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Research Article

Awareness of Iron Deficiency Anaemia among Female Patients: Knowledge based Questionnaire Survey

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ABSTRACT

Objective: Iron deficiency anemia (IDA) is a critical global public health crisis that heavily impacts children, women of reproductive age, and pregnant individuals. This study aims to systematically evaluate the foundational awareness, clinical insight, and dietary knowledge regarding IDA among a target group of female healthcare students and professionals. Methods: A cross-sectional, questionnaire-based epidemiological survey was deployed among $N=100$ female participants aged 18 years and older within academic and clinical environments. A pre-validated, 15-item multi-domain tool was utilized to gather metrics covering the etiology, pathophysiology, symptom recognition, diagnosis, management, and dietary modulation of systemic iron status. Results: High baseline familiarity was observed, with over 80% having heard of IDA and 85% recognizing its elevated prevalence in females during pregnancy and adolescence. While 75% identified core systemic signs (fatigue, pallor, poor concentration), significant deficits were noted in clinical and nutritional mechanics: only 45–50% understood absorption modulators (Vitamin C optimization vs. polyphenolic inhibition via tea/coffee), and only 55% correctly identified basic hemoglobin dynamics in laboratory investigations. Conclusion: Although overall baseline recognition of IDA is satisfactory, targeted educational gaps exist regarding physiological interactions, preventive clinical care, and laboratory diagnostics. Structured continuing medical education (CME) and enhanced clinical curriculum modifications are highly recommended to turn theoretical awareness into effective patient counseling and public health strategies.

INTRODUCTION

Anaemia is a medical condition wherein the number of red blood cells or their oxygen-carrying capacity is insufficient to meet physiological needs.[1] Anaemia can be caused by a variety of reasons, including vitamin A, B12, folate, and iron

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deficiency; chronic inflammation; parasite infection; and hereditary disorders.

On the other hand, iron deficiency is regarded as the leading cause worldwide, resulting from insufficient iron levels required for the production of red blood cells.[2]

Iron deficiency is the leading cause of anaemia around the world.[3] Iron performs a vital role as an essential micronutrient in numerous reactions in the human body. Iron is indispensable from the fundamental biochemical activities because of its extraordinary property to readily exchange electrons, correlate with proteins and oxygen binding ability.

Certain important proteins such as haemoglobin, myoglobin, and cytochromes, iron- Sulphur clusters such as respiratory complexes and other functional groups has iron integrated in them.

Moreover, some of the vital functions including oxygen transport, mitochondrial respiration, nucleic acid replication and repair have these proteins which have iron bound to them as their important constituent. Nonetheless various enzymes such as peroxidases, ribonucleotide reductase and P450 class of detoxifying cytochromes also need iron that serves as an important

Role in their Functions.[4]

Anaemia is more prevalent in children, women of reproductive age, and pregnant women. This has a strong association with an increased risk of miscarriage, stillbirth, preterm, and low birth weight for the infant.

Iron deficiency accounts for around 20% of neonatal death and 10% of maternal mortality in developing countries.[5]

Anaemia - Its prevalence in developing and developed countries:

According to the definition by The World Health Organization (WHO) anaemia develops when haemoglobin concentration found less than12g/dl in non-pregnant women over 15 years of age and below 11g/dl in pregnant women and less than 13g/dl for men over 15 years of age.[6]

If this criterion is taken into consideration there will be 10-20 percent of women and 6-30 percent of men above the age of 65 who may be anaemic. Anaemia forms a public health problem in developing countries.[7]

Children and pregnant women are the most susceptible groups in the population, while next affected are the non-pregnant women and the elderly. In the developed countries it is predicted that 10-20% of the preschool age children whereas in developing countries 30-80% are anaemic by the age of 1.[8]

A very important impact to analyse resulting due to IDA is its effect on the economy. Iron deficiency anaemia triggers 25million cases of Disability Adjusted Life Years (DALY's) if we talk in terms of lost years of healthy life, this reports for 2.4% of the entire global DALY's.[9]

