status and its effect on menstrual health.
- To create awareness among women about the importance of nutritious diet and iron rich foods to prevent anaemia.
- To give health education to women about the importance of menstrual health and hygiene and its relationship with iron status.

REVIEW OF LITERATURE

II REVIEW OF LITERATURE

The review of literature pertaining to the study entitled "**Dietary Iron Status of Adult Women and Its Relationship with Menstrual health**" is presented under the following headers.

1.Prevalence of Anaemia and its causes

2.Impact of anaemia on women 's health

3.The importance of dietary iron and factors affecting its bioavailability

4.Menstrual health related issues

5.Menstrual hygiene and its importance

1.Prevalence of Anaemia and its causes

Anaemia is a globally widespread public health problem especially among women. Anaemia is defined as a condition in which the concentration of blood haemoglobin decreases. Anaemia is found to affect around 2.36 billion individuals globally. More than 20 % of women are iron deficient in their reproductive age. It affects globally both the developing and developed countries and is the leading cause of nutritional deficiency. (Percy *et al., 2017*)

According to the reports published by the National Family Health Survey 5 (NFHS-5) which was conducted between 2019 to 2021,it was inferred that 54.1 percent of non – pregnant women of urban area and 58.7 per cent of rural area between the age group of fifteen to forty – nine years were anaemic. It was found that around 45.7 per cent of pregnant women of urban area and 54.3 per cent of rural area between the age groups 15 – 49 years , 53.8 per cent of all women in urban area and 58.5 per cent of all women in rural area between the age group of 15 to 49 years were anaemic in India. (National Family Health Survey , 2019 – 2021)

The women and children population are more susceptible to anaemia. It is defined as the second most leading cause of maternal mortality in the country. Among the developing countries , the incidence of anaemia is found to be highest in India. (Kalaivani *et al.,* 2018).

Little et al ,2018 reported that from a study done on men and non-pregnant women of age group 20 years and above, the results obtained revealed various information about the prevalence of anaemia. The anaemia prevalence among women was 57.2 % whereas among men the prevalence was 39.3%.The high prevalence of mild and moderate forms of anaemia among women was found to be associated with factors like television ownership, livestock

ownership, refined grain consumption, low dietary iron intake, low meat consumption and commercial agricultural production. The main remark from this study is that both men and women of South India may be chiefly defenceless to anaemia.(Little *et al.*,2018).

A study was conducted to assess the prevalence of anaemia among 250 women residents of Coimbatore district in Tamil Nadu. The results obtained from the study showed that around 35.6 per cent of women had normal haemoglobin level. The majority of the women population around 58 per cent was found to be moderately anaemic and four percent of women were found to be severely anaemic. Among 250 women the majority that is 64.4 percent had anaemia with the mean haemoglobin level 11.16 ±1.66. (Sathya *et al.*, 2017)

Anaemia is characterised by the reduction in red blood cell (RBC) mass. The decrease in red blood cell may be of any causes. The major causes of anaemia are various. Anaemia can be triggered by the decreased or abnormal erythropoiesis, or due to immense blood loss and another factor is due to truncated life span of red blood cell. The most usual cause is iron deficiency.(Powell *et al.*,2016).

Anaemia is a global health concern affecting children ,women and the elderly. It is also a cause of co-morbidity in multiple medical conditions. The causes of anaemia are variable and attributed to several risk factors. The risk factors associated with anaemia are decreased dietary iron intake and absorption or increased demand or loss of iron. An individual may face multiple aetiologies often co – existing with one another. The symptoms associated with anaemia may be non- specific.(Cappellini *et al* .,2020).

There are various etiological factors contributing to Anaemia. Schop *et al* .,2020 carried out an analysis to find out the etiological factors using extensive laboratory analysis. The results showed that the etiological factors of anaemia consisted of single aetiology and multiple aetiologies. The most common single cause was iron deficiency and anaemia of chronic disease. The most common cause of anaemia due to multiple aetiologies were folic acid deficiency and suspected bone marrow disease. Certain type of anaemia like the incidence of iron – deficiency anaemia is found to decrease with age. Based on the gender it was found that the anaemia due to chronic disease is more common among men and iron – deficiency anaemia is more common among women.

The causes of iron deficiency anaemia vary among different populations and it depends on various factors like age , gender, ethnicity and socioeconomic status. The contributing factors

of anaemia are multiple. It is inferred that heavy menses which is characterised by menstrual bleeding for more than seven days and blood clots in premenopausal women and low intake of red meat and occult gastrointestinal bleeding from gastrointestinal tract in men and postmenopausal women were found to be associated with severe anaemia. The most common cause of anaemia is menses followed by nutrition. (Abate *et al.,2021)*

The deficiencies of vitamin B12 and folate are found to be associated with anaemia. They are called as anaemia due to vitamin deficiencies. The type of anaemia caused by the deficiency of vitamin is called megaloblastic anaemia. The mechanism of megaloblastic anaemia in most of the cases is ineffective erythropoiesis in the bone marrow due to the deficiency of vitamin B12 and folate. Malabsorption is the most common cause of vitamin B12 deficiency and the reason for folate deficiency is inadequate dietary intake.(Green *et al.*, 2017)

In India , 50 % of women of reproductive age are anaemic. The other causative factor that is found to be a major contributory reason in anaemia is gender norms. In India gender inequalities negatively affect women, as the all the decisions made in the family is male dominated. The unequal gender norms that may affect the prevalence of anaemia among women of reproductive age are due to double burden of work women lack the time to do health check-ups to find out anaemia , women are always anticipated to prioritize the health of the family than their own health. The other unequal gender norms that contribute to anaemia among women are women lack the independence to seek the health care. Men are primary source of income and they decide on what the money has to be spent , this reduces the ability of the women to buy iron rich foods or other house hold resources. Women often eat what is left over after the whole family has taken their meals , which leaves them with little food to eat which is usually less in quantity and deficient in nutrients.(Sedlander *et al.*,2021).

2.Impact of anaemia on women's health

Anaemia is the most common nutritional problem that affect the people 's health status all around the world. Anaemia at any age has significant impact on the health and has a negative impact on the individual. National Nutritional Prophylaxis programme (NNAPP) was started in India as early as 1970 to control anaemia. Though there are many strategies developed to combat anaemia , it is a prevailing condition. It is intolerable to have high prevalence of anaemia when the nation is working towards achieving sustainable developmental goals. The prevalence of anaemia among tribal women and children were much higher in the range of 78.3% to 96.5%.(Rakesh., 2017).

Anaemia affects more than 500 million women of reproductive age worldwide. It is measured as major public health concern especially affecting women of developing countries. Anaemia is found to cause various physiological problems among women like weakness, weakened tissue oxygen delivery, fatigue , loss of productivity, reduced work capacity , impair cognitive capacity, enhances the individual 's susceptibility to infections. It is the major contributor to maternal mortality and morbidity. (Jamnok *et al.,* 2020)

Anaemia has an undesirable impact on women and children population and also on the economic growth of the country. It has adverse effects on the women of reproductive age and causes miscarriages/still birth and maternal mortality. It also results in poor feto – neonatal outcomes like low-birth-weight infants, preterm birth , depletion of the iron stores of the new-born infant and increases the rate of infant mortality. (Teshale *et al*.,2020)

The impact of iron – deficiency anaemia especially on women is high. It has antagonistic effects on women who are pregnant and affects the maternal and foetal wellbeing. The mothers who are iron deficient experience breathing difficulties, tiredness, fainting , palpitations and sleep difficulties. The rate of developing perinatal infection, pre – eclampsia and bleeding are relatively high among anaemic pregnant women. The perinatal outcomes among women of developing countries include intrauterine growth retardation, prematurity and low birth weight. Anaemia in post-partum stages causes cognitive impairment and behavioural abnormalities.(Abu-Ouf and Jan 2015)

Anaemia is one of the most common conditions that has major impact on pregnancies. Maternal anaemia had been associated with increased risk of both maternal and neonatal outcomes. Hypertension experienced by anaemic women during pregnancy is called as gestational hypertension. Eclampsia, antepartum haemorrhage, postpartum haemorrhage, transfusions, induction of labour, and urgent caesarean section were significantly more common among anaemic women than non – anaemic women. The infants born to anaemic women faced adverse neonatal outcomes like small for gestational age , early neonatal death, still birth, preterm delivery, birth asphyxia and foetal anaemia.(Mahmood *et al*.,2019)

A study by Beckert *et al.,*2019, to describe the adverse maternal and neonatal outcomes in women with anaemia in pregnancy showed that anaemic mothers were more likely to suffer from hypertension, diabetes , placental abruption or chorioamnionitis. The pregnant women with anaemia were more likely to require a blood transfusion or admission to intensive care unit. The infants born to anaemic mothers were more likely to be preterm. Anaemia during

pregnancy was associated with higher risk of peri – partum , intra – partum , post – partum complications for the mother.

Lee *et al.,*2020 opined that there is an association between iron deficiency anaemia and psychosocial problems. The iron deficiency group were found to suffer from various disorders like anxiety disorders , bipolar disorders , depression , sleep disorders and psychotic disorders. Anaemia due to iron deficiency is also found to cause physiological problems like tiredness , unusual fatigue, headaches, dizziness, restless legs , impaired immune function , pica. Studies showed that women who suffered from heavy and prolonged menstrual bleeding as well as pregnant and lactating women were at higher risk of developing iron deficiency. Iron deficiency was associated with increased risk of sleep related disorders. The sleep quality was affected by anaemia due to iron deficiency.

Iron deficiency is the major cause of anaemia among women of reproductive age. It is found to cause deterioration in productivity, decreased academic performance. Iron is required for the proper myelination of the spinal cord and cerebral folds of the white matter of the brain. The failure to deliver iron to these cells cause delay in motor maturation. Iron deficiency anaemia can cause depression, irritability, sleepiness, fatigue, mood disorders and has effects that diminish the quality of life. Iron is related to brain functions, cognition and behaviour including emotional behaviour.(Noorazar *et al.,*2015)

The various signs that are noted in iron deficiency anaemia are paleness of skin, lethargy , headache , tinnitus, loss of appetite. Damages to the cognitive and intellectual functions can also be observed. The monoamines in the brain are metabolised properly by iron , hence a deficiency in iron causes symptoms like apathy, drowsiness, irritability and attention loss. Anaemia due to iron deficiency has various emotional and behavioural outcomes. Sleep is the period of physiological , periodic and reversible changes in consciousness and behaviour. Iron deficiency anaemia is found to affect the quality of sleep.(Murat *et al*., 2015)

3. The importance of Dietary Iron and factors affecting its bioavailability

Iron is essential for various physiological processes. It is an important nutrient that cannot be synthesised in the body and should be made available through the diet. Food is the main and natural source of supply of this nutrient to the body. The human body continuously losses iron and it is very essential to replace the nutrient through proper food intake. Food satisfies only 5 to 10 % of the iron requirements. Various factors influence the iron needs, such as basal physiological iron loss, menstrual iron loss, foetal requirements in pregnancy, elevated

requirements during growth stages of life and iron storage. Menstruating women loose around 0.5 mg per day. So women of reproductive age require higher intake of iron. Iron intake is very crucial for women of reproductive age to replenish the lost iron in the blood during menstrual cycle. The dietary iron is of two types , heme and non-heme. The foods derived from animals mainly meat , fish , poultry and eggs come under heme and all plant derived foods come under non-heme iron. (Coad and Pedley,2014)

The role of iron in the health and diseases is known to man from ancient times. Iron has been used in traditional medicine by people . Low iron intake and or bioavailability are the major causes of nearly half of the anaemia in developing countries. The body has two – thirds of the iron stored in the haemoglobin present in circulating erythrocytes. The total body iron in women is 2.3 g ,with almost 60 to 70 percent is incorporated in the circulating protein haemoglobin , 20 per cent in iron deposits of ferritin , and about 15 percent in other proteins like myoglobin in muscle tissue together with non – heme and heme enzymes and iron transport proteins. The blood content of this metal is referred to as marital status. (Briguglio *et al.,* 2020)

Dietary iron intake is of prime importance as the mineral is involved in various functions in the body. Lack of dietary iron leads to iron deficiency in women. Iron deficiency is associated with impaired physical work capacity, reduced mood and cognitive function and poor pregnancy outcomes. When there is a lack of dietary intake of iron the individual ‘s iron status falls continuously and therefore iron deficiency is an increased risk factor to anaemia. Dietary factors play a prominent role in the development of iron deficiency and subsequent development of iron deficiency anaemia. The iron store in the body is affected by menstruation and the iron bioavailability of individual foods consumed within a diet. Young women in industrialized countries are vulnerable to iron deficiency. The dietary iron intake is based on the intake of iron rich foods, iron inhibitors , enhancers of iron absorption.(Beck *et al*., 2014)

Iron is present in the human diet in number of forms which includes heme from meat and variety of non – heme iron compounds. Absorption of heme iron is 20 to 30 percent, though it constitutes a smaller part of the diet and it is highly bioavailable. The absorption of non – heme iron is variable and is affected by other dietary components , with 1 to 10 percent of absorption. There are various dietary compounds from food that are capable of interacting with the iron absorption. In addition to the dietary factors the iron status of the body also affects the absorption rate. Low iron status of the body increases the absorption of iron and high iron status

of the body decreases absorption. Iron balance is controlled by iron absorption by the gut enterocytes.(Sharp, 2010)

