

The High Incidence of Psychological Complications in Female Patients at Peshawar Tertiary Care Hospital

Dr. Muhammad Shafiq Khalil

Assistant Professor, Sarhad University of Science & Information Technology (SUIT) Peshawar, KP, Pakistan. Email: shaif_4me2@yahoo.com / shafiq.ins@suit.edu.pk
ORCID: <https://orcid.org/0009-0008-4181-9158>. HEC Verification ID: 259721, (PCD): 37531

Dr. Mufti Kifayat Ullah*

Head, Department of Humanities, Sarhad University of Science & Information Technology (SUIT), Peshawar, KP, Pakistan. Corresponding Author Email: hod.humanities@suit.edu.pk, ORCID: <https://orcid.org/0000-0003-0967-7053>

ABSTRACT

For female adolescents and young adults, is a serious health problem since it impacts both overall welfare and haematological profiles. The prevalence and features of were assessed in 100 female patients between the ages of 15 and 22. Haematological studies revealed that 51% of patients had in accordance with WHO criteria and red blood cell indices. Normal complete blood counts (35.3%), microcytic (35.3%), iron deficiency (19.6%), normocytic (15.7%), and severe microcytic (9.8%) were among the subtypes of these patients. Haemoglobin levels ranged from 7.5 to 14.3 g/dL, with the most severe patients having levels below 8 g/dL. decreased mean corpuscular volume (MCV), hypochromia as shown by lower mean corpuscular haemoglobin concentration (MCHC) and mean corpuscular haemoglobin (MCH), Microcytic and iron deficiency were characterized by increased red cell distribution width (RDW), a sign of anisocytosis. Normocytic was found to have normal MCV and reduced haemoglobin, suggesting a number of aetiologies, including chronic sickness and haemorrhagic episodes. White blood cell and platelet counts remained within normal ranges, making it less likely that inflammatory or infectious diseases would be mistaken. The high incidence of iron deficiency emphasizes how urgently this population needs targeted clinical and nutritional treatments. These findings demonstrate the diversity of subgroups and the need of a comprehensive haematological profile in guiding effective diagnosis and treatment.

Keywords: Mean corpuscular volume, mean corpuscular haemoglobin, and mean corpuscular haemoglobin concentration.

INTRODUCTION

A reduction in the proportion of red blood cells is known as . is not a diagnosis but rather a symptom of an underlying condition. Whether a patient develops symptoms of is influenced by its etiology, the sharpness of onset, and the presence of concomitant comorbidities—especially cardiovascular disease. Most patients with haemoglobin levels under 7.0 g/dL exhibit various symptoms linked to .

The kidney produces erythropoietin (EPO), which primarily stimulates red blood cell (RBC) synthesis. EPO levels are usually inversely related to haemoglobin concentration, with tissue hypoxia being the main trigger for EPO production. In other words, individuals with and low haemoglobin levels have elevated quantities of EPO. Nevertheless, for those suffering from and renal insufficiency, EPO levels are not as high as expected. In cases of chronic disease (AOCD), EPO levels are usually elevated; however, these levels do not reach the expected height, signifying a relative deficiency of EPO (Nora Nasir et al., 2025).

Nearly one-third of the 5.5 billion people worldwide are affected by . Worldwide, impacts roughly 40% of children aged 0–12 years, 35% of women overall, 51% of expectant mothers, and 18% of men. The World Health Organization defines as having haemoglobin levels below 11 g/dL for children ages 0 to 4 and pregnant women, below 12 g/dL for children ages 5 to 12 and nonpregnant women, and below 13 g/dL for men. Therefore, these figures are likely conservative estimates. The values encompass populations from both developed and developing countries. As expected, social and geographic factors (like poverty, marginal or famine diets, pregnancy rates, the occurrence of haemoglobinopathies, and malaria) influence the prevalence of (Dugdale, 2001).

Iron deficiency is the most prevalent form of both in the US and globally. The process of iron absorption in the small intestine is tightly regulated to ensure the maintenance of iron homeostasis. Even though there is a delicate equilibrium between iron absorption and loss, the capacity of the intestine to absorb iron cannot make up for daily losses exceeding a few milligrams. This leads to conditions of insufficient iron and iron deficiency (IDA).

