

## Iron Insights: Exploring Age-Specific Variations In Anaemia Prevalence In Islamabad

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### ABSTRACT

**Background & Introduction:** Blood, a specialized connective tissue, facilitates the vital transport of oxygen, carbon dioxide, minerals, hormones, and salts throughout the body. Anemia, characterized by reduced oxygen-carrying capacity, often stems from factors such as diminished red blood cell (RBC) synthesis or excessive blood loss. Notably, iron deficiency stands out as a prominent cause, particularly among females of reproductive age, due to factors like inadequate dietary iron intake and menstrual blood loss.

**Objectives:** This study aims to assess the prevalence of iron deficiency anemia (IDA) in both males and females across different age groups. Specifically, we seek to determine the frequency of IDA and its distribution among age cohorts spanning 6-12 years, 13-19 years, and 20-50 years.

**Methodology:** Employing a cross-sectional study design, we surveyed a population of 2071 individuals, selecting a sample of 3<sup>1</sup>24 participants through non-probability convenient sampling methods. Descriptive statistics, facilitated by SPSS, guided our analysis. Hematological parameters including hemoglobin (HB) levels, RBC count, mean corpuscular volume (MCV), and mean corpuscular hemoglobin (MCH) were evaluated to ascertain the hematological status of the study cohort.

**Results:** Our findings reveal notable trends in IDA prevalence across age groups. Among participants aged 16-30 years, IDA incidence stood at 51%, whereas the 31-35 years age group exhibited a 26% prevalence, and the 46-60 years age group recorded a 23% incidence of IDA. Additionally, our analysis indicates a higher prevalence of IDA among females, constituting 65% of all IDA cases, particularly pronounced in the reproductive age bracket of 16-30 years.

**Conclusion:** The study underscores a gender-based discrepancy in IDA prevalence, with females exhibiting a higher incidence compared to males. Notably, females within the reproductive age range of 16-30 years emerge as a particularly vulnerable demographic. These findings emphasize the importance of targeted interventions to address iron deficiency, especially among at-risk populations.

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**Keywords:** IDA, Prevalence, Hemoglobin, Anemia, Iron, Reproductive Age, RBCs, WHO.

**Statements and Declarations:**

We are grateful to all the patients and their families for participating and cooperating in this study. No specific funding from any agency in the public, commercial, or not for profit sectors was received for this study.

1. **Research funding:** None declared.
2. **Author contributions:** All authors have made equitable contributions to the manuscript.
3. **Conflict of interest:** The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.
4. **Data availability statement:** The data that support the findings of this study are available from the corresponding author upon reasonable request.
5. **Informed consent:** Written informed consent for participation and publication of clinical data was obtained from the families. The written informed consent was obtained from all participant families for clinical examination
6. **Ethical approval:** The study received ethical approval on September 25th, 2023, with the assigned IRB approval number (F.1/IUIC-ANMC/IRBC-265/2023).

**INTRODUCTION**

Anaemia affects 24.8% of the worldwide population. The biggest population impacted by it is non-pregnant ladies (30.2%) which live in Southeast Asia.<sup>1</sup>It is a condition where haemoglobin concentration as well as red blood cells (RBC) value are less than typical and deficient to fulfill a person's body requirements. It hits about 33% of people globally. It is related to diseases and deaths in ladies and toddlers, unfortunate births, diminished efficiency in youngsters, and mental and social impairment in children. Pre-school youngsters (PSC) and women of reproductive age are especially impacted.<sup>2</sup>