Heme and non – heme iron are the two types of iron present in food. Non heme iron contributes to more iron nutrition than heme iron Inspite of its low bioavailability. A number of dietary factors influence iron absorption. Ascorbate and citrate increase iron intake by acting as weak chelators to help solubilize the iron in the duodenum. Ascorbic acid has the power to overcome the inhibitory effect on absorption of all iron inhibitors which include phytates, polyphenols, and calcium and proteins in milk. In fruits and vegetables, the enhancing effect of ascorbic acid is repressed by polyphenols. The vegetarian diet consists of only ascorbic acid as iron enhancer. The other iron enhancers are meat , fish and poultry. The iron absorption inhibitors are phytates that are present in cereals and pulses, polyphenols that are present in vegetables, fruits, tea , coffee and wine , calcium, egg proteins and albumin, casein , whey, egg white and soybean proteins. The iron competitors that share the iron intestinal absorption sites are lead, manganese, cobalt and zinc. (Abbaspour *et al.*,2014)

In the individuals who exhibit low intakes of heme iron and low intakes of iron enhancing factors and or high intakes of iron inhibitors , iron absorption may be an issue. The polyphenol content of tea is found to reduce the iron absorption in both iron deficient women and non-anaemic women. The intake of such beverages should be done between meals and not along with the meals. To maintain the balance between the sum of losses plus the iron required for growth in infants, children, adolescents, pregnant mothers and the iron required for normal body functions must be provided by the diet. Considering the iron bioavailability affecting factors like inhibitors and iron enhancers and competitors that affect the absorption of iron , the intake of iron from the diet should be planned. (Lazrak *et al.,2021)*

4.Menstrual health related issues

Menstrual disorders are common among women of reproductive age and it has an impact on the day-to-day activities of women. It affects the quality of life of women. In a community based cross- sectional study among women who have attained menarche , it was seen that from a total of 119 women majority of them suffered from menstrual problems. The prevalence of dysmenorrhea was 45 % and that of menorrhagia was 17%. The most common menstrual problems among women of reproductive age are irregular menstrual cycles, menorrhagia, dysmenorrhea and white discharge. These problems had an impact on the quality of life of women and were found to be responsible for physical , behavioural and emotional changes that

happens during menstrual cycle. The most common systemic complaints during periods are headache, sleeplessness, giddiness, nausea and vomiting .These disorders had an impact on the normal functioning of women and their social life. In India , due to cultural taboos the menstrual problems are often unreported. (Lakshman *et al.*, 2019).

The study conducted by Mohite *et al.*,2013 in India showed that oligomenorrhea , menorrhagia , hypomenorrhea , dysmenorrhea and premenstrual syndrome was meaningfully associated with anaemia. The poor nutritional status and anaemia were found to be linked to the causing of the common menstrual problems. Menstrual problems are often neglected thinking it is not a major health concern and it is not related to health agenda especially for women in developing countries. Physical ,mental, psychological , social , reproductive problems are often associated with menstrual problems. Menstrual irregularity refers to the changes occurring in the onset , frequency , duration of flow , volume of menstrual blood. The high prevalence of irregular menstruation was observed among the age groups 21- 25 years.

The other major menstruation related problem is irregular periods. Irregular menstruation is a form of abnormal menstruation can enable the women to face various health problems. The cause of this may be attributed to hormonal imbalance, medications, drug – treated depression, type 2 diabetes, endometriosis, underweight , obesity and reproductive factors like age at menarche and parity and stress. In the age of 20 to 30 women experience various menstruation related problems like amenorrhea , menstrual pain, abnormal uterine bleeding . women with such menstrual problems often show poor health status. The menstrual cycle is an indicator of general health status of women. The menstrual problems are considered crucial among working women as it affects their psychological status causing health – related anxiety and frustration.(Kwak et al , 2019)

Abnormal uterine bleeding is a condition in which the bleeding from the corpus luteum is abnormal in duration, volume, frequency, irregularity. The abnormal uterine bleeding has adverse effects on physical , mental , social aspects of women and decrease the quality of life of female population. Heavy menstrual bleeding (HMB) is the most common symptom of abnormal uterine bleeding. (Whitaker and Critchley.,2016)

Heavy menstrual bleeding (HMB) is a common problem that has an significant impact on the women population. It majorly affects the quality of life of women and the activities of daily life. Heavy menstrual bleeding is defined as a menstrual blood loss (MBL) of 80 ml or greater. A normal menstrual cycle is characterised by the menstrual bleeding of 4.5 – 8 days with an

interval of 24 -38 days. Most of the blood is lost during the first two days of the cycle .The average blood loss during normal flow is ≤3o ml and menstrual blood loss more than 80 ml is considered abnormal. Heavy menstrual bleeding has a great influence on the physical , psychological , social , professional and family atmospheres. It also results in decreased work productivity , limited social activities and fear of embarrassment.(Sriprasert *et al*., 2017)

Women of reproductive age face certain symptoms during late luteal phase of their cycle and these symptoms are collectively termed as premenstrual symptoms. Dysmenorrhea is a very common condition which is often associated with painful menstrual cramps. There are two main types of dysmenorrhea that is primary and secondary dysmenorrhea. Primary dysmenorrhea is a condition which is characterised by menstrual pain without any pelvic pathology. The primary dysmenorrhea is found to affect around 50 % of menstruating women. Dysmenorrhea is often associated with abdominal pain. The pain associated with dysmenorrhea was reported to be very severe by the study population. The menstrual blood often occurred with clots of normal size. The presence of clots was related to dysmenorrhea.(Kural *et al.*,2015)

Menstrual irregularities like dysmenorrhea are found to be associated with anaemia but showed less association with obesity. Subject who had menstrual irregularities had pale colour of conjunctiva. The incidence of menstrual abnormalities like oligomenorrhea , poly menorrhagia and irregular pattern were observed to be high. These abnormalities and condition contribute to anaemia in women of reproductive age. Polymenorrhagia and menorrhagia are common risk factors of anaemia.(Qazi *et al*.,2019)

The prevalence of physical and emotional symptoms among women of reproductive age is high before the onset of menstruation. These symptoms are called as premenstrual symptom. These symptoms are found to have a negative impact on women and it interferes with their mental health, interpersonal relationship and studies. It is found that the prevalence of premenstrual syndrome is higher among women who are unmarried and in women aged 35 – 44 years and in women who belong to socially deprived areas and low socioeconomic group. The premenstrual syndrome includes a series of indications like abdominal bloating and cramps. The common psychological symptoms include mood swings and irritability, the other symptoms include back pain . muscle pain, joint pain and breast tenderness as the most prevalent. The other signs also experienced by women before menstruation include skin disorders, swelling of extremities , gastrointestinal problems like decreased appetite and

headaches. These premenstrual symptoms should be treated with utmost care.(Mohib *et al.*, 2018).

5.Menstrual hygiene and its importance

The definition for menstrual hygiene given by the United Nations is "Women and adolescent girls using a clean menstrual management material to absorb or collect blood that can be changed in privacy as often as necessary for the duration of the menstruation period , using soap and water for washing the body as required , and having access to facilities to dispose of used menstrual management materials". In resource – poor countries the insanitary practices adversely affect the health of adolescents and women. The various impediments to proper following of menstrual hygiene are lack of support from family, teasing by peer group, accidental menstrual soiling of clothes, lack of acceptance of new or alternative menstrual products due to cultural hindrance .Women and adolescents face many barriers in achieving adequate menstrual management. Menstrual hygiene management is imperative but it is often unrecognised. Menstrual hygiene management is highly correlated with the social development , empowerment and education of the women population. (Kuhlmann *et al ,* 2017)

Menstrual hygienic practices are a set of healthcare needs and requirements of women during the menstrual cycle and is essential for overall hygiene for women and adolescent girls between the onset of menarche and menopause. The menstrual period of women is the most vulnerable period of life. Improper hygienic practices during menstrual cycle are the main causes of various health issues especially reproductive tract infections, various sexually transmitted diseases and urinary tract infections. Menstruation is a major indicator of reproductive health. The menstrual hygienic practices play a major role. Menstruation is a natural process but is often surrounded with various perceptions , religious barriers and practices within the community , which sometimes result in adverse health issues. Menstrual hygiene is an important factor that has to be considered as it has an impact on the rates of morbidity and mortality of female population. It is very important to teach such hygienic practices from childhood as it may lead to future safe practices.(Deshpande *et al.,*2018).

The menstrual practices are even now subjected to various socio-cultural restrictions. It was observed that many adolescent girls and the women population were oblivious about the scientific details behind menstruation and also did not know the importance of hygienic practices to be followed and their relationship with opposing health outcomes. It is important to discuss about menstruation in public and its relation with good health. There was found to

be a relation between the household decision making power of women to the use of hygienic practices during menstruation. The use of menstrual hygiene products and women empowerment was closely related. It was revealed that overall, more than one – thirds of women in age group of 15 – 24 years were still using unhygienic method during menstruation to manage blood stains. The usage of cloth and other means of unsanitary methods was due to its easy accessibility.(Vishwakarma *et al.*,2020)

In a study conducted by Afiaz and Biswas.,2021, it was seen that only a quarter of women around 24.3% used modern absorbents. The study showed that majority of the person were using unhygienic traditional practices. The use of modern absorbents was mostly concentrated in cities. It was seen that majority of women in the developed and developing countries failed to follow hygienic practices irrespective of their knowledge on hygiene due to adverse socio-cultural views and stigmatisation of menstruation. Menstrual hygiene management is gaining importance. It is a growing public health concern in various low- and middle-income countries for its association with various health problems.

The study conducted among the women of India by Anand *et al.,* 2015 revealed many important findings. There was found to be a positive association between the socio – economic status of women and the use of hygienic practices during menstruation. Only a small percentage of women were found to use sanitary pad. Women who followed unhygienic practices showed higher incidence of vaginal discharge and reproductive tract infections (RTI). Unhygienic practices during menstruation are the major cause of reproductive morbidity. Awareness, affordability and privacy are the major factors that has to be strengthened to make more women use sanitary napkins.

Kaur *et al.*,2018 stated through his study that the importance of sanitary practices during menstruation is often overlooked. The menstrual hygiene practices are still subjected to various taboos , social, cultural and religious restrictions. These restrictions impose a barrier against the menstrual hygiene management. It is the need of the hour to promote menstrual hygiene. Girls and women should be educated about the hazards of disposing used napkins in toilet flush. This study revealed that the lack of privacy is a major concern both in household and schools. The other factors that affect the sanitary practices were ignorance , fallacies , unsafe practices and illiteracy of the mother and child regarding menstruation is the root cause of many problems.

The management of menstruation hygienically is vital to the overall wellbeing and dignity of women. It is a major component of basic hygiene, sanitation and reproductive health services. May 28th is observed as Menstrual Hygiene Day worldwide since 2014. This day is celebrated to create awareness regarding the obstacles which women and girls face to manage their menstrual cycle and to formulate various solutions at global , national and local levels to the issues. The availability and accessibility to clean and safe menstrual absorbents is still being a dream for many women in India. Optimal menstrual hygienic practices increase self-confidence, self-esteem and conducive to health. (Sinha and Paul.,2018).

METHODOLOGY

II. METHODOLOGY

The methodology pertaining to the study on “Dietary Iron status of Adult Women and Its Relationship with Menstrual Health” encompassed the following phases:

Phase I Selection of area and samples

A. Selection of study area

B. Selection of women subjects

C. Framing of questionnaire for survey

Phase II Conducting online survey

A. Conducting the survey among the women subjects

B. Obtaining Ethical Clearance for the study

Phase III Developing education modules and conducting nutrition education

A. Development of education modules

B. Dissemination of nutrition and Health Education among women

C. Assessment of knowledge before and after nutrition education

Phase IV

A.Statistical analysis and Interpretation of data

Phase I Selection of area and samples

A. Selection of study area

The research topic under the study is “Dietary Iron Status of Adult Women and Its Relationship with Menstrual Health”. The initial step was the selection of area and sample. The background for selecting Coimbatore as the target area of study is as follows:

Anaemia is classified as a major public health problem in India. It is estimated that 52 per cent of non-pregnant women of reproductive age are anaemic. The primary cause of anaemia is iron deficiency which often co – exists with nutritional deficiencies. The effect of iron deficiency as a cause of anaemia varies with region. There is an adverse health outcome associated with high prevalence of anaemia among menstruating women especially iron deficiency anaemia has a major impact on the daily life of adult women The anaemia caused by iron deficiency

increased to 70 per cent in India among the premenopausal women. Iron deficiency has various health impacts on the women of reproductive age. (Chai *et al* , 2021),.Since the effect of iron deficiency as a cause of anaemia is region specific , the study was conducted in Coimbatore District to know the dietary iron status of the selected adult women subjects of Coimbatore and as it is one of the most populated and industrialised district of Tamil Nadu. Another aspect for selecting Coimbatore as the place of study was due to the investigator 's familiarity with the place and people of the city.

B. Selection of women subjects

Sampling is defined as the process of selecting the individuals or sampling units from the sampling frame. To answer a research question, it is difficult to collect data from all the cases. Thus, here comes the need of sampling. (Martinez – Mesa ,J et al, 2014).

The sample selection for the study was done by the following methods. The first step was that the target population was clearly defined. Population is commonly related to the number of people living in a particular place. In this stage the sampling frame was formulated. The sampling frame is the group of individuals that is selected from the target population by using the sampling method specified in the study. The sampling frame was selected in such a manner that it is the representative of the entire population. After this, the type of sampling method was selected. The sampling method selected was purposive sampling which is a type of non-probability sampling method.