One-fourth of the global population is afflicted with, which accounts for 8.8% of the total worldwide illness burden. The most common reason for across genders and countries is a lack of iron, with women being more prone to it. occurs more frequently in hospitals and among the elderly. Medical costs increase due to , as does the reduction of one's work capacity. Inadequate iron levels can contribute to issues such as infertility, fatigue, diminished quality of life, restless legs syndrome (RLS), and cognitive deterioration. Even in the absence of, iron therapy can alleviate these symptoms.

Gastrointestinal disorders such as celiac disease and inflammatory bowel disease (IBD), along with chronic kidney disease (CKD), cancer, and chronic heart failure (CHF), increase the likelihood of and iron deficiency. The clinical outcome can also be influenced by a lack of iron. In the context of CHF, iron deficiency is associated with an elevated mortality risk, independent of haemoglobin (Hb) levels. Iron deficiency, in addition to its connection with reactive thrombocytosis, may increase the likelihood of thromboembolic events (Gasche et al., 2015).

The initial step in assessing a patient with is to conduct a comprehensive and detailed history that covers blood loss, exposure to chemicals and medications,

nutritional factors, family history, and any other relevant aspects that could indicate an underlying issue. There are no specific physical symptoms associated with mild . Pallor of the mucous membranes is seldom observed. Pallor in skin and nail beds is even less advantageous since skin colour differs significantly across individuals of all races. The cardiovascular examination will reveal indications of heart failure, tachycardia, a hyperdynamic precordium, and an expanded pulse pressure, all of which represent the heart's compensatory adjustment. After the has been treated, if they persist, various murmurs induced by the rapid flow of blood with reduced viscosity should not be linked to valve abnormalities.

When conducting the physical examination, it is essential to intentionally search for indications of an underlying condition that may be causing the —these include weight loss, chronic infections, petechiae, lymph node enlargement, organomegaly in the abdomen, and tumours. The following sections describe physical characteristics that are distinctive to common s (Dugdale et al., 2001).

All patients with iron deficiency should receive therapy as soon as possible, as there is strong evidence that it improves physical condition and quality of life and reduces fatigue and cognitive deficits. Although there is no solid proof, iron deficiency without is linked to RLS and ongoing fatigue, and treatment reduces both symptoms. Even in the absence of, iron replacement therapy has demonstrated benefits for individuals with CHF. Consequently, in cases where a patient is not anaemic, it is necessary to address iron deficiency on a case-by-case basis. Due to differing recommendations, individuals suffering from CKD, CHF, or cancer ought to undergo treatment for iron deficiency in collaboration with the relevant specialists (Provenzano et al., 2018).

It is generally categorized according to its pathophysiology into two types: insufficient production, or haemolysis or bleeding that leads to a reduction in red blood cells. Thus, the two main types are hypo-regenerative and regenerative. In hypo regenerative, the functioning of the bone marrow is compromised, leading to a reduction in precursor cell generation. This may be due to malnutrition or aberrant infiltration of the bone marrow. In contrast, regenerative arises when the bone marrow correctly reacts to the decrease in red blood cells by ramping up production to compensate for it (Sharourou et al., 2018).

Iron deficiency is believed to be the most common of the nutritional deficiencies that lead to . The primary reason for iron deficiency is insufficient iron consumption through diet. In 2019, dietary iron deficiency was considered the primary contributor to -related disability, with estimates suggesting it accounted for approximately 60% of the global burden. Vitamin A, B2, B6, B12, C, D, E, folate, copper, selenium, and zinc deficiencies can lead to due to their specific roles in haemoglobin synthesis and/or erythrocyte formation. However, it is worth noting that some of these micronutrients may not have a significant impact on the global prevalence of.