Up to 4.05%losses in gross domestic product per annum costs the developing countries due to physical a cognitive loss because of iron deficiency anaemia.[10]

Paradoxically, owing to the aging population it becomes challenging and difficult to decrease iron-deficiency anaemia in high-income countries where its prevalence is found to be more as compared to the in low-income countries. Elevated level of iron deficiency in aging populations grounds for this apparent paradox.[11]

Iron metabolism and homeostasis:

Iron in the form of haem is vital to many metabolic functions including oxygen transportation in haemoglobin. Iron is also a component of multiple enzymes, including cytochromes, necessary for energy generation and drug metabolism.[12]

Through the donation or acceptance of an electron, iron exists in either a reduced ferrous (Fe21) or an oxidative ferric (Fe31) state. The majority of functional iron is contained in haemoglobin, with smaller quantities found in myoglobin and cytochromes.[13]

The liver, which is the site of production of iron transport proteins, contains the largest non-functional iron stores either as ferritin or hemosiderin.[14]

Ferritin is both diffuse and soluble, and is the primary iron storage protein.[15]

Hemosiderin is similar in structure, but has more iron relative to protein and is insoluble (3). Iron is also stored in reticuloendothelial cells of the bone marrow and spleen.[14]

Dietary iron is absorbed mainly in the duodenum. Only ferrous iron is absorbed, and it is transported across the apical membrane of the enterocyte by divalent metal transporter 1. It is then transferred across the enterocyte to the basolateral membrane by an unknown mechanism. Iron is exported across the basolateral membrane of enterocytes by ferroportin, then bound to transferrin in the plasma and transported for use in target organs and/or storage.[13],[15]

Body stores of iron are tightly regulated to provide adequate iron for cellular needs without developing toxicity from excess. Because the body lacks a mechanism to excrete excessive iron, homeostasis is tightly controlled by limiting enteric iron uptake through impaired efflux from enterocytes. Iron efflux is regulated by hepcidin, a recently discovered hormone produced by hepatocytes. When iron stores are adequate or high, hepcidin is released and binds to intestinal ferroportin causing internalization and destruction of ferroportin. The reduction in ferroportin causes absorbed dietary iron to remain in the enterocyte, where it is lost by enterocyte shedding. Conversely, when iron stores are low, hepcidin production and secretion are suppressed, increasing iron efflux from enterocytes into the blood.[16]

Tight homeostasis of iron is critical, as excessive iron accumulation in hepatocytes can cause pathologic damage, termed hemochromatosis.[17]

Risk factors:

Iron Deficiency anaemia is a very common disease in women especially at the time of Menarche & pregnancy including delivery. The following people are in the main risk for Iron deficiency anaemia

- People taking poor diets,
- People donating blood frequently,
- Women who are in childbearing age,
- Pregnant women,
- Especially those born prematurely or experiencing a growth spurt
- Infants & children,
- Vegetarians who don’t change meat with another iron rich food.[18]

Common Causes:

There are two main causes of low iron levels. One is increased iron requirements, while the other is decreased iron absorption.[19]

Increased iron needs may be due to the increasing needs of the body as part of development, blood loss during menstrual cycles, worm infestation, pregnancy, infections, inflammatory or bowel disease.