Non probability sampling is a method in which some rationale is required for the inclusion of some cases or individuals rather than others. Purposive sampling is also called as judgemental sampling in which particular people are selected purposively in order to provide important information that cannot be produced by others. (Taherdoost , 2016)

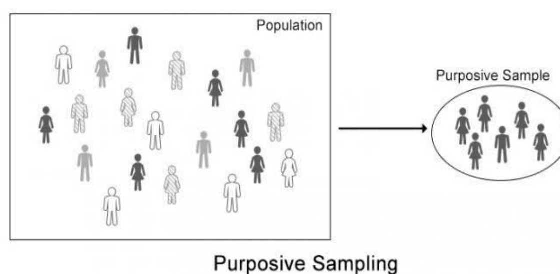

Figure 1 Purposive Sampling

The target population was selected as adult women of age group 20 to 25 years. The target population was defined as narrow as possible to aid in proper sample selection. The type of sampling used was purposive sampling method. The reason for selecting purposive type of sampling is it is one of the most cost – effective and less time - consuming sampling method. The judgement used to select the respondents are adult women between the age group of 20 to 25.The sample was decided in a such a way that it provided maximum information on the topic of study. The number of respondents was decided as 200 adult women of age group 20 – 25 years.

The samples were selected based on the following inclusion and exclusion criteria

Inclusion criteria

- 20 to 25 years old women
- Non- pregnant and non – lactating women
- Women who are willing to cooperate in the study
- Women without any chronic illness

Exclusion criteria

- Pregnant and lactating women
- People with chronic disease
- Women who are non – cooperative for the study

C. Framing of questionnaire for survey

The most important aspect of a survey is questionnaire. The effectiveness of the data depends on the type of questions asked in a questionnaire. The questionnaire forms the backbone of the study. The questionnaire framed for the study is presented in Appendix I. The questionnaire was prepared in such a way that it was simple and easier to understand by the respondents and the probability of getting the right answer was increased. The questionnaire was equipped with questions that helped to collect all necessary information. The number of questions was also an important consideration that was made as too many questions may yield less responses , and the respondents will become impatient to fill the lengthy questionnaire. The questions were carefully framed to stick to the objectives of the study and yield the relevant data.

The questionnaire consisted of questions based on the following categories. Background information which entailed of the basic information such as name, age , educational qualification and occupation of the respondent. The next heading was economic profile in which the monthly income of the family was asked. The next category of questions asked were the anthropometric measurements like height , weight , body mass index, waist circumference , hip circumference and waist / hip ratio. The formula and method to calculate the anthropometric measurements was given in the form of pictures for easier understanding and application. The next header was lifestyle pattern , this included questions on the type of activity performed , type of physical exercise performed along with its duration. The details on dietary pattern which included questions on diet restrictions , skipping of meals , how many meals consumed per day , description of one 's appetite and the type of snacks consumed. The daily food consumption pattern which had a tabulation of foods from the various food groups and the frequency of consumption was also included in the questionnaire. Next category of questions was related to the clinical signs and symptoms of anaemia, in this category the various signs and symptoms of anaemia related to the different organs in the body was given. Questions on the practices and knowledge towards anaemia was collected to analyse the faulty practices and knowledge gaps that has to be changed .The data related to menstruation comprised questions such as the age of onset of menarche, duration of menstruation, the volume of menstrual blood flow, the psychological and physiological problems experienced during menstrual cycle. The last category of questions were based on the practices towards menstrual health , the questions asked were the type of absorbent used, the time interval between the change of sanitary absorbents , the method of disposal of sanitary pads.

Phase II Conducting online survey

A. Conducting the survey among the women subjects

The survey was conducted online . Online surveys are internet – based survey tool with advantages and disadvantages in every survey stage. Considering these advantages online survey is found to be beneficial in data collection.(Nayak and Narayan , 2019).

The online mode of survey was selected due to the pandemic condition and to decrease the direct contact with the respondents. The online platform for conducting the survey was done using google forms. The data collection process for the survey was done through the use of questionnaire. The questionnaire was posted online in the google form. It collected each and every data and stored it and displayed it as responses. The google forms recorded each and

every data which can was analysed and was used for interpretation. The survey was conducted by posting the link to fill the questionnaire to the target population in social media platforms like WhatsApp, Instagram and for those who are not in either of these platforms the link was mailed to their personal mail Id with consistent follow – up. The responses got recorded as soon as the respondent filled the survey and submitted it. The survey method gives quantitative data and the success of the survey depends on the type of questionnaire. The survey method was selected as it provides high representativeness and is an economical method. It is a convenient data gathering method that can be done in this pandemic period. It has good statistical significance and the results are reliable with no bias. It displays the data in the form of tabulations , pie chart and bar diagrams. This helps to understand and interpret the data easily. The respondents were communicated through a mail of their response along with a short message to thank them for participating in the study. The survey gives precise results. It can be conducted at low cost. It can be done in a short period of time. It can be paused and restarted whenever required.

B. Obtaining Ethical Clearance for the study

The Ethical application form explaining the protocols used in the research study was submitted to the Ethical Committee of the Avinashilingam Institute and Ethical Clearance was obtained. The Ethical Approval form is attached in the Appendix II and the approval number is given below.

IHEC Approval number: AUW/IHEC/FSN-21-22/XPD-21

Phase III Developing education modules and conducting nutrition education

A. **Development of education modules**

Nutrition education is a term that denotes a broad vision. The term encircles various educational strategies and environmental tools to create a healthier food intake practice, sustainable food choices and eating pattern. It is the most widely used method to deliver healthy diet and nutrition education. It is used for a range of population groups and is a medium of information delivery. There are various modes of nutrition education interventions. The study conducted on to check the effectiveness of nutrition education in disseminating the nutrition information showed that it had a beneficial impact in dietary changes of the study population. (Lua and Elena, 2012)

The nutrition and health education were conducted by creating an audio-visual aid. An audio-visual aid is a useful method in providing clarity of the information. As the target audience used both their visual and auditory senses it enhanced their understanding. The type of audio-visual aid used were You Tube videos which were made of short duration in an innovative manner to attract the attention of the target population. The nutrition and health education videos were prepared with voice over explaining all information given in the video. The video also consisted of pictures synchronizing with the information given. Totally there were six videos , among which three were based on nutrition education and three were based on health education.

B.Dissemination of Nutrition and Health Education among selected women subjects

The nutrition and health education were conducted for adult women of age group 20 to 25 years. "Nutrition education is an education for life". The nutrition and health education videos were created to enlighten women on the importance of maintaining the health and nutritional status. The main "motto" behind the videos were "Women 's Health Matters". All the six videos consisted of quotes related to women 's health at the end. The nutrition and health education videos were posted online in the YouTube platform and the link for the video were sent to the respondents.

The name of the You Tube channel is "Health and Nutrition Education Channel"

The nutrition education was planned with the following aims:

- To create awareness among women about the importance of nutritious diet and important nutrients during reproductive years and the steps to make the diet nutritious
- To emphasize the role of iron rich foods in treating anaemia.

Video 1 Nutritious diet and its importance

The video dealt with the details about what is nutritious diet , the type of nutrients in food , macro and micro nutrients their recommended intake and functions in the body and the importance of nutritious diet. The duration of this video was 5 minutes and 35 seconds.

The link for the video was https://youtu.be/xHLrheyrp-8

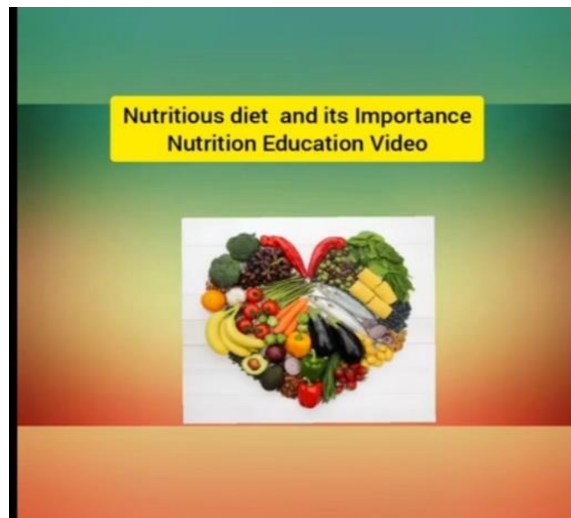

PLATE 1 NUTRITIOUS DIET AND ITS IMPORTANCE

Video 2 Important nutrients for women during reproductive years and steps to make the diet nutritious

In this video the topics covered were the important nutrients for women during reproductive years their function and food sources , balanced diet , food pyramid and steps to be followed to make the diet nutritious. The duration of this video was 6 minutes and 41 seconds.

The link for the video was https://youtu.be/jLg9UmQNb1Y

PLATE 2 IMPORTANT NUTRIENTS FOR WOMEN DURING REPRODUCTIVE YEARS AND STEPS TO MAKE THE DIET NUTRITIOUS

Video 3 The importance of Iron Rich foods in treating anaemia

The video gave information on what is anaemia, its causes , strategies to prevent anaemia , the role of iron rich foods in preventing anaemia, iron rich foods along with the iron content per 100 g , the relationship between iron rich foods and vitamin C ,vitamin C rich foods and the content of vitamin C per 100 g. The duration of the video was 5 minutes and 1 seconds.

The link for the video was https://youtu.be/Ea_nPmGRkow

PLATE 3 IMPORTANCE OF IRON RICH FOODS IN TREATING ANAEMIA

The health education is conducted with the following aims

- To enhance the motivation of people to adopt hygienic practices during menstruation and to educate women the importance of proper nutritional intake during menstrual cycle.

Video 4 Health benefits of iron and possible problems due to iron deficiency

The video dealt with the health benefits of iron like anaemia treatment , haemoglobin concentration , boosting of energy and combating fatigue and possible problems due to iron deficiency in the body. The duration of the video was 4 minutes and 29 seconds.

The link for the video was https://youtu.be/AbLzAJ14xag

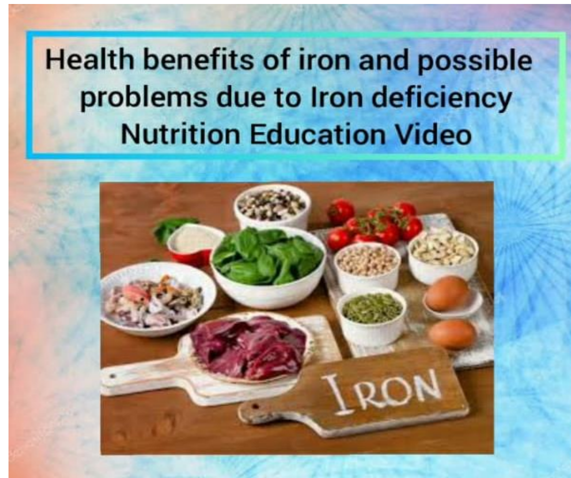

PLATE 4 HEALTH BENEFITS OF IRON AND PROBLEMS DUE TO IRON DEFICIENCY

Video 5 Steps to maintain menstrual hygiene and improve menstrual health

The video gave information on the definition of menstrual health and the importance of menstrual health. The video also suggested eleven simple steps that can be followed to uphold and recover the menstrual health and hygiene in a descriptive manner. The duration of the video was 3 minutes and 47 seconds.

The link for the video was https://youtu.be/jLg9UmQNb1Y

PLATE 5 STEPS TO MAINTAIN MENSTRUAL HYGIENE AND IMPROVE MENSTRUAL HEALTH

Video 6 Relationship between iron status and menstrual health

The video consisted information on the role of iron in blood and the major mechanisms that cause the loss of iron from the body and the relationship between iron status ,menstrual health and the impacts of low iron status on menstrual health and the symptoms caused during the menstrual cycle which is associated with iron status. The duration of the video was 3 minutes and 39 seconds.

The link for the video was https://youtu.be/L3EXSFPd-Xo

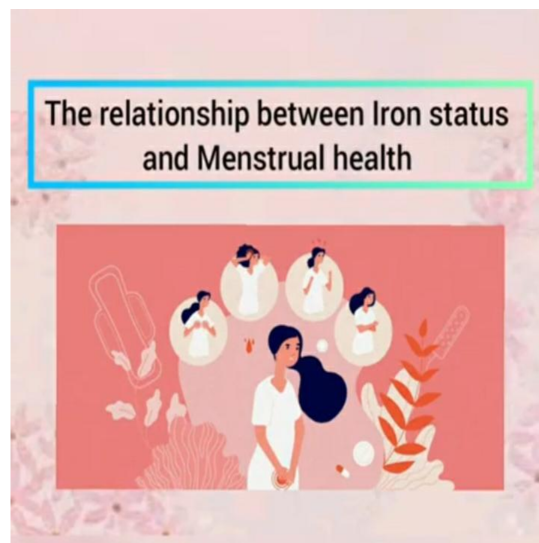

PLATE 6 RELATIONSHIP BETWEEN IRON STATUS AND MENSTRUAL HEALTH

The nutrition and health were conducted successfully as the education strategies were planned according to the target population age group and understanding level. The nutrition and health education were followed by a post survey to analyse the degree of fulfilment of the videos in meeting its objectives and in educating the women subjects.

C. Assessing the nutrition knowledge before and after nutrition education

The nutrition knowledge of the adult women subjects was assessed before the nutrition education by using the questionnaire that is presented in Appendix I. The questionnaire consisted of question related to the knowledge and practice related to anaemia, iron intake and menstrual health of the adult women. The survey participants were subjected to post nutrition education survey to assess the impact of nutrition education on the participant 's knowledge. After the conduct of nutrition education, the questionnaire was sent again to the selected women subjects who participated in the survey through mail , WhatsApp and Instagram. Both

the data that were collected and compared using statistical analysis to check whether there is difference in the knowledge of participants after the nutrition education.