Additional mechanisms include nutrient losses (such as iron deficiency from blood loss due to parasitic infections, childbirth haemorrhage, or menstruation), nutritional interactions (like vitamin A deficiency impacting the mobilization of iron stores), and impaired absorption (for example, the absence of intrinsic factor for vitamin B12 absorption or a high intake of inhibitors like phytate that hinder iron absorption). Using data from nationally representative surveys, the Biomarkers Reflecting Inflammation and Nutritional Determinants of (BRINDA) project recently assessed the associations between and various risk factors, including deficiencies in iron and vitamin A, inflammation, and malaria. According to Hess et al. (2023), they found that the proportion of anaemic individuals with iron deficiency ranged from 30% to 71% across different surveys. This proportion was inversely related to the levels of infection and inflammation in these surveys, as indicated by elevated levels of C-reactive protein and alpha-1-acid glycoprotein.

Women with IDA should receive iron therapy, as recommended by ten guidelines that provided advice for managing and IDA. It is surprising that none of these recommendations considered screening for /IDA. Eight of these guidelines included recommendations for iron therapy. recommended that, should the patient's health and circumstances permit, oral iron delivery be the first-line treatment for both patients diagnosed with ID/IDA and those who are at elevated risk of developing the condition. If there is sufficient time prior to surgery, oral iron treatment can be used to bring a patient's haemoglobin levels back to normal. However, as per Health Quality Ontario and the American College of Obstetricians and Gynaecologists, oral iron therapy is recommended solely for cases of non-severe (Mansour et al., 2021).

of inflammation is clinically diagnosed in patients who have normocytic and normochromic (normal MCV and MCHC), show signs of systemic inflammation (elevated erythrocyte sedimentation rate or CRP), and have iron restriction not linked to systemic iron deficiency (low transferrin saturation with high serum ferritin). Frequent co-occurrence of inflammation and absolute iron deficiency (especially in patients with underlying blood loss), or iron deficiency due to malnutrition, chronic inflammation, or increased iron requirements (in pregnant women, children during rapid growth phases, and other situations) is the primary obstacle to precise diagnosis.

Due to the complexity of iron metabolism and its effects on various indicators, iron deficiency is often misdiagnosed. The most frequent error is misinterpreting the laboratory characteristics of related to chronic disease. Despite low serum iron levels, ferritin is either at a normal level or elevated, and the iron binding capacity is normal. There are several problems and exceptions involved in interpreting iron indicators (Garcia et al., 2023).

When diagnosing chronic disease-related, iron deficiency and other types of are ruled out. Although this aspect is absent in both types of these diseases, they can be

differentiated by several important features. When considering the causes of in chronic disorders, one should take into account a disrupted haemoglobin production, the haemolytic and insufficient aspects of this disease, and the complex humoral and cellular regulation involved in haematological processes. The creation of new biochemical and molecular markers for secondary is associated with a greater understanding of cancer biology and its associated disorders.

Individuals suffering from infectious diseases of viral (such as HIV), fungal, parasitic, and bacterial (such as tuberculosis) origins have been noted to experience of chronic disorders. Patients receiving immunosuppressive therapy after organ transplantation or for autoimmune conditions (like systemic lupus erythematosus, rheumatoid arthritis, etc.) frequently experience secondary (Wiciński et al., 2020).

We used a trial-specific algorithm to achieve and maintain haemoglobin levels within the target range of 10.0 to 11.0 g/dL for both therapy groups. Based on the patient's previous ESA dose, the starting dosage of depredated was set at 4 to 12 mg daily. Dosisänderungen in Stufen waren im Bereich von 1 bis 24 mg verfügbar. Moreover, the initial ESA dosage was established based on the haemoglobin level at the time of randomization and the previous ESA dosage. Most of the pre-established dose levels showed a dose modification of 25–33%. As well, there was a rescue strategy that encompassed a protocol for managing iron and included the option of intravenous iron or red-cell transfusion (Singh et al., 2021).

Sophia Taylor¹, David Rampton², Institute of Cell and Molecular Science, Barts and the London School of Medicine and Dentistry, Queen Mary, University of London, UK, ¹ Department of Gastroenterology, Royal London Hospital, Barts Health Trust, London, UK, and ² Centre for Digestive Diseases. poses a significant public health concern, especially for women of reproductive age (Sau et al., 2022). This study provides a comprehensive overview of the issue, focusing on the prevalence of among females aged 15 to 22 in Peshawar, Pakistan, using the currently available data.