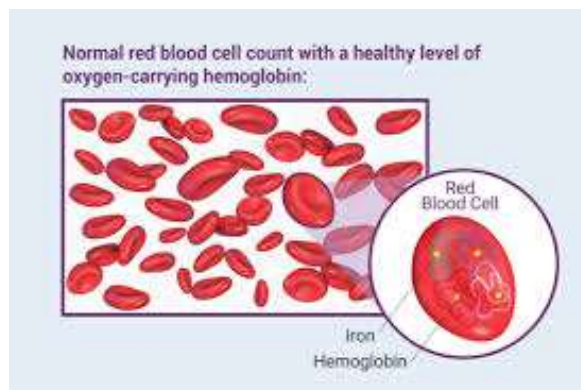


Figure 1: Normal shape and structure of RBCs

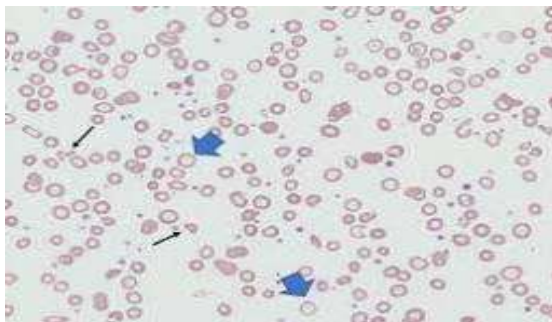
Anaemia by etiology (e.g., Iron Deficiency Anaemia, Haemolytic anaemia, anaemia of inflammation, or by RBC morphology (microcytic, megaloblastic). IDA is a

condition in which blood contains an insufficient number of red blood cells due to lack of iron.<sup>3</sup>Iron is micronutrient that is necessary for red blood cells development (RBCs) in the body. Decreased iron concentration in the body leads to IDA. Reduced supply of iron implies that there is diminished production of RBCs.<sup>4</sup>

### **Iron deficiency Anemia (IDA):**

A deficiency in iron, a micronutrient required by the body, can result in major issues including anaemia. Millions of individuals throughout the world, especially pregnant women, suffer from iron deficiency anaemia (IDA), which is brought on by insufficient iron intake or malabsorption. Due to the increased need for iron during pregnancy, the group of pregnant women are thought to be most at risk for developing IDA.<sup>5</sup>

World Health Organization (WHO), anaemia affects 38% of expectant women. IDA is considered to be a major factor, affecting both the mother and the foetus' health during pregnancy. IDA in the mother is linked to poor physical performance, increased tiredness, impaired cognitive function, an increased risk of infection and hospitalization, and hindered breastfeeding. Additionally, women who are fragile throughout pregnancy have a higher risk of perinatal death and malaise. Examples of adverse foetal outcomes include premature delivery, low birth weight, abortion, foetal death, hypertension, neurologic disability, and others.<sup>6</sup>



**Figure 3: Blood Picture showing IDA**

An individual's iron balance is changed by a variety of factors, both non-modifiable and modifiable. Iron balance can be affected by age, gender, marital status, income, education level, and ethnicity, as well as the quality and quantity of food and beverages consumed.<sup>7</sup>A person's health (mental and physical) medication use, underlying diseases, and genetics can also be factors. Iron deficiency (ID) is a condition caused by an imbalance between the amount of iron ingested and required and the amount required to maintain normal body tissue functions.<sup>8</sup> Impairments in working capacity, mental activities, fertility, and pregnancy outcomes are all possible outcomes of ID. Anaemia and low haemoglobin synthesis are two consequences of iron deficiency, which is accompanied by functional deficits as a result of an imbalance between supply and demand. Functional iron deficiency (FID) is the result of inadequate iron incorporation into erythroid precursors despite sufficient body iron stores.<sup>9</sup>

**IDA & Ferritin:** In developing countries, low ferritin level is considered the main cause behind IDA and its value (<12ng/ml) is the main symbol in the analysis of IDA. Men had higher values of serum ferritin than women that is men aged between 30-39 are found to have a high value of serum ferritin and it gets constant until 70 years of age. However, women have relatively low serum ferritin levels until menopause, and then a rise is shown in serum ferritin levels.<sup>10</sup>Numerous studies have revealed that IDA is the most prevalent type of weakness worldwide; in developing

nations, approximately 50–60% of children and pregnant women and 20–30% of non-pregnant women have an IDA.<sup>11</sup>