Phase IV

A. Statistical analysis and Interpretation of data

Data consolidation is the corralling , combining and storing of varied data in a single place. Data consolidation is also referred to as data interpretation. The consolidation of data is as important as collection of data. The consolidated data helps to combine the large amount of data collected into a precise form current status of the topic under study. The consolidation process helps to manipulate different types of data and helps to convert raw data into insights that aids in faster , better decision making. Consolidation is a straight forward summation of data from multiple sources. The merging of the data is usually not a simple process.

The statistical analysis is an important method of expressing the data collected through the survey in the form of statistics. The statistical analysis helps to draw inference and its also helps in generalization of the data that is obtained from a small subset of the overall population. It helps to make sense of the large amount of data and helps to present the research in a coherent manner and with a justification. To define the statistical analysis concisely , it helps to fill the gap between information and knowledge.

The statistical tools used for the study are : Mean and Standard Deviation, Pearson Correlation Test ,Chi – Square test, Paired Sample T – Test. After statistical analysis , interpretation of data is done. The interpretation is a process of reviewing data through some predefined processes. This predefined process will help to assign certain meaning to the data and aid in arriving at conclusions. Interpretation includes arriving at results from the statistically analysed data. The main pre requisite for the data interpretation is data analysis. Data analysis is the process of data ordering , categorising followed by summarising. All these processes ultimately leads to obtaining answers for the research questions. The data interpretation is an important method and it was carefully and properly done. The collected data was consolidated , tabulated and analysed to check the dietary iron status of the selected women subjects and to find the relationship between dietary iron intake and menstrual health. The data analysed and the inferences made were documented.

RESEARCH DESIGN

Phase I

Selection of area and samples

1. Selection of study area
2. Selection of women subjects
3. Framing of questionnaire for survey

Phase II

Conducting online survey

1. Conduct of the study and data collection
2. Obtaining Ethical clearance

Phase III

Developing education modules and conducting nutrition education

1. Development of education modules

2. Dissemination of nutrition and health education among women

3. Assessment of knowledge before and after nutrition education

Phase IV

Statistical Analysis and Interpretation of data

Figure 2 Research Design

RESULTS AND DISCUSSION

IV. RESULTS AND DISCUSSION

The results of the present study entitled “Dietary Iron Status of Adult Women and Its Relationship with Menstrual Health” are presented and discussed under the following headings,

Phase I Selection of area and samples

A. Age of the women subjects

B. Socio economic background of women subjects

1. Educational status
2. Occupational status
3. Monthly income of the family

Phase II Conducting online survey

A. Nutritional status of women subjects

1.Anthropometric Measurements

a. Height and weight of selected women subjects

b. Body mass index (BMI)

c. Waist – hip ratio

d. Correlation between anthropometric measurements of the women subjects

B. Lifestyle pattern of women subjects

1.Type of activity

2.Regularity of physical exercise and duration of physical exercise

C. Dietary pattern of women subjects

1. Type of diet
2. Diet restriction , meal pattern and pattern of skipping meal
3. Presence of good appetite and description of the nature of appetite of the women subjects
4. Composition of the diet
5. Habit of consuming snacks and the type of snacks consumed by women subjects
6. Type of Beverages consumed
7. Food Consumption frequency

8. Mean dietary iron intake per day

D. Data related to Anaemia

1.Clinical signs and symptoms of anaemia

E. Menstrual health status

1. Duration of menstruation and menstrual flow
2. Psychological problems and physiological problems during menstrual cycle
3. Menstrual cramps

F. Relationship between dietary iron status and menstrual health

Phase III Developing education modules and conducting nutrition education

A. Assessment of nutritional knowledge of women subjects before and after nutrition education

Phase I Selection of area and samples

A. Age of the women subjects

Table I presents the categorization of women subjects according to their age.

TABLE I

Categorization of Women Subjects according to their Age (N=200)

Age (years) of the Women Subjects	Number	Percentage (%)
20	30	15
21	33	16.5
22	42	21
23	31	15.5
24	35	17.5
25	29	14.5
TOTAL	200	100

Among the 200 women subjects , 15 percent of the women belonged to the age of 20 years, 16.5 percent belonged to the age of 21 years, 21 percent belonged to the age of 22 years , 15.5 percent in the age group of 23 years, 17.5 percent and 14.5 percent were in the age group of 24 and 25 respectively.

B.Socio economic background of women subjects

The details pertaining to the socio - economic background of women subjects are discussed as follows.

1.Educational status

Table II presents data on the educational status of the women subjects

TABLE II

Educational Status of the Women Subjects (N=200)

Educational status of the Women Subjects	Number	Percentage (%)
Upto higher Secondary school	27	13.5
Pursuing Graduation	112	56
Undergraduate	31	15.5
Postgraduate	30	15
TOTAL	200	100

Out of the women subjects , 56 percent of the women subjects are pursuing either under graduate or post graduate degree , 15.5 percent had education upto undergraduate level and 15 percent had education upto postgraduate level. 13.5 percent had education upto higher secondary school,

2.Occupational status

Table III presents data on the occupational status of the women subjects

TABLE III

Occupational Status of the Women Subjects (N=200)

Occupation of the Women Subjects	Number	Percentage (%)
Student	112	56
Housewife	45	22.5
Government sector	29	14.5
Private sector	14	7
TOTAL	200	100

With regard to the occupation of the women subjects , 56 percent of them were students , 22.5 percent were housewives, 14.5 percent were women working in government sector, and seven percent were working in private sector.

3.Monthly Income of the family

Table IV present the details on the monthly income of the family of the women subjects

TABLE IV

Monthly Income of the Women Subjects (N=200)

Monthly income of the Women Subjects	Number	Percentage (%)
Rs 1166 – 2253	14	7
Rs 2253-3808	7	3.5
Rs 3808 – 7769	55	27.5
Rs 7770 and above	124	62
TOTAL	200	100

(Source – BG Prasad Socioeconomic Status Classification , 2021)

The 200 women subjects were classified according to the monthly income of the family as per the Socioeconomic Status Classification by BG Prasad , 2021. Among the 200 women subjects , seven percent of the family had an income of Rs 1166-2253 which comes under lower middleclass category of the socioeconomic classification, 3.5 percent belonged to middle class category as the monthly income of the family was Rs 2253- 3808, 27.5 percent belonged to a family income of Rs 3808-7769 which is the upper middle-class category and 62 percent belonged to the upper class as the monthly income of the family was Rs 7770 and above.

Phase II Conducting online survey

A.Nutritional Status of Women Subjects

The nutritional status of the women subjects was assessed by anthropometric measurements.

1.Anthropometric measurement

a. Height and weight of selected women subjects

Table V presents distribution of the women subjects according to the height and weight classification.

TABLE V

Height and Weight of the Women Subjects (N=200)

Details	Number	Percentage (%)
Height (cm) < 145	3	1.5
146 – 150	18	9
151 – 155	53	26.5
156 – 160	70	35
160 – 165	35	17.5
>165	21	10.5
TOTAL	200	100
Weight in (kgs)		
< 50	45	22.5
51 – 60	69	34.5
61- 70	38	19
71 – 80	21	10.5
> 80	27	13.5
TOTAL	200	100

Table V indicates that 1.5 percent of women subjects were less than 145 cm height , nine percent were between 146 – 150 cm height , 26.5 percent were between the height of 151- 155 cm. 35 percent of women were in the height of 156 – 160 cm , 17.5 percent were in the height of the range 160 – 165 cm and 10.5 percent were of height greater than 165 cm.With regard to weight 22.5 percent of women subjects were less than 50 kg weight, 34.5 percent were between the weight of 51 – 60 kg, 19 percent of women were of the weight between 61 – 70 kg , 10.5 percent of women had their body weight between 71 – 80 kg and 13. 5 percent of women had their body weight greater than 80 kg. it can be inferred from the data that 24 percent of the women were weighing above 70 kg and thus they were overweight and obese.

b. Body mass index (BMI)

Table VI and Figure 3 represents the Body Mass Index of the women subjects

TABLE VI

Body Mass Index of the Women Subjects (N=200)

Parameters	**BMI of the Women Subjects**	**Number**	**Percentage (%)**
Underweight	< 18.5	30	15
Normal	18.5 – 22.5	120	60
Overweight	23.0 – 24.9	30	15
Obese	> 25	20	10
	TOTAL	200	100

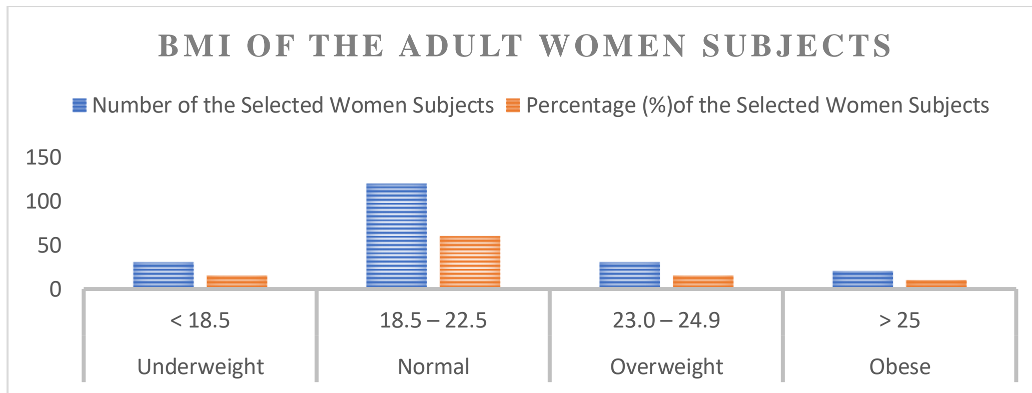

Figure 3 Body Mass Index

The Table VI and Figure 3 shows the BMI of the women subjects. Out of the women subjects, 15 percent of the women had BMI less than 18. 5 and they were under weight, 60 percent of the women had their BMI between the range of 18.5 to 22.5 and had normal BMI, 15 percent of the women subjects had their BMI between 23.0 – 24.9 and belonged to the overweight category. Ten percent of the women subjects belonged to obese category as their BMI was greater than 25. The BMI of 25 percent of women was overweight and obese, which was similar to the data given in the Table V about the weight of the subjects.

c. Waist – hip ratio

Table VII shows the waist hip ratio of the women subjects

TABLE VII

Waist Hip Ratio of Women Subjects (N=200)

Waist hip ratio	Health risk of the Women Subjects	Number	Percentage (%)
< 0.80	Low risk	99	49.5
0.81 -0.85	Moderate risk	57	28.5
> 0.85	High risk	44	22
	TOTAL	200	100

The data shows that around 49.5 percent of the women subjects had waist hip ratio values within the low - risk range of less than 0.80 , 28.5 percent of the women subjects showed moderate risk as their waist – hip ratio was between the range of 0.81 – 0.85 and 22 percent of the women subjects exhibited high risk as their waist – hip ratio was greater than 0.85.

d. Correlation between anthropometric measurements of the women subjects

Table VIII shows the correlation between anthropometric measurements of the women subjects.

TABLE VIII

Correlation between Anthropometric Measurements of the Women Subjects

Anthropometric Measurements	Correlation Value
Body weight Vs BMI	r =<.001
Body weight Vs WHR	r =<.001
BMI vs WHR	r = 0.942

From the Table VIII, it was inferred that there is a strong positive correlation between body weight and Body Mass Index of the women subjects which was found using the Pearson 's correlation test. There was also a strong relationship between body weight and Waist / hip ratio and Body Mass Index and Waist / hip ratio of women subjects.

B.Lifestyle Pattern of Women Subjects

Details on the lifestyle pattern of the women subjects are discussed under the following headings.

1.Type of activity

The data about the type of activity revealed that 72 percent of the women subjects were engaged in sedentary type of activity , 26.5 percent of the women subjects were involved in moderate level of activity and 1.5 percent were involved in heavy activity.