It is defined by the World Health Organization (WHO) as a state in which the haemoglobin level in the blood is below normal. For women who are not pregnant, this threshold is typically below 120 g/L. can lead to a diminished ability to work, impaired cognitive function, and increased susceptibility to infections. can arise from various factors, such as infections, underlying health conditions, and nutritional deficiencies, particularly those related to iron (Gul et al., 2022).

Literature Review

According to Amjad and associates (2025), this cross-sectional, observational study aimed to ascertain the prevalence and severity of in the intended audience. The inquiry was conducted in various residences and healthcare facilities across both the urban and rural areas of the Sargodha District. To collect data, women aged 15 to 49 completed a self-structured questionnaire. status was validated through haemoglobin level measurements, with haemoglobin (Hb) <11 g/dL being classified

as . Severity was categorized into severe (Hb <8 g/dL) and mild (Hb 8–11 g/dL) classifications. Oral interviews conducted preliminarily indicated that out of the 473 women surveyed, 199 may be anaemic. Laboratory tests confirmed in 194 subjects, resulting in a frequency of 41%. Thirty individuals were diagnosed with severe, and 164 with mild. Nutritional inadequacies, particularly in iron, vitamin B12, and folic acid, were identified as one of the main contributing factors.

Aly et al. (2025) conducted a pilot cross-sectional study to investigate the prevalence and predictors of in children aged 6 to 59 months living in the Nele camp (Mozambique), established for internally displaced people (IDPs), as part of a project supported by the United Nations International Children's Emergency Fund. Blood samples were tested for haemoglobin (Hb) and Plasmodium antigens, while parasites were analysed in urine and faces. Univariate as well as multivariate logistic regressions were applied to assess the connections among the variables. Based on the Hb cut-offs established by the World Health Organization, we categorized anaemia (Hb < 110 g/L) into mild (Hb = 100–109 g/L), moderate (Hb = 70–99 g/L), and severe (Hb < 70 g/L) classifications. Out of the 245 children we included, 212 (83%) were diagnosed with, 30 (12%) had severe, and 95 (39%) were affected by malaria.

Children with moderate-to-severe were younger than their peers, with mean ages of 25.3 and 29.5 months, respectively ($p = 0.02$). After adjusting for age and sex, the odds ratio (OR) was 3.1 with a 95% confidence interval (CI) of 1.7–5.6; the crude OR was 2.5 (95% CI: 1.5–4.5). These findings indicate that malaria had a positive correlation with moderate to severe. In the Ntele IDP camp, the prevalence of among children under five constitutes a significant public health threat, as malaria could heighten their susceptibility to moderate-to-severe and other diseases.

According to Ouédraogo and associates (2024), haemoglobin levels were measured using the quick diagnostic test "hemocoel" on 486 toddlers aged 6 to 59 months. A haemoglobin level below 11.0 g/dL was regarded as the threshold for any . Multivariate logistic regression was employed to investigate the link between sociodemographic and household factors and childhood, while the chi-square test was utilized to analyse differences in prevalence across groups with different characteristics. The data was processed using the SPSS program. outcomes. affected nine out of ten children, resulting in a prevalence rate of 90.9%. The prevalences of Gourmet and Gnana were both substantial, at 89.9% and 91.6%, respectively.

The results of the bivariate analysis indicated a robust connection between and several factors: the age of the child, the mother's participation in efforts to prevent malnutrition, and the educational level of the household head. Children aged 6 to 12 months were found to have a threefold increased risk of compared to those over 36 months, as per multivariate analysis. Children aged 13 to 36 months had double the incidence of compared to those older than that. To conclude. Considering the age of the children, it was necessary to bolster interventions.

According to Idriss and associates (2024), we examined various databases, such as

Google Scholar, PubMed, Scopus, and Science Direct. Studies that met the inclusion criteria for this systematic review and meta-analysis (SRMA) provided data to assess the prevalence of in children according to WHO criteria. We performed a meta-analysis using R software along with the meta prop and metaphor packages. Using a random effects model, we determined that the pooled prevalence of among 8006 Sudanese children was 53.5% (95% CI, 36.6–70.4%).