Genetic abnormalities also contribute to iron deficient anaemia. Thalassemia and sickle cell disease are two disorders which cause anaemia. Also, bone marrow illnesses that inhibit red cell formation may result in anaemia.[20],[21]

During pregnancy, the body requires approximately 700-850 mg of iron, while lactation results in extra iron loss via breast milk. However, lactation amenorrhea makes up for this loss. The condition increases with subsequent pregnancies, as physically iron stores are diminished.[22],[23]

The formation and maturation of red blood cells and cell growth and repair again essentially requires folic acid. Folate deficiency diminishes the rate of DNA synthesis with subsequent impaired cell proliferation and intramedullary death of resulting abnormal cells; this shortens the lifespan of circulating red blood cells and thereby resulting in anaemia.[24]

The real-time polymerase-chain-reaction assays of fecal samples outcome shows that the gravity of iron deficiency intensifies if infection is coupled with *Ancylostoma duodenale* (hookworm).[25] Patients with hyper menorrhea may also have concomitant malabsorption of iron.[26]

Clinical manifestation:

- Uncharacteristic paleness or absence of colour of the skin
- Irritability
- Lack of energy or tiring easily (fatigue)
- Increased heart rate (tachycardia)
- Sore or inflamed tongue
- general fatigue
- weakness
- pale skin
- shortness of breath(dyspnoea)
- dizziness
- a tingling or crawling feeling in the legs
- cold hands and feet
- fast or irregular heartbeat
- fragile nails
- headaches
- Enlarged spleen(splenomegaly)
- A plea to eat peculiar substances, such as dirt or ice (also called pica) [27]

Pathogenesis of iron deficiency anaemia:

Iron deficiency anaemia may be classified into 3 stages: storage iron deficiency, iron deficient erythropoiesis, and iron deficiency anaemia. Initially during blood loss, iron body stores are preferentially utilized for accelerated erythropoiesis. After depletion of body iron stores, erythropoiesis and production of other iron-containing proteins (such as myoglobin) become limited, leading to an overt iron deficiency anaemia.[12],[13]

Anaemia is exacerbated as iron-deficient erythrocytes have a shortened survival due to their fragility, which accelerates reticuloendothelial cell sequestration and destruction.[28]

The observed erythrocyte morphologic changes with the underlying iron deficiency reflect the severely hampered haemoglobin synthesis and are characterized by hypochromasia and microcytosis.

Furthermore, the haemoglobin-deficient erythroid precursors are thought to undergo additional mitoses while attempting to achieve ideal cytoplasmic haemoglobin levels, thereby exaggerating the microcytosis.[29]

While normocytic normochromic erythrocytes contain approximately 1/3 haemoglobin, red blood cell indices of animals with iron deficiency anaemia demonstrate progressive decreases in mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration, and mean corpuscular volume.[13]

Early iron deficiency states may not be suspected as the anaemia may be initially normocytic and normochromic. However, evaluation of the erythrogram and reticulocyte count, along with novel parameters such as reticulocyte haemoglobin content, may provide an earlier indication of iron deficiency anaemia once these assays are available in canine and feline commercial laboratories.[30]

Initially, reticulocytosis is present due to increased production and release of reticulocytes secondary to anaemia. However, as iron stores are depleted and the iron deficiency becomes more severe, the absolute reticulocyte count becomes inadequate for the degree of anaemia. Furthermore, due to the lack of haem and reduced haemoglobin synthesis, the red blood cells become more fragile which can result in mild haemolysis, worsening the anemia.[14]

Disease states with functional iron deficiency can occur when iron is not available for haem synthesis despite normal to increased body stores of iron.[31]

One example is anemia of inflammatory disease, which can be mistaken for iron deficiency anemia based on the hemogram. In this condition, serum iron levels are decreased secondary to iron sequestration in the liver, spleen, and bone marrow, which results in a functional iron deficiency, defective heme synthesis, and the formation of some microcytic and possibly hypochromic erythrocytes despite adequate body iron stores.[12],[13]

Animals with chronic renal disease develop anemia, which is most commonly normocytic, normochromic, and non-regenerative.[32]

This anemia is mostly due to decreased renal erythropoietin synthesis, but chronic low-grade gastrointestinal hemorrhage with loss of iron and anemia of inflammatory disease can also contribute.[33]

Following treatment with recombinant human erythropoietin, the iron reserves can become limited and thus impair erythropoietin-induced erythropoiesis.[34]