2.Regularity and duration of physical exercise

Regularity and duration of physical exercise done by the women subjects is presented in table IX and in Figure 4

TABLE IX

Regularity and Duration of Physical Exercise done by Women Subjects (N=200)

Performing regular exercise					**Not performing regular exercise**					
Number	**Percentage (%)**				**Number**		**Percentage(%)**			
134	67				66		33			
Duration	**Walking**		**Cycling**		**Stretching, aerobics and Zumba Exercises**		**Yoga**		**Jogging**	
	No	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**
Daily 30 minutes to 1hour	5	25	16	8	7	3.5	2	1	4	2
Weekly once 30 Minutes to 1 hour	-	-	2	1	4	2	-	-	2	1
Weekly twice 30 minutes to 1 hour	-	-	18	9	-	-	-	-	-	-
Monthly once 30 minutes to 1 hour	15	7.5	-	-	36	18	-	-	-	-

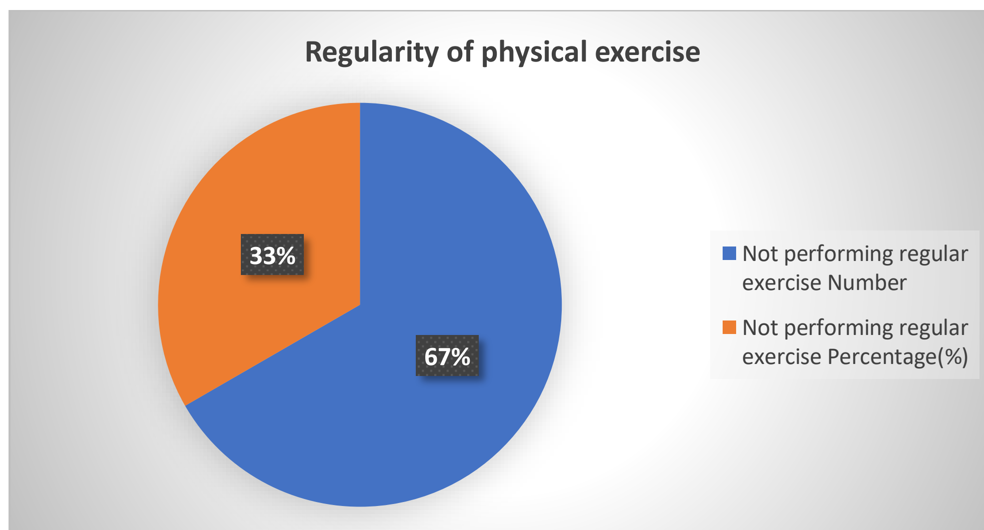

Figure 4 Regularity of Physical Exercise

The Table IX and Figure 4 shows the regularity of physical exercise and it was inferred that 67 percent of the adult women performed regular physical activity , and 33 percent of the adult

women were not involved in regular physical activity. The data about the duration of physical exercise shows that the physical exercise that was done daily for 30 minutes to 1 hour showed that 25 percent were involved in walking , eight percent of the women subjects did cycling ,3.5 percent did exercises such as stretching , aerobics and Zumba etc, one percent did yoga and two percent did jogging. The percentage of women who did physical exercise weekly once for a duration of 30 minutes to 1 hour showed that only one percent of the women subjects did cycling, and two percent did stretching , aerobics and Zumba exercises. One percent women subjects did jogging for 30 minutes to 1 hour weekly once , 9 percent of women subjects did cycling twice a week for 30 minutes to one hour. Thirty three percent of the women subjects did not perform any form of physical exercise. It was inferred that 67 percent of the women subjects performed regular physical activity , and thirty three percent of the adult women were not involved in any type of physical exercises.

C.Dietary Pattern of Women Subjects

Details on the dietary pattern of the women subjects are discussed under the following headings.

1.Type of diet consumed by the women subjects

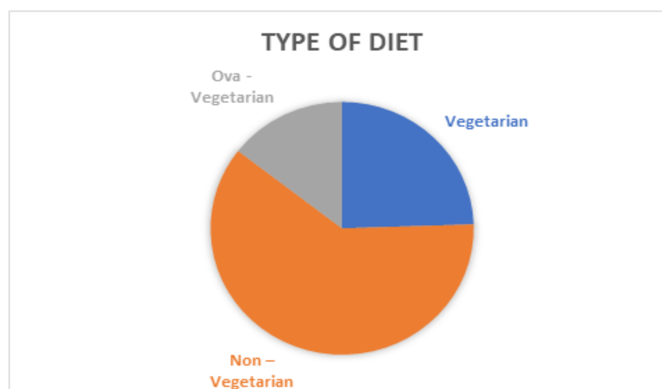

Figure 5 Type od Diet Consumed

Information on the general diet consumed by the women subjects from the Figure 5 revealed that 24.5 percent of them consumed vegetarian diets and 61 percent consumed non – vegetarian foods in their diets and 14.5 percent of them were ova vegetarians consuming only egg with the vegetarian diet.

2.Diet Restrictions ,Meal Pattern and Pattern of Skipping Meals

The diet restrictions , meal pattern and pattern of skipping meals of the women subjects is presented in Table X and Figure 6

TABLE X

Diet Restrictions , Meal Pattern and Pattern of Skipping Meals (N=200)

Following diet restrictions	**Number**	**Percentage (%)**
Yes	51	25.5
No	149	74.5
Number of meals / day		
Two	84	42
Three	110	55
Four	6	3
TOTAL	200	100
Pattern of skipping meal	**Number**	**Percentage (%)**
Yes , rarely skip meal	67	33.5
Yes , regularly skip meals	90	45
No skipping of meals	43	21.5
If Yes , most commonly skipped meals		
Breakfast	100	50
Lunch	29	14.5
Dinner	28	14
TOTAL	200	100

The data from the Table X, shows that 25.5 percent of the women subjects follow diet restrictions and 74. 5 percent of the women subjects do not follow any diet restrictions when consuming food. The data about the meal pattern showed that , out of 200 women subjects majority of them that is 55 percent consumed three meals per day, while 42 percent of them consumed two meals per day and three percent consumed four meals per day. Information about the skipping of meals pattern showed that 33.5 percent of the women subjects skipped meals rarely , 45 percent skipped meals regularly and 21.5 percent did not skip meals. Among those who skipped meals 50 percent skipped breakfast , 14.5 percent skipped lunch and 14 percent skipped dinner.

3.Presence of good appetite and description of the nature of appetite of the women subjects

The presence of good appetite and the description of the nature of appetite of the women subjects is given in Table XI

TABLE XI

Presence of Good Appetite and Nature of Appetite of Women Subjects (N=200)

The presence of good appetite	Number	Percentage (%)
Yes	115	57.5
No	85	42.5
Description of appetite		
Good (able to eat and enjoy moderate sized meals without any difficulties)	115	57.5
Fair (able to eat and enjoy moderate sized meals and have difficulties in eating occasionally)	80	40
Poor(Never have the feeling of hunger and don't like to eat food at all)	5	2.5
TOTAL	200	100

The data from the Table XI ,showed that 57.5 percent of the women subjects reported to have good appetite and 42. 5 percent of the women reported the absence of a good appetite. The details on the description of the appetite of the women subjects was collected and it was inferred that about 57.5 percent of the women subjects had a good appetite in which they were able to eat and enjoy moderate sized meals without any difficulties and 40 percent of the women subjects reported to have a fair appetite that defined that they were able to eat and enjoy moderate sized meals and had difficulties in eating and 2. 5 percent of selected women subjects have poor appetite as they never had the feeling of hunger and do not like to eat food at all.

4. Composition of the diet

The major composition of the diet consumed by the women subjects, it was observed that 60 percent consumed high carbohydrate food in the diet as Indian diet is always predominated by carbohydrate based foodst,34 percent of the women subject 's women consumed protein rich foods and only 6 percent of the women subject 's consumed high fat foods

5. Habit of Consuming Snacks and the Type of Snacks Consumed by the Women Subjects

Habit of consuming snacks and the type of snacks consumed by the women subjects is given in the Table XII

TABLE XII

Habit of Consuming Snacks and the Type of Snacks Consumed (N=200)

Habit of eating snacks	Number	Percentage (%)
Yes	187	93.5
No	13	6.6
TOTAL	200	100
Type of snacks consumed		
Fruit , fruit juice , milkshakes	30	15
Biscuits , bread , crackers , chips , popcorn, sweets , chocolates , ice cream,	143	71.5
Sprouts , sundal and vegetables soups and salad	12	6
Dry fruits and nuts	3	1.5

The Table XII shows the data on the habit of eating snacks and the type of snacks consumed by the women subjects. About 93.5 percent of the women subjects had the habit of eating snacks and 6.6 percent did not have the habit of consuming snacks. Among the 93.5 percent women who consumed snacks, 15 percent of the women subjects consumed fruit , fruit juices and milkshakes as snacks , 71.5 percent of the women subjects preferred to eat biscuits , bread, crackers , chips , popcorn , sweets , chocolates and ice cream as snacks. Six percent consumed sprouts, sundal ,vegetables soups and salad as snacks, 1.5 percent had the habit of eating dry fruits and nuts as snacks which were healthy food choices.

6. Frequency of Food Consumption of the Women Subjects

a. The frequency of Cereals, Millets and Pulses Consumption

The frequency of Cereals, Millets and Pulses Consumption by women subjects is given in the Table XIII

TABLE XIII

Frequency of Cereals , Millets and Pulses Consumption (N=200)

Foods	Daily		Weekly once		Weekly twice		Monthly once or twice		Occasionally		Rarely		Never	
	No	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Cereals and Millets														
Rice	192	96	8	4	-	-	-	-	-	-	-	-	-	-
Rice flakes and puffed rice	20	10	16	8	30	15	31	15.5	58	29	15	7.5	30	15
Wheat	15	7.5	44	22	112	56	10	5	7	3.5	7	3.5	5	2.5
Ragi , varagu and maize	3	1.5	18	9	30	15	47	23.5	50	25	12	6	40	20
Bajra ,samai	2	1	15	7.5	4	2	22	11	53	26.5	36	18	68	34
Pulses														
Black and red gram dal	145	73	27	14	23	12	-	-	-	-	-	-	5	3
Chickpea and roasted Bengal gram	4	2	33	16.5	17	8.5	33	16.5	58	29	27	13	28	14
Green gram and green gram dhal	67	33.5	123	62	-	-	-	-	10	5	-	-	-	-
Horse gram and cowpea	3	1.5	30	15	7	3.5	30	15	61	30.5	32	16	37	18.5
Soyabean and rajma	45	22.5	46	23	17	8.5	30	15	51	25.5	11	7	-	-

From the Table XIII ,the frequency of consumption of cereals , millets and pulses was analysed and the following inferences were made. Among the cereals , rice was consumed daily by 96 percent of adult women daily as it the staple food. About 10 percent women reported daily consumption of iron rich cereals like rice flakes and puffed rice. The consumption of other iron rich millets like bajra and samai was also good among the women subjects. 22 and 112 percent of the women subjects reported to consume wheat weekly once or twice. Under the food group pulses , the daily intake was dominated by black gram dhal and red gram dhal as 73 percent adult women reported its daily consumption. The iron rich pulses such as green gram and green gram dhal was consumed daily by 67 percent women subjects.

b. Frequency of green leafy vegetables, roots and tubers and other vegetables consumption

The frequency of green leafy vegetables , roots and tubers and other vegetables consumption by women subjects is given in the Table XIV

TABLE XIV

Frequency of green leafy vegetables, roots and tubers and other vegetables consumption

Green Leafy Vegetables	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Curry leaves and Coriander and	104	52	**15**	7.5	46	23	7	3.5	11	5.5	7	3.5	10	5
Amaranth , agathi and Manathakkali leaves	4	2	35	17.5	15	7.5	71	35.5	50	25	5	2.5	20	10
Mint	46	23	29	14.5	67	33.5	18	9	16	8	9	4.5	15	7.5
Moringa and paruppu keerai	5	2.5	33	16.5	12	6	85	42.5	40	20	20	10	5	2.5
Spinach and Fenugreek leaves	7	3.5	33	16.5	21	10.5	31	15.5	49	24.5	29	14.5	30	15
Roots and Tubers														
Potato	21	10.5	66	33	65	32.5	6	3	19	9.5	14	7	9	4.5
Onion	189	94.5	11	5.5	-	-	-	-		-	-		-	-
Sweet potato and yam	2	1	20	10	11	5.5	43	21.5	57	28.5	29	14.5	38	19
Carrot and beetroot	12	6	60	30	58	29	14	7	27	13.5	16	8	13	6.5
Other Vegetables														
Tomato	145	72.5	11	5.5	-	-	4	2	22	11	18	9	-	-
Peas , lady 's finger , Brinjal , winter Squash	9	4.5	65	32.5	23	11.5	23	11.5	46	23	24	12	10	5
Cauliflower, drumstick	6	3	67	33.5	30	15	16	8	48	24	23	11.5	10	5
Beans, Broad beans, plantain green and Sundakkai	4	2	55	27.5	12	6	31	15.5	54	27	29	14.5	15	7.5

The Table XIV presents the data on the frequency of consumption of green leafy vegetables , roots and tubers and other vegetables. The data regarding the consumption of green leafy vegetables, showed that the major green leafy vegetable that was consumed daily by 52 percent of adult women subjects were curry leaves and coriander. The iron rich leafy vegetable mint was consumed by 23 percent of women . The other iron rich green leafy vegetables such as agathi, amaranth , spinach , manathakkali leaves , fenugreek leaves, moringa and paruppu keerai were reported to be consumed weekly once or twice by majority of the women subjects. In a study conducted by Taneja *et al* , 2020 , the green leafy vegetables like mint , curry leaves , parsley , coriander , amaranth and drumstick though high in iron content were consumed less frequently.

The roots and tubers are a source of energy. Among the roots and tubers , onion was consumed by 94. 5 percent of adult women daily. The other roots and tubers like potato , sweet potato , carrot , beetroot and yam were stated to be consumed weekly once or twice.