**Prevalence of Iron Deficiency Anemia:** Anaemia is an alarming medical condition that impacts people of all ages, with 43% of those affected in impoverished nations and 9% in wealthy nations.<sup>12</sup> Although dietary deficiencies (such as those in vitamin B12 and Fe), inherited blood disorders, environmental toxins (such as lead), infectious diseases (like malaria), socioeconomic factors (such as low maternal education and household income), demographic factors (such as age and gender), autoimmune diseases (such as haemolytic anaemia), malabsorption problems, and chronic illnesses (such as cancer) all play a role in anaemia. A World Health Organization (WHO) research from 2001 states that IDA accounts for 50% of all instances of anaemia, which affects almost two billion people globally. IDA remains the most common form of micronutrient deficit in underdeveloped countries because of a chronically low iron balance. Until severe anaemia develops, iron deficiency normally proceeds slowly and without showing any clinical signs.<sup>13</sup>

IDA falls are analysed assuming that the haemoglobin concentration falls under 10 g/dl and is related to worse foetal outcomes, premature birth, and maternal mortality.<sup>14</sup> Public health significance categories were devised by WHO according to the dominance of anaemia. Anaemia with a severity of 4.9% or less is regarded as normal, 5.0–19.9 as mild, and 20.0–39.9 as moderate. An extreme general medical condition is defined as having a prevalence greater than 40%.<sup>15</sup> In conclusion, this study emphasizes that the majority of university students particularly females suffer from IDA, which may become more severe as a result of poor nutrition and poor lifestyle habits.<sup>21</sup>

Culture-specific lifestyle and socioeconomic differences greatly influence the occurrence of anaemia during pregnancy. From 1993 to 2005, the WHO looked at nationally representative surveys and found that approximately 42% of pregnant women are found to be anaemic worldwide.<sup>16</sup> In developing nations, the prevalence was 52%, while in developed nations, it was 23%. Iron deficiency is considered to be the cause of 50% of cases of anaemia, which affects 1.6 billion people worldwide. According to Omate et al., (2020), iron deficiency is thought to affect twice as many people as anaemia. Anaemia and iron deficiency are frequent complications of pregnancy. During pregnancy, a typical physiological response to the increase in blood plasma volume is a slight decrease in haemoglobin (Hb) levels. During the second trimester, Hb levels typically fall by around 20 g/l before returning to pre-pregnancy levels as the pregnancy approaches term.<sup>17</sup> An increase in total blood cell volume is the cause of the rise in iron requirements during pregnancy.<sup>18</sup>

## **2.1 Incidence of IDA:**

To ascertain the incidence of IDA and risk variables among Yemeni students at Hodeida University who looked to be in excellent health, Abu et al. undertook cross-sectional research in 2021. 500 blood samples were randomly drawn from medical students, 326 of which were from males and 174 from women. Complete blood counts (CBC), total iron binding capacity (TIBC), serum ferritin (SF), and serum iron (SI) tests were performed on the sample. To learn more about people's demographics, eating and drinking preferences, and socioeconomic position, a questionnaire was also created. The study found that female students (54%) were more likely than male students (46%) to be affected by IDA overall (30.4%). In addition, the percentage of IDA was higher among students between the ages of 20 and 22 (59.2%) than among those between the ages of 17 and 19 (25%) and 23 and 25 (25.8%). In addition, low income, smoking, and khat (*Catha edulis*) chewing were identified as the main risk factors for the development of IDA ( $p=0.001$ ), whereas

coffee and cola consumption showed insignificant influence ( $p = 0.585$  and  $p = 0.513$ , respectively).