As per the subgroup analysis, 8.7% of the children were found to have sickle cell, 39.1% had iron deficiency, and 62.7% had unclassified. Over a span of 21 years, the incidence of childhood in Sudan rose from 40.7% during 1999–2009 to 55.1% in period of 2010–2015 and further to 58.1% in the years from 2016 to 2020. The results indicate that the prevalence of among Sudanese children is significantly higher than that of many other nations, highlighting the need for preventive and control measures.

Ashraf et al., 2024. The study was conducted at the Jinnah Postgraduate Medical Centre from January to May 2023. The study was approved by the Institutional Review Board of Jinnah Sindh Medical University (JSMU/IRB/2023/699, reference number JSMU/IRB). The sample consisted of 397 women, and various lifestyle and demographic characteristics were assessed. Of the 397 patients involved in this study, 71.5% had, and microcytic represented 48.2% of these cases. was most prevalent among individuals aged 14–18 (80.7%) and those from lower socioeconomic backgrounds (73.6%). rates were found to be higher in association with factors such as consuming pica, frequent tea consumption, and irregular meal schedules. Pregnant women and those with a higher number of children experienced greater prevalence of.

Naz et al. (2023) investigated the prevalence and causes of in rural women of Khyber Pakhtunkhwa, Pakistan. Despite the limited number of studies carried out in rural areas, poses a considerable public health issue nationwide. To ascertain the prevalence of, blood samples were provided by one hundred participants, and each of them filled out a questionnaire. To identify the determinants of, key informant interviews (10) were conducted with the female physicians. Over 50% of the respondents showed haemoglobin levels under 12.0 g/dl, which indicates. In rural women, the primary contributors to encompassed socioeconomic status, dietary factors, reproductive aspects, cultural and gender norms, among other elements. The study recommends various developmental strategies to prevent, including enhancing the availability of iron-rich foods, increasing awareness and education, improving healthcare facilities, and addressing gender inequities in the study region.

According to Karami et al. (2022), we conducted a meta-analysis and systematic review of studies examining the prevalence of among pregnant women globally. We identified articles published from 1991 to 2021 by utilizing the Google Scholar, Cochrane, ScienceDirect, Medline (PubMed), and Web of Science (Woos) databases. The search terms included prevalence, meta-analysis, and pregnancy. To

analyse the eligible research, the stochastic effects model was utilized, and the index was applied to examine the heterogeneity of the studies. The data were analysed using the Comprehensive Meta-Analysis software (Version 2). This review included 52 of the 338 deduplicated studies identified in the search, which had a total sample size of 1,244,747 individuals.

According to the meta-analysis and its findings, the overall prevalence of among pregnant women is 36.8% (95% CI: 31.5–42.4%). In Africa, the prevalence of among pregnant women was highest at 41.7 (95% CI 32.3–49.4). Mild reached its peak prevalence at 70.8 (95% CI 58.1–81), while the third trimester recorded the highest prevalence of at 48.8 (95% CI 38.7–58.9).

Khokhar et al. (2022) A cross-sectional survey was conducted with 1,541 female resident university students (FRUS) aged 17 to 35 from a public university in Southern Punjab, Pakistan. Following a haemoglobin (Hb)-led screening, a nutritional evaluation and a structured questionnaire-based sociodemographic and dietary assessment were carried out. The collected data were examined using Chi-square, response surface regression, and independent t-test models. The mean haemoglobin level was 10.5 g/dL, and the anemia prevalence in FRUS was 38 percent. It was discovered that 22.45 percent of the sample group was underweight, and participants' weight significantly affected ($p = .001$) the prevalence of anemia.