The food frequency data showed that the vegetable that was majorly consumed by 72.5 percent of women subjects daily is tomato. Iron rich vegetables such as beans , broad beans, plantain green and Sundakkai had good weekly consumption as it was reported to be consumed weekly once by 27 . 5 percent women subjects.

c. Frequency of fruits Consumption

The frequency of fruits Consumption by women subjects is given in the Table XV

TABLE XV

Frequency of Fruits Consumption

Foods	Daily		Weekly once		Weekly twice		Monthly once or twice		Occasionally		Rarely		Never	
	No	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Pomegranate, orange, lime and apple	39	19.5	16	8	32	16	19	9.5	50	25	25	12.5	19	9.5
Banana	51	25.5	31	15.5	40	20	8	4	46	23	16	8	8	4
Mango and amla	7	3.5	25	12.5	13	12.5	22	11	67	33.5	39	19.5	27	13.5
Pine apple, seethaphal and guava	45	22.5	13	6.5	43	22.5	23	11.5	40	20	16	8	20	10

The Table XV shows the information about the frequency of consumption of fruits . It was inferred that banana was consumed daily by 25.5 percent of the women subjects. The iron rich fruits such guava, pineapple, and seethaphal were reported to be consumed daily by 22.5 percent of women subjects which shows a good consumption pattern.

d. Frequency of Milk and milk products and Non – Vegetarian foods consumption

The frequency of Milk and Milk products and Non – Vegetarian foods consumption by women subjects is presented in the Table XVI

TABLE XVI

Frequency of Milk and milk products and Non – vegetarian foods Consumption

Foods	Daily		Weekly once		Weekly twice		Monthly once or twice		Occasionally		Rarely		Never	
	No	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Milk	119	59.5	24	12	24	12	2	1	10	5	9	4.5	12	6
Paneer, yoghurt and cheese	17	8.5	21	10.5	15	7.5	19	9.5	38	19	36	18	54	27
Curd	56	28	30	15	42	21	4	2	27	13.5	15	7.5	26	13
Buttermilk	16	8	22	11	22	11	12	6	38	29	14.5	11.5	57	28.5
Egg	61	30.5	34	17	34	17	7	3.5	5	2.5	13	6.5	46	23
Fish	4	2	67	33.5	31	15.5	22	11	14	7	13	6.5	49	24.5
Poultry	4	2	44	22	28	14	19	9.5	13	6.5	16	8	76	38
Mutton	1	0.5	34	17	26	13	22	11	17	8.5	13	6.5	87	43.5

The Table XVI shows the data regarding the consumption of milk and milk products . It was inferred that milk was consumed by 59 percent followed by curd which had a higher per day intake as reported by 28 percent adult women. The other milk products like yoghurt , cheese and buttermilk had a frequency of consumption ranging from weekly once to rarely

Under non – vegetarian foods , the most frequently consumed was egg , which was consumed daily by 17 percent of women. Non – vegetarian foods are good sources of heme iron and the iron rich non – vegetarian foods like poultry and mutton were reported to be consumed weekly

once by 22 and 17 percent women subjects respectively and 14 and 13 percent women consumed them weekly twice respectively.

e. Frequency of Nuts , Oilseeds , Dry fruits and Fats and Oils consumption by

The frequency of nuts , oilseeds, dry fruits and fats and oils consumption by women subjects is presented in the Table XVII

TABLE XVII

Frequency of Nuts , Oilseeds and Dry fruits and Fats and Oils Consumption

Foods	Daily		Weekly once		Weekly twice		Monthly once or twice		Occasionally		Rarely		Never	
	No	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Almond and cashew	36	18	19	9.5	17	8.5	18	9	79	39.5	31	15.5	-	-
Dates and raisins	46	23	-	-	28	14	20	10	81	40.5	26	13	-	-
Sesame and groundnut	12	6	8	4	22	11	52	26	96	48	10	5	-	-
Coconut , sunflower and groundnut oil	200	100	-	-	-	-	-	-	-	-	-	-	-	-
Ghee and butter	34	17	51	25.5	62	31	13	6.5	18	9	14	7	8	4

The Table XVII shows the information about the consumption of nuts, oilseeds and dry fruits and fats and oils. The data about the intake of nuts , showed that almond and cashew which are iron rich were consumed by 18 percent of women subjects daily. The other commonly consumed iron rich dry fruits such as dates and raisins were reported to be consumed by 23 percent women subjects.

The data on the consumption of fats and oils , showed that 100 percent women subjects reported to consume either one of the cooking oils such as coconut , sunflower and groundnut oil. Ghee and butter were consumed by 17 percent of women subjects daily.

f. Frequency of Beverages consumption

The Frequency of Beverages consumption by women subjects is presented in the Table XVIII

TABLE XVIII
Frequency of Beverages Consumption

Foods	Daily		Weekly once		Weekly twice		Monthly once		Occasionally		Rarely		Never	
	No	%	No.	%	No.	%	No.	%	No.	%	No	%	No	%
Tea	97	48.5	39	19.5	24	12	4	2	22	11	7	3.5	7	3.5
Coffee	80	40	49	24.5	23	11.5	7	3.5	14	7	9	4.5	18	9
Carbonated and Sweetened beverages	22	11	53	26.5	35	17.5	8	4	56	28	20	10	6	3
Fruit juices	26	13	62	31	48	24	15	7.5	7	3.5	42	21	-	-

The frequency of consumption of beverages is given in the Table XVIII. It was inferred that 48.5 percent consumed tea daily and 40 percent women subjects consumed coffee daily. The daily intake of sweetened and carbonated beverages were reported by 11 percent of women. 13 percent of women subjects consumed fruit juice daily.

3.Mean iron intake of women subjects according to the age groups:

The mean iron intake per day of women subjects according to the age group is given in Table

TABLE XIX

Mean Iron Intake of Women Subjects Per Day (N=200)

Age group of the Selected Women Subjects	**Number of adult women in this age category**	**RDA of iron in mg per day**	**Minimum intake of iron mg / day**	**Maximum intake of iron mg / day**	**Mean Iron intake Mean ±S.D**
20 years	30	15	3.78	23.07	10.77 ± 8.11
21 years	33	15	3.25	30.75	12.15 ± 7.42
22 years	42	15	3.25	25.22	9.51 ± 7.22
23 years	31	15	2.40	29.85	11.75 ± 7.63
24 years	35	15	2.11	20.19	10.45 ±5.95
25 years	29	15	2.05	23.35	12.90 ± 5.40

The Table XIX shows the individual intake of iron per day calculated from food frequency consumption pattern of women subjects. The calculated total intake of iron was compared to the standard RDA of iron for women which is 15 mg according to ICMR (2020). Based on the difference between the two values the intake of the adult women was classified as excess and deficit. It was inferred that 110 women had deficit iron intake , whereas 90 women had excess or adequate iron intake. The women who had deficit iron intake were grouped into inadequate dietary iron status category and the women who had excess or adequate iron intake were grouped into adequate dietary iron status category. The women of age 20 years have iron intake of 10.77 ± 8.13 , the women of age 21 years have iron intake of 12.15 ± 10.27 , the mean intake of adult women of age group 22 years is 9.51 ± 11.59, the iron intake of adult women of age group 23 years is 11.75± 7.63 , the iron intake of adult women of age group 24 years is 10.45 ± 5.95 and the iron intake of adult women of age group 25 years is 12.90 ± 5.40 The

minimum and maximum iron intake of the selected women subjects depicts the minimum and maximum per day iron intake of the selected women subjects within the age group.

E. Data Related to Anaemia

1. Signs and symptoms of anaemia of the women subjects

Details on the signs and symptoms of anaemia of the women subjects is given below in Table XX

TABLE XX

Signs and Symptoms of Anaemia (N=200)

S.no	Signs and Symptoms	Number of women Subjects who answered			
		YES	%	NO	%
1.	Thinning , fragility of hair and hair loss	160	80	40	20
2.	Dry and brittle hair	136	68	64	32
3.	Pale and depigmented nails	103	51.5	97	48.5
4.	Spoon shaped nails	35	17.5	165	48.5
5	Pale or yellow skin	100	50	100	50
6.	Bleeding of gums	106	53	94	47
7.	Frequent bouts of headache	120	60	80	40
8.	Feeling drowsy always	122	61	78	39
9.	Presence of shortness of breath	101	50.5	99	49.5
10.	Tiredness and dizziness	139	69.5	69	34.5
11.	Insomnia	95	47.5	105	52.5
12.	Difficulty in concentrating	120	60	80	40

The Table XX, presents the data on the clinical signs and symptoms related to anaemia faced by the subjects. It was observed from the data about the symptoms related to hair, 80 percent experienced thinning of hair, fragility and hair loss and 68 percent had dry and brittle hair. In

the clinical signs related to nails, it was observed that 51.5 percent had pale and depigmented nails and 17.5 percent reported to have spoon shaped nails. In the symptoms related to skin , 50 percent of the selected adult women reported to have paleness of skin. In the clinical signs related to mouth , 53 percent were found to suffer from bleeding gums . The data related to the signs and symptoms associated with respiratory system , showed that 50.5 percent had shortness of breath. The questions related to other symptoms showed that 69.5 percent suffered from tiredness , 47.5 percent has insomnia, 60 percent of the adult women had difficulty in concentrating.

F. Data Related to Menstrual Health

1.Average duration of menstruation

The average duration of menstruation in days of the women subjects is presented in Table and Figure XXI

TABLE XXI
Average Duration of Menstruation and Menstrual Flow of the women subjects
(N=200)

Average duration of menstruation in days	Number	Percentage (%)
Less than 3 days	42	21
3 to 5 days	76	38
More than 5 days	33	16.5
Irregular	49	24.5
TOTAL	200	100
Menstrual flow		
Normal flow	87	43.5
Very less flow	67	33.5
Heavy flow	38	19
Chronic bleeding (Heavy flow throughout the cycle)	8	4
TOTAL	200	100

The Table XXI, shows the details regarding the average duration of menstruation in days of women subjects. It was inferred that 38 percent had 3 to 5 days of menstrual cycle, 21 percent had less than 3 days of menstruation , 16. 5 percent of adult women faced more than 5 days of menstruation and 24.5 percent had irregular periods. The data about the menstrual flow showed that, 43. 5 percent of women subjects had normal flow during menstrual cycle, 33. 5 percent

had very less flow, 19 percent had heavy flow and 4 percent had chronic bleeding that is heavy flow throughout the menstrual cycle.

2.Psychological and physiological problems during menstrual cycle

The psychological and physiological problems experienced by women subjects during the menstrual cycle is presented in Table XXII

TABLE XXII
Psychological and physiological problems during menstrual cycle
(N=200)

Psychological Problems during menstrual cycle	Number	Percentage (%)
Irritability	12	6
Mood swings	39	19.5
Loss of temper	39	19.5
Lack of concentration	37	18.5
Normal behaviour	73	36.5
Total	200	100
Physiological Problems during menstrual cycle		
Back pain	36	18
Vomiting sensation	38	19
Body pain	20	10
Leg pain	24	12
Headache	11	5.5
Healthy	71	35.5
Total	200	100

The Table XXII, ,shows the data about the psychological problems encountered by the women subjects and it was seen 19.5 percent had mood swings during the menstrual cycle, 19.5 percent experienced short temperedness during the cycle, 18. 5 percent of adult women faced inability to concentrate , six percent reported irritability and 36 . 5 percent had normal behaviour during their menstrual cycle. The physiological problems encountered by the women subjects during the menstrual cycle showed that 18 percent faced back pain, 19 percent of the adult women had vomiting sensation , 10 percent of the adult women had body pain , 12 percent had leg pain, 5.5 percent suffered from headache , 35.5 percent women were healthy.

3.Menstrual cramps

The data regarding the intensity of menstrual cramps experienced by women subjects is given in the Table XXIII

TABLE XXIII

Menstrual cramps (N=200)

Intensity of menstrual cramps	Number	Percentage (%)
Normal pain	70	35
Medium pain	68	34
High pain	62	31
TOTAL	200	100

The data about the intensity of menstrual cramps faced by the selected women subjects is presented in the Table XXIII**.** It can be inferred that 35 percent of the adult women faced normal pain during the menstrual cramps , 34 percent experienced medium pain and 31 percent faced high intensity of pain caused by menstrual cramps.

G. Relationship between Dietary Iron Status and Menstrual Health

1. Relationship between Dietary Iron Status and Average Duration of Menstruation in days

The relationship between Dietary Iron Status and Duration of Menstruation in days is given in the Table XXIV

Chi – Square test:

Hypotheses

The null hypothesis is :

H^o - There is no relationship between dietary iron status and duration of menstruation.

The alternate hypothesis is :

H_a -There is relationship between dietary iron status and duration of menstruation

TABLE XXIV

Dietary Iron Status and Duration of Menstruation in Days

Duration of menstruation in days	**Average Dietary Iron Intake for a day**					**X2 Value**		**P value**
	Women subjects with adequate intake		**Women subjects with inadequate intake**		**Total**			
	No	**%**	**No**	**%**		**Dietary iron intake**	**Duration of menstruation in Days**	.001
3 to 5 days	54	27	22	11	76	84.244	93.794	
Less than 3 days	4	2	38	19	42			
Greater than 5 days	27	13.5	6	3	33			
Irregular	5	2.5	44	22	49			
TOTAL	90		110		200			

The Table XXIV , shows the duration of menstruation in days and dietary iron status , it was seen that 54 women subjects who had adequate iron intake had menstrual duration of 3 to 5 days , 4 women subjects had a duration of less than 3 days , 27 women subjects with adequate intake reported had duration of menstruation greater than 5 days and 5 have irregular periods. Among the selected women subjects who have inadequate iron intake , 22 experienced duration of menstruation to be 3 to 5 days , 38 had less than 3 days of menstruation , 6 have greater than 5 days and 44 have irregular menstrual cycle. The estimated chi – square values reveal that dietary iron status is significantly associated with duration of menstruation with the level of significance 0.001.

2. Relationship between Dietary Iron Status and Menstrual Flow

The data regarding the menstrual blood flow of selected women subjects is presented in Table XXV

Chi – Square test:

Hypotheses

The null hypothesis is H^o There is no relationship between dietary iron status and menstrual flow.

The alternate hypothesis is H_a -There is relationship between dietary iron status and menstrual flow.