Jacquier et al., 2021. showed that the World Health Organization estimates that up to 27% of the world's population suffers from iron deficiency anaemia (IDA), making it one of the most common nutritional deficiencies. According to research conducted in several Middle Eastern nations, including Saudi Arabia, IDA is a frequent cause of anaemia, particularly in females. The purpose of this study was to determine the prevalence of ID and IDA among young, healthy university students in four Saudi Arabian regions. Participants who gave their informed consent were asked to fill out a survey questionnaire, and blood samples were taken from them, the survey was completed by 981 students, and 11% of them reported anaemia symptoms. 34% of the participants had an IDA diagnosis, while 6% had a hemoglobinopathy diagnosis. An analysis of the participants' blood revealed that 28.5 percent had ID and 10.7 percent had IDA, mostly females (88.5% and 94%, respectively). In addition, sickle cell trait and thalassemia trait were found in 1.3 percent and 7% of participants, respectively. This Saudi Arabian national survey of young university students reveals a high prevalence of ID and IDA.<sup>22</sup>

Koyyada A's research from 2021 showed that iron deficiency is a key contributor to anaemia and is more prevalent in underdeveloped countries. This places further stress on healthcare systems that are already under pressure due to a shortage of funding. Children and women are more susceptible, with females being physiologically more vulnerable in comparison. Numerous circumstances, some of which may have severe effects, can lead to anaemia. The aim of this literature review was to analyse and summarise the data from numerous sources on the incidence, causes, consequences, and therapies of iron deficient anaemia in developing countries. An exhaustive search of several databases, including PubMed, Google Scholar, Science Direct, the World Bank, and the WHO, was conducted using keywords such as "anaemia," "iron deficiency," "risk factors of anaemia," "outcomes of anaemia," "interventions," and "developing countries." The literature study identified several predictors of iron deficient anaemia, including genetic and environmental variables. Genetics, a bad diet, a low socioeconomic situation, a high gender parity, and a lack of access to high-quality healthcare are only a few of the causes of anaemia. Anaemia can also result in a number of detrimental effects, such as postpartum haemorrhage, stillbirth, premature delivery, exhaustion, poor mental health, and difficulty concentrating. Iron deficiency anaemia is a serious problem for public health in poor countries, particularly among women who are in their reproductive years. Age, parity, and socioeconomic level, as well as food, can have an impact on this group's iron reserves.<sup>23</sup>

Elstrott and others studied the incidence of iron deficiency anaemia was made widely known in Bahawalpur, a sizable city in Pakistan's Southern Punjab Region, in 2020. showed that iron deficiency anaemia, especially in females and those living in rural areas, is the most common kind of anaemia in the Bahawalpur region. When developing interventions to combat iron deficiency anaemia in this region of Pakistan, this information ought to be taken into consideration.<sup>24</sup>

Garzon et al., 2020 reported that due to monthly losses and higher iron needs during pregnancy and breastfeeding, iron insufficiency (ID), a common dietary deficit, disproportionately affects women of reproductive age. Both developed and developing countries are affected by it. Pregnant women are more prone to develop iron deficiency anaemia (IDA) due to the increased iron needs for foetal development and the expansion of blood volume/red cell mass. The study found that

despite the introduction of the IRON MOM initiative, the prevalence of ID among pregnant women remained high.<sup>25</sup>

**Objectives:**

1. To determine the frequency of Iron deficiency anemia in males and females.
2. To find out the percentage of iron deficiency anemia in different age groups.

**METHODOLOGY**

Cross-sectional study design was adopted to carry out this research on the patients visiting at Al-Nafees Medical College and Hospital Islamabad. Non-probability conveniencesampling technique used to get samples for the study and the duration of the study is 6 months from September 30<sup>th</sup> 2023 to December 25<sup>th</sup> 2023.

2071 people made up the entire population of August making the sample size determined by the sample size calculator to be 324. Included are Males and females of different age groups (16-60 years). Males and females of different age groups (16-30), (31-45) & (46-60). Pregnant women or women who are currently breastfeeding while excluded are Children below 16 years, Individuals over 60 years.

**Blood sample collection:**The subject's blood samples for blood CP are included in the study. The blood was taken from the cubital vein using 5CC syringes, and the samples were taken in an EDTA tube. After that, vials are placed right away on the blood rotator to thoroughly mix the sample both horizontally and vertically.

**Techniques:**

Anti Spetic technique: It involves using sterile equipment, cleaning the skin with an antiseptic solution, and properly disposing of used materials to maintain a clean and safe environment.