Microcytosis, hypochromasia, and low serum iron concentrations have been reported in dogs with congenital portosystemic shunts but not other hepatic diseases.[35]

The pathogenesis of this apparent functional iron deficiency is not well understood, but thought likely to be a direct consequence of the portosystemic shunt as these features normalize following surgical intervention.[36]

Rare genetic defects in ferroportin and hepcidin regulation have been reported to cause iron refractory iron deficiency anemia in humans but these have not been reported in animals. However, a single currently unpublished case of iron refractory iron deficiency anemia in a cocker spaniel has recently been identified by the authors involving a defect in the hepcidin regulator, *Tmprss6[35]*.

DIAGNOSIS:

To identify iron deficiency anaemia, doctor may run tests to look for

- **Size and colour of red blood cell:** With iron deficiency anaemia; red blood cells are smaller and paler in colour when comparing with normal.
- **Haematocrit:** It may be defined as percentage of your blood volume made up by red blood cells. Standard levels are generally between 35.5 and 44.9 percent for adult women and 38.3 to 48.6 percent for adult men. These values may differ depending on your age.
- **Haemoglobin:** Lower than standard haemoglobin levels indicate anaemia. The standard haemoglobin range is generally defined as 13.2 to 16.6 grams (g) of haemoglobin per decilitre (dl) of blood for men and 11.6 to 15. g/ dl for women.
- **Ferritin:** This protein supports store iron in your body, and a decreased level of ferritin typically indicates a low level of stored iron.

  The total iron binding capacity (TIBC) is a measure of the plasma's ability to carry iron and represents the maximum concentration of iron that can be bound by plasma transferrin. This test is often performed as part of an iron panel, but is of limited clinical value in small animals, as it does not assess serum or tissue iron levels and does not change dramatically in disease. Iron saturation (IS) reflects the amount of iron bound to transferrin and is low (<20%) in cases of iron deficiency anemia. Finally, the unsaturated iron binding capacity (UIBC) measures transferrin's open iron binding sites and is elevated in iron deficiency anemia.[37]

  If your blood work point toward iron deficiency anaemia, doctor may recommend for additional tests to recognise an underlying cause, such as:

- **Endoscopy:** Doctors frequently check for bleeding from a hiatal hernia; an ulcer or the stomach with the aid of endoscopy. In this method, a thin, lighted tube fitted out with a video camera is passed down from your throat to your stomach. This permits doctor to view the tube that tracks from your mouth to your stomach (oesophagus) and your stomach to look for sources of haemorrhage.
- **Colonoscopy:** To rule out lower intestinal sources of haemorrhage, doctor may vouch for a procedure called a colonoscopy. A thin, flexible tube fitted out with a video camera is introduced into the rectum and guided to your colon. You are generally sedated during this test. A colonoscopy permits your doctor to view inside some or all of your colon and rectum to look for internal haemorrhage.
- **Ultrasound:** Women may also have a pelvic ultrasound to look for the reason of excess menstrual haemorrhage, such as uterine fibroids.[38],[14]

Complications:

Most of the cases of iron deficiency anaemia are mild and improved easily. Though, if anaemia or iron deficiency is left untreated, it can cause to other health problems. These include

Rapid or irregular heartbeat

When you are anaemic, heart has to pump supplementary blood to make up for the low volume of oxygen. This can cause irregular heartbeat. In major cases, it can cause heart failure or an enlarged heart.

Pregnancy complications

In major cases of iron deficiency anemia, a child may be born in advance or with a low birth weight. Furthermost pregnant women take iron supplements as part of their prenatal care to prevent complication.

Delayed growth in infants and children

Infants and children who are ruthlessly deficient in iron may cause delayed growth and development. They may also be more susceptible to infections.