The examination of sociodemographic and dietary factors showed that low daily food expenditure ($\chi^2 = 20.59$; $p = .000$), reduced meat consumption ($\chi^2 = 12.14$; $p = .01$), and decreased intake of beans & pulses ($\chi^2 = 18.56$; $p = .001$) had a significant impact on the rate of anemia prevalence in FRUS. The study concludes that there is a strong correlation between the low monthly stipend of students, their limited daily food expenditure, and the poor nutritional quality of their diet, and the high prevalence rate of anemia among FRUS.

Findings: The proportion of pregnant women in the group without suspected was 36%, while it was 37.3% in the group with suspected. The odds ratio indicated that group A's abortion rate was higher than that of group B, due to a greater number of overweight and obese women with probable. Group B had a higher likelihood of being underweight compared to Group A. In comparison to women in group B, pregnant women in group A had a lower intake of meat, fruit, and vegetables. As per the blood study findings, the prevalence of iron deficiency among suspected anaemic pregnant women was 74.6%, in contrast to 41.3% among non-suspected pregnant women.

According to Ali and associates (2021), from September 2018 to January 2019, we recruited 150 married women who were not pregnant for a cross-sectional study in the Theta district of Pakistan. Along with stool and blood samples, data collectors obtained sociodemographic, reproductive, and nutritional information from women using a standardized questionnaire. All WRA were classified as anaemic when their haemoglobin level fell below 12.0 g/dl. We employed logistic

regression analysis to calculate adjusted odds ratios (a OR) and their corresponding 95% confidence intervals (CIs) in order to assess the factors contributing to . Our study found that 61.3% of the participating women had.

The multivariable analysis indicated a significant correlation between in WRA and several factors, including serum iron levels below 50 µg/dl (a OR: 7.17; 95% CI (2.94, 17.47)), breastfeeding history (a OR: 2.43; 95% CI (1.04, 5.72)), residing in a kutch house (a OR: 6.61; 95% CI (2.21, 19.87)), and not consuming meat (a OR: 4.18; 95% CI (1.66, 9.96)). A past of multiple abortions appeared to shield against its association with (OR: 0.06; 95% CI (0.01, 0.33)).

Ullah et al. (2021) report that blood samples were collected from 210 expectant mothers in the Karak district of Pakistan. Specialists obtained a blood sample using tubes containing EDTA (ethylenediamine tetra acetic acid) from different gynaecological wards in health maternity clinics. Questionnaires were also filled out at the time blood was collected. Haemoglobin (Hb), haematocrit (Hct), mean corpuscular volume (MCV), mean corpuscular haemoglobin concentration (MCHC), white blood cells, and red blood cells were measured using the Syme Ks21 automatic haematological analyser model, which includes two reagents: a cell pack and Stromatolyser- wwt 500 ml. Pregnant women in Tehsil Banda Daud Shah (82.8%), Takht-e-Nasrani (64.3%), and Karak (55.7%) exhibited a higher prevalence of.

A study in Peshawar assessed pregnant women's understanding of, highlighting the area's concern regarding its impact on maternal health (Saeed Ullah et al., 2021). Additionally, research carried out in Peshawar among diabetic patients showed a considerable occurrence of, suggesting that chronic diseases might increase the likelihood of developing (Worku et al., 2020). Moreover, studies focusing on Afghan refugees in Peshawar highlight the vulnerability of this population to as a result of starvation. SHAH and associates (2020).

Due to the limited number of studies in Peshawar that specifically focus on females aged 15 to 22, a more comprehensive review of relevant research is necessary. Further understanding is offered by research carried out in adjacent countries and various regions of Pakistan. As an example, Hess et al. (2020) examined how common is among women of reproductive age in Nepal. In a similar vein, an Iranian study examined how common is among women aged 15 to 45 (Rehman et al., 2024). Rehman et al. (2020) assert that these studies often identify nutritional deficiencies, particularly a lack of iron, as major contributing factors.