Venipuncture technique: It was performed to collect samples for the CBC. Each subject provided an EDTA vial containing a 3-milliliter sample, which was then analysed on a Hematology analyser. The generated reports served as a sample and simple random sampling technique was used for sample collection.

**Laboratory tests:**The laboratory test performed on these samples for this study included;

Measurement of BLOOD CP

**Estimation of blood CP:**

The analyser used to analyse blood samples for complete blood estimation is the Celtax alpha Hematology analyser. The size and volume of the cells are determined using Coulter's concept. In order to use Coulter's concept, two electrodes are used. The blood sample cells are passed through an aperture using hydrodynamic focusing technology so that just one cell passes at a time. For a brief while, as cells pass through the orifice, they generate electrical resistance to the medium's current. 3-part differential cell counters then noted, quantified, amplified, and appropriately processed this resistance, and the numbers are translated into a reasonable histogram in the computer using the right logarithms.

It is able to differentiate between 3 types of WBC's, neutrophils, lymphocytes, and monocytes. In a 3-part differential cell counter basophils and eosinophils cannot be differentiated and are grouped with population of either neutrophils or monocytes

Haemoglobin (Hb), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), and red blood cell count (RBC) will be used to assess blood CP. Haemoglobin (Hb) is a marker for the blood's ability to transport oxygen. The normal Hb levels depend on your age, your sex, and other things. Mean Corpuscular Volume (MCV) is the average size of red blood cells is represented by MCV. It is computed by dividing the RBC count by the haematocrit (HCT). Mean Corpuscular Haemoglobin (MCH) shows how much haemoglobin is present in each red blood cell on average. Red Blood Cell Count (RBC) count shows how many red blood cells are present in each microliter of blood.

Samples with abnormal characteristics were excluded are Hemolyzed Sample, Insufficient Sample and Improperly stored Sample.

**Data analysis:** The data underwent analysis using suitable software, specifically SPSS version 22. The occurrence of IDA was determined based on the criteria established by the World Health Organization (WHO). Descriptive statistics were utilized to summarize the data and frequency was computed.

## RESULTS

The results of this investigation are shown in the tables. 1,2,3&4. Iron deficiency anaemia, which affects the majority of patients, is the most common kind of anaemia. Of the 324 patients, 70 exhibited anaemia due to iron deficiency. The age range with the lowest frequency of iron deficiency anaemia was between the ages of 46 and 60, whereas the majority of patients with this condition were between the ages of 16 and 30. The gender with the highest occurrence is female.

**Age Group distribution:** Within our population, three distinct age groups can be identified. Our research reveals that (IDA) is higher among individuals in group one (16-30 years) at a rate of 51% compared to the other two groups. Group two (31-45 years) exhibits a lower incidence of IDA, with only 26% affected, while group three (46-60 years) experiences the least impact, with a prevalence of IDA at 23% as shown in Table 1 and Figure 4.