Therapy:

Oral Iron Supplements

Iron supplementation should be provided to patients with iron deficiency. Ferrous sulphate, ferrous fumarate or ferrous gluconate given as 200mg twice or thrice a day as an oral iron supplement treatment for Iron deficiency which cannot be cured by dietary iron is the best option. Whenever there is intolerance to oral iron or when diagnosed late in pregnancy there could be an alternative treatment via parenteral as iron dextran.[39]

The absorption of iron is up regulated when there is an iron deficiency, depending on the iron deficit. In the stomach and proximal duodenum, a bio-availability of 80-97% is accomplished, but it expects that iron is provided in an aqueous solution or discharged promptly from the administered preparation. About 83% of it, is absorbed, if iron is dispensed in enteric-coated pellets. If the iron is fully discharged and iron stocks are depleted, this portion can rise up to 95%.[40]

Absorption improves with the addition of Vitamin C. Patients with iron deficiency anemia having a low level of hepcidin certifies efficient iron absorption and speedy progress of hemoglobin concentration level; however, for the satiety of iron stores and the regularization of serum ferritin levels approximate 3 to 6 months of medication is required. Thing to be noted is that there can be slight side effects of long-term use of oral administration. like nausea, vomiting, constipation and metallic taste, although these are not very grave side effects but are worrisome for the patients.[41]

Parenteral Iron Supplements

The intravenous dispensation of iron diminished traditionally because of the likelihood of hypersensitivity reactions to high molecular weight iron. This clinical practice has been modified by the newly approved, safer iron formulations.[42]

Intravenous iron administration is effective and increases hemoglobin level more quickly than oral iron absorption as a result intravenous iron circumvents the problem of iron.[43]

Another benefit is that in some patients a single infusion can provide the total dose of up to 1000 mg.[44]

The dose required by the individual is calculated with the formula i.e. body weight in kilogram 2.3

hemoglobin deficiency (hemoglobin level target at–hemoglobin level of the patient) + 500 to 1000mg iron for the repletion of ion stores. The cost is comparatively more for such sort of medication. Anyway, there is a significantly reduced number of hospital or clinic visits over the years.[45]

Iron deficiency anemia can be considerably prevented by food fortification and dietary diversification with iron which are an important measure for the vulnerable group such as pregnant women and children.[46]

Prevention of anaemia:

Anaemia can be caused by a number of reasons, including dietary deficiencies (such as iron, vitamin B12, or folate), chronic illnesses (such as renal disease or cancer), hereditary disorders (such as sickle cell anaemia), and others. The prevention of anaemia is dependent on the underlying cause. However, some basic actions that may be done to prevent anaemia include eating healthy and balanced diet rich in iron, folate, and vitamin B12, avoiding excessive alcohol intake, stopping smoking, controlling chronic conditions, and receiving frequent blood count checks. Depending on the patient's Hb level and underlying co-morbid condition, iron deficiency can be treated with dietary or oral iron supplements, intravenous iron treatment, and/or red cell transfusion. Late infantile anaemia is treated with dietary intervention such as iron supplementation and iron fortification of newborn food. Iron is an important dietary component that is required for growth and health. Iron-rich foods include liver, legumes, beans, nuts, green leafy vegetables, and fortified cereals; however, bio-absorption varies greatly. Daily oral iron supplementation is a widely recommended strategy for both the treatment and prevention of iron deficient anaemia. The recommended approach to prevent IDA is through nutritional education, which involves consuming a wider variety of meals and adding more iron-rich foods to the diet, as well as taking iron and folate supplements.[47]

Foods high in iron include:

- pork, chicken, and beef
- beans
- pumpkin and squash seeds
- leafy greens, such as spinach
- raisins and other dried fruit
- eggs
- seafood, such as clams, sardines, and oysters
- iron-fortified dry cereals
- Foods high in vitamin C include-
- fruits such as oranges, grapefruits, strawberries, kiwis, papayas, pineapples, melons, and mangoes
- broccoli
- red and green bell peppers
- Brussels sprouts
- cauliflower
- tomatoes
- green leafy vegetables.[48]