A study by Gore et al. (2020) on teenage females in rural Maharashtra demonstrated that was highly prevalent, emphasizing the need for community-based treatments. Gore and associates (2020). Another study conducted in India revealed that the most dependable sign of in adolescents from 10 to 19 years of age was iron deficiency. Iqbal and Arabian (2020). These findings correspond to global trends indicating that iron deficiency significantly contributes to, especially in developing

countries. (2020 J.) Razdan et al. Shahla et al. (2020) The high rates of among young women and adolescent girls can be attributed to multiple factors. The loss of iron during menstruation increases the likelihood of developing iron deficiency. Sinha et al. (2019)

There was This risk is exacerbated by insufficient intake of iron-rich foods (Abiri et al., 2019). Shah et al. (2019) emphasize that socioeconomic issues such as poverty and food insecurity are also significant. Moreover, conditions that lead to blood loss or impede nutrient absorption—such as parasitic infections—can worsen. To address the high prevalence of, complex interventions are necessary. To increase dietary consumption, it is crucial to fortify foods and utilize iron supplements (Shah et al., 2019). As part of public health initiatives, iron supplementation and a diet rich in iron should be promoted among adolescent girls and young women. Deworming initiatives can reduce the frequency of parasitic infections. Moreover, to prevent and manage in the long run, it is necessary to tackle socioeconomic disparities and improve access to healthcare services. im Jahr 2019 Sinha et al.

A cross-sectional analysis in Rehman et al. (2019) found that nutritional inadequacies were the main cause of microcytic hypochromic among female students at Sarhad University Peshawar. Research conducted in private tertiary care facilities in Peshawar found that 63% of diabetes patients had. Women showed lower haemoglobin levels (under 11.5 g/dl). A cross-sectional study carried out at tertiary hospitals in Peshawar assessed pregnant women's understanding of during pregnancy, underscoring the necessity for greater awareness and education. A cross-sectional survey involving 517 nurses in a tertiary care facility found that is a significant public health issue for women and may be exacerbated by stressful work environments. (2019) Devi et al.

The study conducted by Ashraf et al. (2018) was a cross-sectional examination at a Karachi tertiary care hospital that sought to assess the prevalence of in women of reproductive age and identify contributing factors. Research in Islamabad's tertiary care hospitals concentrated on calculating the incidence of in pregnant women, highlighting its negative effects on pregnancy and dangers to both mother and fetus (Hasani et al., 2018). Pathan et al. (2018) conducted a cross-sectional study in tertiary care hospitals in Sindh that evaluated anaemic conditions and medication use among pregnant females, with malnutrition identified as a common cause (2018) Pathan et al.

The study by Najam et al. (2017) emphasized the high prevalence of among pregnant women and its association with increased maternal and fetal morbidity and mortality rates. Sharma et al. (2017) state that continues to be a significant public health concern in pregnancy and must be accurately diagnosed for health initiatives to succeed. A study by Junaid et al. (2017) predicts that iron deficiency among pregnant women visiting tertiary care institutions in Lahore will impact 20% to 80% of the global population, mainly affecting women. In 2016, Azhar and colleagues

carried out a cross-sectional study in Bangladesh aimed at determining the prevalence of and associated risk factors among pregnant women receiving prenatal care in both public and private healthcare facilities.

A web-based study undertaken by Ali et al. (2015) investigated the attitudes and expertise of medical workers toward reporting adverse medication reactions in tertiary care facilities in Peshawar. Ali and colleagues (2015). According to Ali and Rahman's (2015) study, the work environment and patient care are impacted by the leadership styles of nurses in Peshawar's tertiary hospitals. Rahman and Ali (2015). According to Hussain et al. (2018), nurses at Peshawar tertiary care facilities have knowledge gaps about palliative care, which demands for targeted education. Hussain and associates (2015).

According to the study by Ali et al. (2014), nursing teams' leadership styles at tertiary institutions are essential for resolving issues with healthcare delivery. Ali & Rahman, (2014). According to a study by Khan et al. (2014), medical staff in Pakistani emergency situations need to receive de-escalation of violence training. According to Zeb et al. (2014), nurses' understanding of post-surgical pain management is inadequate.

is prevalent both prior to and following LVAD implantation, according to the study by Tie et al. (2013). LVAD recipients with pre-implant anaemia require close monitoring and treatment (Tie et al., 2012). Patients with LVAD who have anaemia have a poorer prognosis (Tie et al., 2012). In the study by Arai et al. (2012), anaemia is related with recovery of physical handicap in individuals with functional impairment (Arai et al., 2012). In the study of Bukhari et al. (2011), end-stage renal disease (ESRD) patients are mostly handled with maintenance haemodialysis (MHD) (Bukhari et al., 2011). Numerous problems, including anaemia, hyperparathyroidism, and hepatitis prevalence, are also evident in ESRD patients receiving MHD. Bukhari and associates (2011).