Table 1: Age group distribution of sample

Age group	N	%age
16-30	164	51
31-45	85	26
46-60	75	23

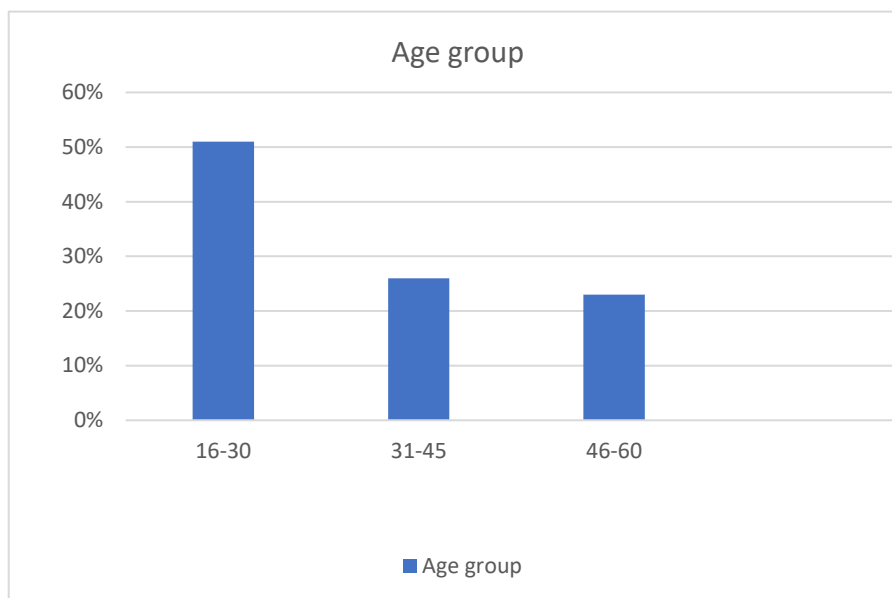


Figure 4: Age distribution of study population

**Gender Distribution:** In a sample population of individuals diagnosed with Iron Deficiency Anaemia (IDA), approximately 35% are males, while the remaining 65% are females.

The 35% of males with IDA refer to a subset of patients identifying as male, who have been diagnosed with this particular form of anaemia. The underlying cause of IDA in males can vary, ranging from inadequate dietary iron intake to gastrointestinal bleeding or other underlying health conditions affecting iron uptake.

Table 2: Gender percentage of sample:

Gender	N	% age
Male	113	35
Female	211	65

Additionally, the 65% of females with IDA represents the majority of patients diagnosed with this condition. Females, especially those in reproductive age, are more prone to developing iron deficiency due to blood loss during menstruation. Conceiving and lactation can further increase the risk of iron deficiency in women. Other factors contributing to IDA in females include insufficient dietary iron intake, certain chronic diseases, and gastrointestinal conditions affecting iron absorption as discussed in Table 2 and Figure 5.



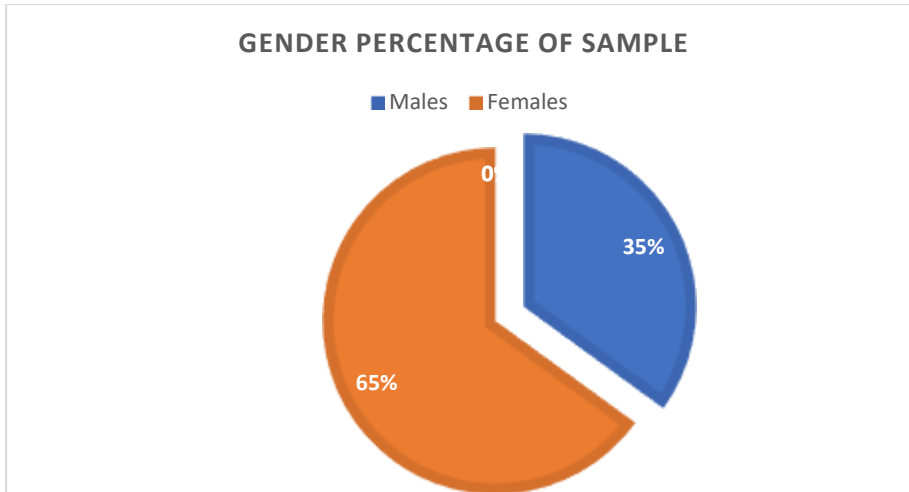


Figure 5: gender percentage of the sample

**Frequency and percentage distribution of IDA & non-IDA patients:**

In a given population, there are two distinct groups: those who have been diagnosed with (IDA) and those who have not. Within this population, approximately 22% of individuals have been identified as IDA patients, while the remaining 78% are classified as non-IDA patients.

The 22% IDA group refers to the subset of individuals who have received a confirmed diagnosis of IDA. This diagnosis indicates that these individuals have contracted the specific infectious disease under consideration. They may exhibit symptoms, undergo appropriate medical testing, and receive targeted treatment and care to manage and potentially recover from the disease.