TABLE XXV

Dietary iron status and Menstrual Flow

Menstrual flow	**Average Dietary Iron Intake for a day**					**X2 Value**		**P value**
	Women subjects with adequate intake		**Women subjects with inadequate intake**		**Total**			
	No	**%**	**No**	**%**		**Dietary iron intake**	**Menstrual flow**	
Normal flow	60	30	27	13.5	87	28.665	28.665	.001
Very less flow	8	4	59	29.5	67			
Heavy flow	20	10	18	9	38			
Chronic bleeding	2	1	6	3	8			
TOTAL	90	45	110	55	200			

The Table XXV , shows the data on menstrual flow and dietary iron status , it was seen that 60 women subjects who had adequate iron intake had normal menstrual blood flow , 8 women subjects had very less flow , 20 women subjects had heavy blood flow and 2 had chronic bleeding throughout the cycle. Among the women subjects who had inadequate iron intake , 27 experienced normal menstrual blood flow , 59 have very less flow , 18 have heavy blood flow and 6 have chronic bleeding throughout the cycle. The estimated chi – square values reveal that dietary iron status is significantly associated with menstrual flow with the level of significance 0.001.

3. Relationship between Dietary Iron Status and Physiological problems during menstrual cycle

The relationship between Dietary Iron Status and Physiological Problems during Menstrual Cycle is given in the Table XXVI

Chi – Square test:

Hypotheses:

The null hypothesis is H^o There is no relationship between dietary iron status and physiological problems experienced during menstrual cycle.

The alternate hypothesis is H_a -There is relationship between dietary iron status and physiological problems experienced during menstrual cycle.

TABLE XXVI

Dietary Iron Status and Physiological Problems during Menstrual Cycle

Physiological Problems during menstrual cycle	**Average Dietary Iron Intake for a day**					**X2 Value**		**P Value**
	Women subjects with adequate intake		**Women subjects with inadequate intake**		**Total**			
	No	**%**	**No**	**%**		Dietary iron status	Physiological problems	
Back pain	6	3	30	15	36	40.423	42.916	<.001
Vomiting sensation	7	3.5	31	15.5	38			
Body pain	13	6.5	7	3.5	20			
Leg pain	11	5.5	13	6.5	24			
Headache	5	2.5	6	3	11			
Healthy	48	24	23	11.5	71			
TOTAL	90	45	110	55	200			

The Table XXVI , shows the physiological problems encountered by the women subjects during their menstrual periods and dietary iron status , it was seen that 6 selected women subjects who had adequate iron intake experienced back pain , 7 selected women subjects faced vomiting sensation , 13 adult women had body pain , 11 faced leg pain , 5 women reported to have headache and 48 were healthy during their menstrual cycle. Among the women subjects who had inadequate iron intake , 30 experienced back pain , 31 women subjects faced the problem of vomiting sensation , 7 faced body pain , 13 faced leg pain , 5 faced headache and 48 were healthy during their menstrual cycle. The estimated chi – square values reveal that dietary iron status is significantly associated with the physiological problems experienced during the menstrual cycle with significance value of .0.001

5. Relationship between Dietary Iron Status and Menstrual Cramps

The relationship between dietary iron status and menstrual cramps is given in the Table XXVII

Chi – Square test:

Hypotheses:

The null hypothesis is H^o - There is no relationship between dietary iron status and menstrual cramps. The alternate hypothesis is H_a -There is relationship between dietary iron status and menstrual cramps.

TABLE XXVII

Dietary Iron Status and Menstrual Cramps

Menstrual Cramps	Average Dietary Iron status for a day					X2 Value		P Value
	Women subjects with adequate intake		Women subjects with inadequate intake		Total			
	No	%	No	%		Dietary iron status	Menstrual cramps	
Normal pain	49	24.5	21	10.5	70	28.675	29.363	<.001
Medium pain	18	9	50	25	68			
High pain	23	11.5	39	19.5	62			
TOTAL	90	45	110	55	200			

The Table XXVII , shows the intensity of pain caused by menstrual cramps experienced by women subjects during their menstrual periods and dietary iron status , it was seen that 49 adult women who had adequate iron intake experienced normal pain, 18 selected women subjects faced medium pain and 23 had high intensity of pain caused by menstrual cramps . Among the adult women who had inadequate iron intake , 21 had normal pain , 50 adult women faced medium pain and 39 faced high intensity of pain caused by menstrual cramps. The estimated chi – square values reveal that dietary iron status is significantly associated with the menstrual cramps experienced during the menstrual cycle with level of significance <.0.001.

Phase III Developing education modules and conducting nutrition education

A. Impact of Nutrition Education on the Knowledge about Iron Rich foods and Menstrual Health

1. Knowledge of women subjects before and after nutrition education

The data about the knowledge of women subjects before and after nutrition education is given in Table XXVIII

TABLE XXVIII

Knowledge Before and After Nutrition Education (N=200)

Parameters	Before nutrition education		After nutrition education	
	No	Percentage (%)	No	Percentage (%)
Nutritional Knowledge	165	82.5	188	94
Nutritional Practice	175	87.5	195	97.5
Knowledge about menstrual health	160	80	189	94.5
Practices towards menstrual health	179	89.5	192	96
TOTAL	200	100	200	100

From the Table XXVIII, ,shows the number and percentage of who gave the right answers to questions on nutrition knowledge and practice related to iron rich foods and anaemia, Knowledge about menstrual health and practice towards menstrual health. It can be inferred that there was a positive impact on women subjects in nutritional and menstrual health related knowledge and practice after the nutrition education.

2. Correlation between Before and After Nutrition Education

The Table XXIX shows the correlation between before and after nutrition education knowledge of women subjects

Paired Sample t- Test

Hypotheses:

The null hypothesis is H^o - There is no difference between before and after nutrition education knowledge of the women subjects.

The alternate hypothesis is H_a - There is difference between before and after nutrition education knowledge of the women subjects

TABLE XXIX

Correlation between Before and After Nutrition Education Knowledge

Before and After Nutrition Education	Confidence %	t– value	Correlation value	Significance	
				One – sided p value	Two – Sided p Value
	95	- 10.375	0.306	<.001	<.001

The Paired Sample T – test data from the Table XXIX , shows the correlation between before and after nutrition education knowledge of the women subjects. The correlational value is r = 0.306, shows that there is a strong correlation between the before and after knowledge of adult women after the nutrition education. The confidence percent of 95 % shows that the observed results are real and not an error caused by randomness. Since the t value is – 10.375 which is less than -2 the H^o - Null hypothesis is rejected with 95 % confidence. It can be inferred that there is a strong evidence that there was a difference in the knowledge of women subjects after nutrition education on topics related to nutritional knowledge, practice , knowledge about menstrual health knowledge and practices with p value of <.001 .

SUMMARY AND CONCLUSION

V. SUMMARY AND CONCLUSION

Iron is important for the body as it takes part in various metabolic processes. Iron deficiency and iron deficiency anaemia is highly ubiquitous among women. Anaemia caused by iron deficiency is found to cause adverse health consequences and is found to affect the physical and mental wellbeing of women of reproductive age. The relationship between iron deficiency and menstruation is that menstrual blood loss is the most common cause of iron deficiency and iron – deficiency anaemia. The impact of iron deficiency as a cause of anaemia differs from region to region. Iron deficiency is the most common cause of anaemia globally. Though there are many studies on iron deficiency and on menstrual health , there are very few studies that is done to assess the relationship between iron intake and menstrual health.

Thus the study entitled "Dietary Iron Status of Adult Women and Its Relationship with Menstrual Health" revealed important details regarding the dietary iron status of adult women in Coimbatore which is the study area. Coimbatore is one of the populated city in Tamil Nadu. Though Coimbatore is one of the industrialised districts of Tamil Nadu , knowledge gap about the importance of iron rich food and its relationship with menstrual health was prevalent among the selected women subjects. The study was conducted among the selected women subjects of age group 20 – 25 years of Coimbatore district with the following objectives:

- To assess the dietary iron status of adult women in the age group of 20 – 25 years.
- To analyse the relationship between iron status and its effect on menstrual health.
- To create awareness among women about the importance of nutritious diet and iron rich foods to prevent anaemia.
- To give health education to women about the importance of menstrual health and hygiene and its relationship with iron status.

The methodology followed for the study involved the following phases

Phase I Selection of area and samples

In this phase the study area was selected according to the familiarity of the investigator. Coimbatore district was selected as the area of study as it is one of the most populated districts of Tamil Nadu. The subjects for the study were selected by purposive sampling by following the inclusion and exclusion criteria. The data collection was done by the use of questionnaire. Questionnaire was formulated in such a way that maximum information was obtained.

Phase II Conducting online survey

The survey was conducted online through google forms. The link for the survey was posted in social media platforms and the survey was carried out. The Ethical clearance application for the conduct of the study was submitted from the Institute ‘s Ethical Committee and approval was obtained.

Phase III Developing education modules and conducting nutrition education

In this phase the education modules for disseminating nutrition and health education were developed. The education modules developed were videos that were created based on the objectives. The videos were posted in You Tube platform for educating the women subjects. The before and after nutrition education knowledge of women subjects was assessed in this phase.

Phase IV

Consolidation of collected data was done in this phase. The statistical analysis of the data by the use of statistical tools and the interpretation of the data was done. The final process under this phase was documentation of the data

The Salient Findings of the Present study titled "Dietary Iron Status of Adult Women and Its Relationship with Menstrual Health "are summarised a s follows :

- The details about the age of adult women subjects who were selected for the study showed that 15 percent belonged to age 20 years , 16.5 percent belonged to age 21 years , 21 percent belonged to the age 22 years , 15.5 per cent belonged to 23 years , 17.5 percent belonged to 24 years and 14.5 percent belonged to 25 years.
- The majority of the women subject's that is 56 percent were pursuing graduation, whereas 15.5 percent were undergraduates, 15 percent were postgraduates and 13.5 percent had education up to higher secondary school. The occupational status showed that 56 percent were students , 22.5 percent were housewives, 14.5 percent were working in government sector and 7 percent were working in private sector. The details about the monthly income of the family revealed that majority of the subject 62 percent belonged to upper class.
- The nutritional status of the adult women subjects showed that about 60 percent of the women were normal weight. The details on the waist – hip ratio showed that 22 percent had waist hip ratio of > 0.85 which indicated high risk , 28. 5 percent had waist hip ratio of 0.81 – 0.85 which indicates moderate risk and 49. 5 percent had a ratio of < 0.80 which shows low risk.

- Among the 200 adult women subject's majority of them followed sedentary lifestyle. The regularity of physical activity showed that , 67 percent were involved in regular physical activity and 33 percent were not involved in regular physical activity.
- It was observed that about 61 percent of the adult women were non – vegetarians , 24.5 percent were vegetarians and 14.5 percent were ova vegetarians.
- The data on diet restrictions restriction , revealed that 25.5 percent followed some type of restriction in the diet , whereas 74.5 percent did not follow any diet restrictions. The percent of adult women who consumed two meals a day is 42 percent , this indicates that women skip one of the three major meals of the day, 55 percent consumed three meals a day and 3 percent consumed 4 meals a day. Around 45 percent of women skipped meals regularly.
- The presence of good appetite is mandatory for a healthy eating pattern. 57 .5 percent of the women stated that they have a good appetite .
- Around 34.5 percent of women subjects reported to consume foods rich in protein, whereas a majority of women that is 59. 5 percent consumed food rich in carbohydrates and 6 percent consumed foods rich in fat.
- Among the women subjects 93. 5 percent had the habit of eating snacks. Among the consumers of snacks majority of the women consumed biscuits , bread or crackers ,sweets , chocolates and the remaining consumed 7.5 fruits juices, dry fruits and sprouts.
- The cereals are the main source of energy. Rice the staple food reported the highest daily consumption of 96 percent. The consumption of iron rich cereals like rice flakes and puffed rice and iron rich millets like bajra and samai was good among the women subjects. Pulses intake revealed that, the daily intake was dominated by black and red gram dhal as 73 percent. The consumption of iron rich pulses such as soyabean , horse gram, rajma and cowpea was consumed weekly once or twice by majority of the women subjects.
- Among the green leafy vegetables , 52 percent women subjects consumed curry leaves and coriander daily. The roots and tubers are a source of energy. Among the roots and tubers , onion was consumed by 94.5 percent of selected women subjects. The other roots and tubers like potato , carrot and beetroot were stated to be consumed weekly once or twice. The other vegetables hold a major part of the diet. The food frequency data showed that the vegetable that was majorly consumed by 72.5 percent adult women daily is tomato. Iron rich vegetables like agathi , amaranth, manathakkali had good weekly consumption and other iron rich vegetables such as beans, broad beans , plantain green was reported to be consumed by 27. 5 percent women.