Early detection and its outcomes

Iron deficiency anaemia is a risk factor for heart failure, ischemic heart disease, and other cardiovascular morbidities. Therefore, it is deemed necessary to detect IDA at an early stage,

which can occur in the form of negative iron balance and iron-deficient erythropoiesis.[49]

IDA in pregnancy, particularly with IV iron more than 10 days before delivery, significantly improves maternal outcomes, reducing blood transfusions, ICU admissions, and preterm births, thereby mitigating haemorrhage-related morbidity.[50]

In children, prolonged iron deficiency can lead to cognitive impairments and hinder physical development.[51]

METHODOLOGY:

Study Design: This is a cross-sectional, questionnaire-based survey conducted among female healthcare students and professionals to assess their awareness regarding iron deficiency anaemia (IDA).

Study Population: 100 female participants, aged 18 years and above, primarily comprising healthcare students and professionals.

Study Tool: A pre-validated knowledge-based questionnaire containing 15 multiple-choice questions, focusing on awareness of IDA causes, symptoms, dietary factors, diagnosis, and prevention.

Data Collection: Participants were approached in academic and clinical settings and given a structured questionnaire. The anonymity and confidentiality of responses were ensured.

Data Analysis: Descriptive statistical analysis was conducted to summarize the percentage of correct and incorrect responses across various knowledge domains. Results were interpreted to identify gaps in awareness and understanding.

Ethical Consideration: Participation was voluntary. Verbal or written consent was obtained. The study maintained confidentiality and followed ethical standards for human research.

RESULT:

The questionnaire-based survey was conducted among 100 women healthcare professionals and students aged 18 years. The key findings from the survey are as follows: More than 80% of participants had heard about Iron Deficiency Anemia (IDA). Around 75% of respondents correctly identified symptoms like fatigue, pallor, and poor concentration. Approximately 60% were aware of iron-rich dietary sources such as green leafy vegetables and meat. Only 45–50% knew that factors like vitamin C enhance iron absorption and that tea/coffee inhibit it. Awareness about preventive measures (e.g., deworming, dietary changes, medical check-ups) was moderate (~50%). Nearly 85% acknowledged that IDA is more common in women and during pregnancy and adolescence.60% correctly identified excessive bleeding as a cause of IDA. More than 70% were familiar with the impact of IDA on maternal and infant health. However, only around 55% knew that haemoglobin levels reflect iron status in blood investigations. The results suggest that while basic knowledge about IDA is fairly good, deeper insights into clinical, nutritional, and preventive aspects are lacking.

DISCUSSION:

This study assessed the awareness and knowledge regarding Iron Deficiency Anemia (IDA) among women in the healthcare field. Although the majority had general awareness about the condition, detailed knowledge, particularly regarding iron absorption mechanisms and preventive strategies, was limited. professionals in this study performed better. However, the

moderate gaps in awareness, particularly around dietary factors and treatment, are concerning, given their role in patient education and clinical care. This highlights the importance of not only theoretical education but also practical training in dietary counseling, maternal care, and anemia management.

CONCLUSION

This study showed the knowledge and awareness of iron deficiency anaemia among female healthcare professionals. Thus, to conclude, knowledge of iron deficiency anaemia is important for leading a healthy lifestyle, especially for women. Hence, the primary focus should be on improving knowledge and awareness through symposia and continuing medical education programs.

The findings of this study conclude that: General awareness about IDA is satisfactory among healthcare professionals and students. Specific gaps remain in understanding prevention strategies, absorption interactions, and clinical management. Educational level plays a key role in awareness, aligning with prior research findings. Targeted interventions, such as continuing medical education (CME), workshops, and curriculum enhancements, are necessary. Female patients must be well-equipped to disseminate accurate information to the general public and promote healthy dietary and lifestyle practices to prevent anemia. Inclusion of periodic awareness drives and nutritional education in academic settings can enhance the competency of future healthcare providers in managing IDA.

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