Table 3: Frequency and percentage distribution of IDA & non-IDA patients

Anaemia	N	%age
IDA patients	70	22
Non-IDA patients	254	78

On the other hand, the 78% non-IDA group includes individuals who have not been diagnosed with IDA. These individuals may be healthy or have other medical conditions unrelated to IDA. They may exhibit symptoms that are attributed to different causes or may remain asymptomatic. While they are not affected by the specific infectious disease in question, they may still be susceptible to other diseases or health conditions as shown in Table 3 and Figure 5.

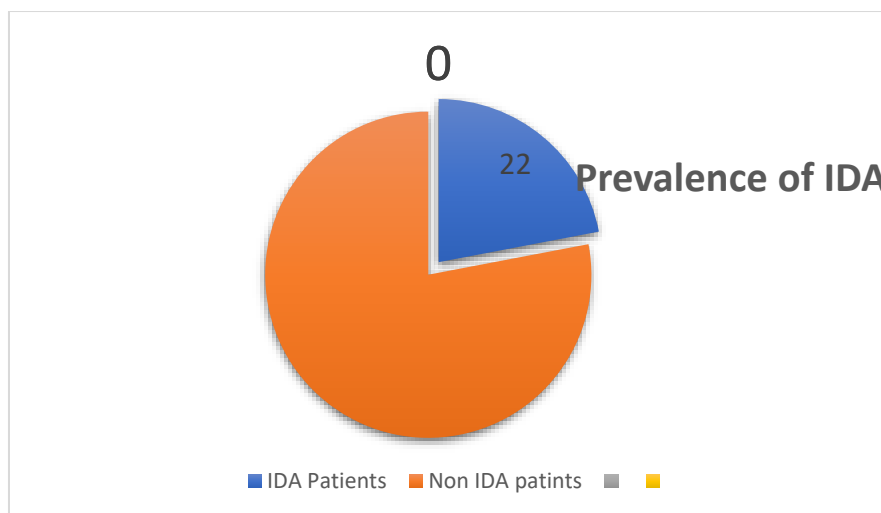


Figure 6 Prevalence of iron deficiency anemia & non-IDA

**Percentage of IDA in both genders:**

In a sample group consisting of 113 males and 211 females, a careful analysis reveals distinct characteristics pertaining to their health conditions. Among the 113 males, approximately 17% of them, which amounts to around 20 individuals, are diagnosed with Iron Deficiency Anaemia (IDA). On the other hand, within the group of 211 females, approximately 24% of them, totalling around 50 individuals, are identified as IDA patients.

**Table 4 Percentage of IDA in both genders**

Gender	Total	IDA	Normal	%age of IDA
male	113	20	83	17
female	211	50	161	24

These findings provide a precise and defined description of the gender distribution and prevalence of IDA in the given population sample. It is important to note that IDA is more prevalent among females, with roughly a quarter of them affected, compared to males, where the condition is observed in around one-sixth of the population. Such information highlights potential gender-based differences in susceptibility to and manifestation of IDA, emphasizing the need for tailored healthcare approaches and interventions to address this specific health concern as shown in Table 4 and Figure 6.