- Fruits contains nutrients like vitamins and minerals that are the pre requisite for the proper functioning of the body. The data on fruits consumption showed that banana was consumed daily by 25.5 percent of the adult women. The fruits like pomegranate , orange , mango, amla , lime and were found to be consumed weekly once or occasionally and iron rich fruits such as guava, seethaphal and pomegranate had was consumed daily by 22.5 percent women subjects.
- The daily consumption of milk was reported by 59 percent women. Curd which is a probiotic was consumed by 28 percent women subjects. The other milk products like yoghurt , cheese and buttermilk had a frequency of consumption ranging from weekly to rarely.
- Under non – vegetarian foods , the most frequently consumed was egg , which was consumed daily by 17 percent of women. Non – vegetarian foods like fish , poultry , mutton were consumed weekly once or twice which is good source of heme iron.
- Among nuts and dry fruits , the iron rich varieties such as cashew ,almond , dates and raisins had good daily consumption. The data on the consumption of fats and oils , showed that 100 percent women reported to consume either one among the cooking oils such as groundnut , sunflower , coconut oil. 17 percent women subjects reported daily consumption of ghee and butter.
- The clinical signs and symptoms of anaemia assessment delivered the following inferences. The major signs and symptoms that the adult women subjects experienced were thinning , fragility and loss of hair was reported by 80 percent of women, followed by 68 percent had dry and brittle hair, 60 percent reported to suffer from frequent bouts of headache, 69. 5 percent had tiredness, 60 percent faced the difficulty in concentrating , 61 percent suffered from drowsiness.
- The data on the individual intake of iron per day calculated from food frequency data of adult women , revealed very important details regarding the iron intake . The intake per day of iron was compared to the standard RDA of iron for women which is 15 mg according to ICMR (2020). It was inferred that 110 women had deficit iron intake , whereas 90 women had or adequate iron intake.
- The menstrual health status of the adult women subjects revealed various details. The duration of menstruation was the first data that was collected. It was seen that the normal duration of 3 to 5 days was reported only by 38 percent of adult women. 21 percent had less than 3 days of flow , 16.5 percent had greater than 5 days of flow and 24.5 percent irregular periods. Another important factor that determines the menstrual health is the blood flow, it was noticed that 41. 5 percent had normal flow , whereas the remaining percent of women faced very less flow , heavy flow and chronic bleeding. The very less flow can be indicative of low iron intake ,

whereas heavy and chronic bleeding can lead to increased loss of iron from the body. The Menstrual cycle is characterised by various psychological and physiological symptoms. The data regarding the same showed that only 36 . 5 percent of the adult women did not face any psychological problems the remaining percent of women faced problems like mood swings , irritability , loss of temper and lack of concentration.

- The relationship between dietary iron status and menstrual health was statistically analysed and it was inferred that there is a relationship between dietary iron status and menstrual health. There was a significant relationship between dietary iron intake and duration of menstruation, 54 adult women who had adequate iron intake had normal duration of 3 to 5 days of menstruation. The 78 women who had inadequate iron intake had menstrual duration of either less than 3 days , greater than 5 days or irregular menstrual cycle.
- The menstrual blood flow was also found to be normal as reported by 60 adult women who had adequate iron intake. The majority of the adult women with inadequate intake had abnormal menstrual blood flow marked by either very less , heavy flow or chronic bleeding, only 27 adult women reported to have normal flow.
- The analysis to determine the relationship between dietary iron status and physiological problems faced by the adult women showed that , women who had inadequate iron status had comparatively high incidence of physiological problems like back pain, vomiting sensation and leg pain. 48 women with adequate iron status did not face any such physiological problems.
- The study to find out whether there is a relationship between dietary iron status and intensity of menstrual cramps showed that , there is a significant relationship between dietary iron status and menstrual cramps. 49 women with adequate iron intake reported to have normal intensity of pain caused by menstrual cramps. 50 adult women with inadequate iron intake reported to have medium pain and 39 women had high pain caused by menstrual cramps. This shows that the intensity of pain was higher among the adult women with low iron intake.
- Nutrition Education plays an important role in bringing about a change in the attitude , knowledge and practice of adult women. The analysis done to check the before and after nutrition knowledge of the adult women showed that the nutrition education had a positive impact on the adult women subjects. The nutrition education improved the knowledge of the women subjects about nutrition and related practices and menstrual health , hygiene and practices. This concludes that the nutrition education conducted was successful in meeting its objectives.

Recommendations for Future Research:

- Iron is a key nutrient that ensures proper functioning of the body and adequate iron intake is imperative to preserve the bodily functions and in the maintenance of reproductive health . Hence the information on rich foods that are cost effective and locally available should be given to the female population.
- The knowledge that is given to a child forms the foundation of healthy practices in the future. The future perspectives can be laid on inculcating the young minds importance of consuming iron rich foods and its relationship with menstrual health even before the onset of menarche.
- Studies can be done to assess the relationship between blood haemoglobin and menstrual cramps.
- Menstrual cramps and the pain associated with it has a major impact on the day-to-day life of women during their menstrual cycle. Studies can be done to find out ways to reduce the incidence of menstrual cramps among the female population.
- The future prospects should aim at developing low-cost sanitary napkins and its free dispersal. Women and adolescents should be educated on the importance of environment friendly method of disposal of used napkins. Guaranteeing menstrual hygiene among women and adolescents should be made as the prime goal to be achieved which requires rigorous action to change the current situation in India.

APPENDICES

APPENDIX I

Questionnaire to Elicit Information on the Dietary Iron status and Menstrual Health Status of Women

Background Information:

1. Name :
2. Age:
3. Educational qualification:

- Upto higher Secondary education
- Pursuing graduation
- Undergraduate
- Postgraduate

4.Occupation**:**

- Student
- Housewife
- Government sector
- Private sector

Economic profile:

Monthly income of family:

- Rs 1166 - *2253*
- Rs 2253 - 3808
- Rs 3808 – 7769
- Rs 7770 and above

Anthropometric Measurements:

Body weight (in kg):

Height (in cm) :

BMI :

Waist circumference (cm):

Hip circumference (cm):

Waist / hip ratio:

Lifestyle Pattern:

1. What type of activity are you engaged in?

- Sedentary
- Moderate
- Heavy

2. Do you perform any type of regular physical exercise?

- Yes
- No

3. What type of physical exercise do you engage in and what is the duration of exercise

Duration	Walking		Cycling		Stretching, aerobics and Zumba Exercises		Yoga		Jogging	
	No	%	No	%	No	%	No	%	No	%
Daily 30 minutes to 1hour										
Weekly once 30 Minutes to 1 hour										
Weekly twice 30 minutes to 1 hour										
Monthly once 30 minutes to 1 hour										
Never exercised										

Details of Dietary Pattern:

1.Are you a?

Vegetarian	Ova -Vegetarian	Non – Vegetarian

2.Do you follow any diet restrictions?

- Yes
- No

3. How many meals do you consume per day ?

- 2 meals/ day
- 3 meals/ day
- 4 meals / day

4.Do you skip meals?

- Yes , rarely skip meals
- Yes, regularly skip meals
- No , skipping of meals

If yes , most commonly skipped meals

- Breakfast
- Lunch
- dinner

5.Do you have a good appetite ?

- Yes
- No

6.Which of the following sentences correctly describes your appetite?

- Good (able to eat and enjoy moderate sized meals without any difficulties).
- Fair (able to eat and enjoy moderate sized meals and have difficulties in eating)
- Poor(Never have the feeling of hunger and don't like to eat food at all)

7. What is your diet mainly based on?
- Protein rich foods
- Fat rich foods
- Carbohydrate rich foods

8.Do you have the habit of eating snacks ?
- Yes
- No

If yes what type of snacks you commonly consume
- Fruits, fruit juice , milk shakes
- Biscuits , bread , crackers ,hot chips, popcorn, sweets ,chocolates , ice-creams
- Sprouts , sundal and vegetables soups and salad
- Dry fruits and nuts

Daily Food Consumption Pattern :

Food group	Daily	Weekly once	Weekly twice	Monthly once	Monthly twice	Occasionally	Rarely	Never
Cereals Rice								
Rice flakes and puffed rice								
Wheat								
Ragi, varagu and maize								
Bajra , samai								
Pulses Black gram and red gram dhal								
Chickpeas and roasted Bengal gram								
Green gram and green gram dhal								
Horsegram and cowpea								
Soyabean and rajma								
Green leafy vegetables Curry leaves and coriander								
Amaranth, agathi and manathakkali leaves								
Mint								

Moringa and paruppu keerai								
Spinach and Fenugreek leaves								
Roots and tubers Potato								
Onion								
Sweet potato and yam								
Carrot and Beetroot								
Other vegetables								
Tomato								
Peas, Lady’s finger, Brinjal, winter Squash								
Cauliflower and drumstick								
Beans , Broad beans , plaintain green and Sundakkai								
Fruits Pomegranate , orange , lime and apple								
Banana								
Mango and amla								
Pineapple , seethaphal and guava								
Milk and mill products								
Milk								
Paneer , yoghurt and cheese								
Curd								

Buttermilk								
Non – Vegetarian Foods Egg								
Fish								
Poultry								
Mutton								
Nuts and oilseeds								
Almond and Cashew								
Sesame and groundnut								
Dry fruits								
Dates and raisins								
Fats and oils								
Coconut , sunflower and groundnut oil								
Ghee and butter								

Clinical signs and symptoms of Anaemia :

Questions	Yes	No
Hair :		
Are you experiencing thinning, fragility of hair and hair loss?		
Do you have dry , brittle hair?		
Nails :		
Does your nails look pale and depigmented?		
Do you have spoon shaped nails ?		
Skin:		
Does your skin look pale or yellowish?		
Mouth:		
Does your gums bleed often?		
Eyes:		
Have you experienced frequent bouts of headache?		
Do you often feel drowsy?		
Respiratory :		

Do you often feel shortness of breath?		
Other symptoms :		
Do you often feel tired and dizzy?		
Do you suffer from insomnia (inability to sleep) ?		
Have you experienced difficulty in concentrating?		

Data Related to Menstruation :

1.When did you first experience your menstrual cycle (in years)?

10 or less than ten years	11 to 12 years	13 to 14 years	Above 14 years

2. What is your average duration of menstruation in days ?

Less than 3 days	3 to 5 days	More than 5 days	Irregular

3.How do you describe your menstrual blood flow?

Normal flow	Very less flow	Heavy flow	Chronic bleeding (heavy flow throughout the cycle)

4.What psychological problems do you experience during your menstrual cycle?

Irritability	Mood swings	Loss of temper	Lack of concentration	Normal behaviour

5. What physiological problems you undergo during menstrual cycle?

Back pain	Vomiting sensation	Body pain	Leg pain	Headache	Healthy

6. How do you rate the intensity of pain that you experience due to menstrual cramps ?

Normal	Medium pain	High pain

Practices and knowledge towards anaemia :

Questions	**Yes**	**No**
1.Have you heard about anaemia?		
2.Is anaemia a health problem?		

3.Do you know about iron-rich foods?		
4.Do you have the habit of eating iron – rich foods?		
5.Do you wash your hands before eating food?		
6.Do you wash the vegetables and fruits before cooking?		
7.Do you follow deworming?		
8.Do you think there is relationship between anaemia and food intake ?		
9.Do you think it is important to prevent anaemia?		

10.What do you understand by anaemia?

Increased Iron in bloods	Decreased iron in blood	Do not know

11. How do you prevent anaemia?

Increasing dietary iron intake	Maintaining personal hygiene	Consuming vitamin C rich foods

12. Which among the foods do you think are iron rich?	Rich in iron	Not rich in iron
Rice flakes		
Sethaphal		
Potato		
Cucumber		
Non vegetarian foods		
Drumstick leaves		
Dates		
Sundakkai		
13.Which among the foods do you think are rich in vitamin C?		
Citrus fruits		
Papaya		
Guava		
Tomato		
Gooseberry		
Beans		
Rice		

Practices towards menstrual health:

Questions :	Yes	No
1.Do you take bath everyday during your menstrual cycle?		

2.Do you wear clean and washed clothes during your menstrual cycle?		
3. Do you wear completely dried undergarments?		
4.Do you use soaps/ vaginal washes to clean your vaginal area during menstruation?		

5.How often you change the sanitary napkins	2 hours once	5 hours once	Daily once
6.What type of menstrual protection you use ?	Cotton Cloth	Sanitary pads	Menstrual cups
7.How do you dispose the sanitary pads?	In open place without wrapping it in a newspaper	Wrapping it in newspaper and disposing in dustbin	Flushing in the toilet

APPENDIX II

INSTITUTIONAL HUMAN ETHICS COMMITTEE

Avinashilingam

Institute for Home Science and Higher Education for Women (Deemed to be University under Category 'A' by MHRD, Estd. u/s 3 of UGC Act 1956) Re-accredited with 'A++' Grade by NAAC. Recognised by UGC Under Section 12 B Coimbatore-641 043, Tamil Nadu, India

Chairman
Dr.Sudha Ramalingam
Director-Research & Innovation,
Professor-Community Medicine,
PSG Institute of Medical Sciences
& Research, Coimbatore

Member Secretary
Dr.S.Uma Mageshwari
Professor and Head,
Department of Food Service
Management & Dietetics

Members
Mr.K.Arunmoli (Legal Expert)
Dr.Subhashini K. Sripathi
Dr.A.Saraswathy (Medical Officer)
Ms.D.Kavitha
Dr.A.R.Sudamani Ramasamy
Dr.G.Victoria Naomi
Dr. Judith Justin
Dr.AnithaSubash

23rd March 2022

To
Ms.Sashmitha .M
Department of Food Science and Nutrition
Avinashilingam Institute for Home Science and
Higher Education for Women
Coimbatore – 641 043

Dear Sashmitha .M,

Ref: Your proposal No. IHEC/21-22/FSN-21 entitled "Dietary Iron Status of Adult Women and Its Relationship with Menstrual Health" resubmitted for approval to IHEC on 15.03.2021.

The Institutional Human Ethics Committee of our University hereby grants approval to your research proposal No. IHEC/21-22/FSN-21 entitled "Dietary Iron Status of Adult Women and Its Relationship with Menstrual Health" resubmitted by you. The Approval number for the same is AUW/IHEC/FSN-21-22/XPD-21.

We wish you all the best in your research endeavours.

Regards,

Dr.S.Uma Mageshwari
Member Secretary

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BIBLIOGRAPHY

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