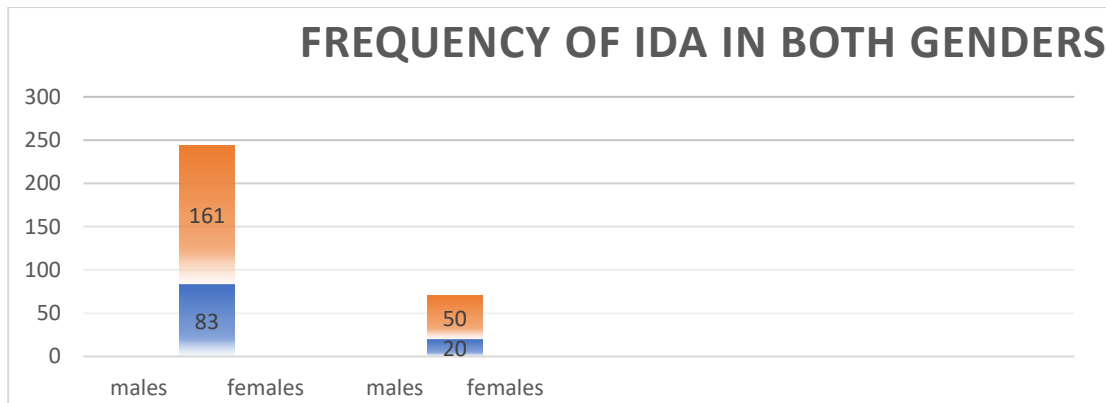


Figure 7 Frequency of IDA in both genders

## DISCUSSION

According to our research, the persistence of anaemia has been reported more in females with an age group of 16-30 which is growing and reproductive age as compared to males, this demonstrates that females are more prone to Iron Deficiency Anaemia, Tan et al. lead a review showing that 19.8% women were anaemic and 13.9% of them were diagnosed with IDA. The predominance of anaemia and IDA according to their research increased in women of age 16-30 which is reproductive age specially at the gestational stages, which affects millions of individuals globally, mostly in developing countries. Hence supporting our findings on the persistence of anemia.<sup>28</sup>

Our investigation discovered that as compared to females, males are less affected by IDA because of certain factors like eating habits, pregnancy, menstruation as well as blood loss. Because of the factors discussed above, females of our data are suffering in greater proportion as compared to males and this fact is also confirmed by the survey showed by Levi et al., 2019. They examined the factors that influence IDA in both males and females in four European nations. Qualitative statistical test was used to estimate the IDA factors using data from national primary care databases.<sup>29</sup>

In our study we have noticed that the females of age group 16-30 are more prevalent to IDA as compared to elder women. The most possible reasons for higher ratio of IDA in this age group is menstruation, poor dietary intake, blood loss. These facts are discussed in table no 4. The findings of Hilmento e al., also supported in parallel manner that 21.1% of girls and 9.4% of women were affected with IDA.<sup>30</sup>

Our research indicates that IDA is prevalent among women in the vicinity of Al-Nafees Hospital, FarashTown Islamabad because of a variety of determinants, including poverty, illiteracy, or restricted approach to medical services. The outcome also shows that the reproductive age group and the growing age is more affected due to the higher need of iron. According to Hu et al.'s 2019 women above the age of thirty had considerably decreased haemoglobin levels. It can be a result of issues they experienced at birth. Both sexes experience it, however, females are more likely to become pregnant during the premenstrual phase and to lose their fertility sooner than males do, as well as the factors contributing to IDA in the vicinity of Al-Nafees are also common in the study of Hu et al.'s 2019.,<sup>31</sup>

One of the main conclusions from our survey was that men in the 45-60 age range were more affected by IDA than those in the 20-40 age range. Cell degeneration, a

sluggish rate of recovery, and poor health are potential causes of a high ratio of IDA in this age group. In 2019, Kant and colleagues conducted a survey wherein they measured the haemoglobin levels of 1219 participants. They observed that anaemia was positively correlated with both the presence of chronic co-morbidity and age greater than 50 years in the age group (50–59) as compared with the age group (18–24 years).<sup>32</sup>

A study conducted by Richard J and Anmol Patted demonstrate that anaemia hits approximately 50% of pregnant women and majority of them are iron deficient. Heavy menstrual blood loss and delivery complications are the factors contribute to iron deficiency leading to Iron Deficiency Anaemia (IDA). Hence supporting the current study in parallel manner.<sup>33</sup>

Current study have showed that females of age 16-30 show high prevalence of IDA as compared to other age groups. According to this study contributing factors to young age iron deficiency anaemia are same as study conducted by Mengistu et al in Ethiopia. who concluded that adolescent school going girls are prone to IDA due to various factors like intestinal bleeding, menstrual bleeding, infectious diseases, poor diet habits and poverty are contributors of IDA hence supporting current study results.<sup>34</sup>

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