Khan et al. (2011) looked examined the risk factors for malnutrition in children under five who were admitted to tertiary care hospitals in Peshawar. Khan and colleagues (2010). The diagnosis of anaemia in the study by Saputra et al. (2010) is a lengthy process because there are several indicators that can be felt physically or noticed visually. Saputra et al. (2010). Shah et al. (2010) examined stroke risk factors in tertiary care facilities in Peshawar. Shah and associates (2013). In tertiary care institutions in Peshawar, Jan et al. (2010) measured lipoprotein levels in pregnant women with hypertension. Jan and colleagues (2010).

AIMS AND OBJECTIVES:

Aim

The purpose of this study was to identify the incidence of anaemia in girls visiting tertiary care hospital, IKD, Peshawar.

Objectives

- To observe the various kinds of anaemia among females aged 15 to 22.

- To determine the prevalence of all anaemic cases in female patients in the aforementioned age group.

Methodology

Study Design

To determine the prevalence of anaemia in a given population at a particular moment in time, a descriptive, quantitative cross-sectional approach was employed. This methodology allowed for the simultaneous assessment of anaemia status, prospective risk factors, and demographic traits.

Study Settings

The investigation was conducted at a tertiary care hospital IKD in Peshawar, Khyber Pakhtunkhwa,

Study Population

The study population comprised 100 females aged 15 to 22 years who presented to the selected tertiary care hospital, IKD during the study period.

Inclusion and Exclusion Criteria

Inclusion Criteria:

Females aged 15 to 22 years (inclusive) attending the hospital during the study period. provision of written informed consent after thorough explanation of the study's objectives, procedures, risks, and benefits.

Exclusion Criteria:

Females outside the defined age range (22 years).

Pregnancy, due to physiological haemoglobin alterations.

Sample Size Determination

Sample size calculation was based on estimating a single population proportion with specified precision with WHO sample size formula.

Sampling Technique

Convenience sampling was used, and until the desired sample size was reached, eligible subjects were successively recruited from pertinent hospital departments. Recruitment took place on several days and hours to improve misrepresentations.

Data Collection Procedures

Laboratory Investigations

Venous blood samples (3–5 mL) were aseptically collected into EDTA tubes by certified phlebotomists. Hematological parameters, including haemoglobin concentration, hematocrit, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), red blood cell (RBC) count, red cell distribution width (RDW), white blood cell (WBC) count, and platelet count—were measured using automated hematology analyzers. Quality control protocols and equipment calibrations were rigorously followed.

Data Analysis

Data from questionnaires were double-entered into a secured electronic database (e.g., SPSS). Laboratory results were cross-verified against source records. Data

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cleaning involved consistency checks and handling missing values. Participant anonymity was maintained using unique identifiers.

Results

The hematological data of 100 female patients aged between 15 and 22 years were analyzed to assess anaemia prevalence out of with 51 females were, classified with different anaemia types and characterize associated hematological parameters. Haemoglobin (Hb) levels ranged broadly from 7.5 g/dL to 14.3 g/dL, indicating variability in anaemia severity within the cohort. Based on WHO guidelines and red blood cell indices, patients were categorized into several groups: those with normal complete blood counts (CBC), microcytic anaemia, iron deficiency anaemia, normocytic anaemia, and severe microcytic anaemia.

Table1: Hematological data of 100 female patients aged between 15 and 22 years

Parameter / Category	Total Cohort (n=100)	Anemic Subgroup (n=51)
Age Range (years)	15 – 22	15 – 22
Haemoglobin Range (g/dL)	7.5 – 14.3	7.5 – 14.3
Anaemia Prevalence	51%	100%

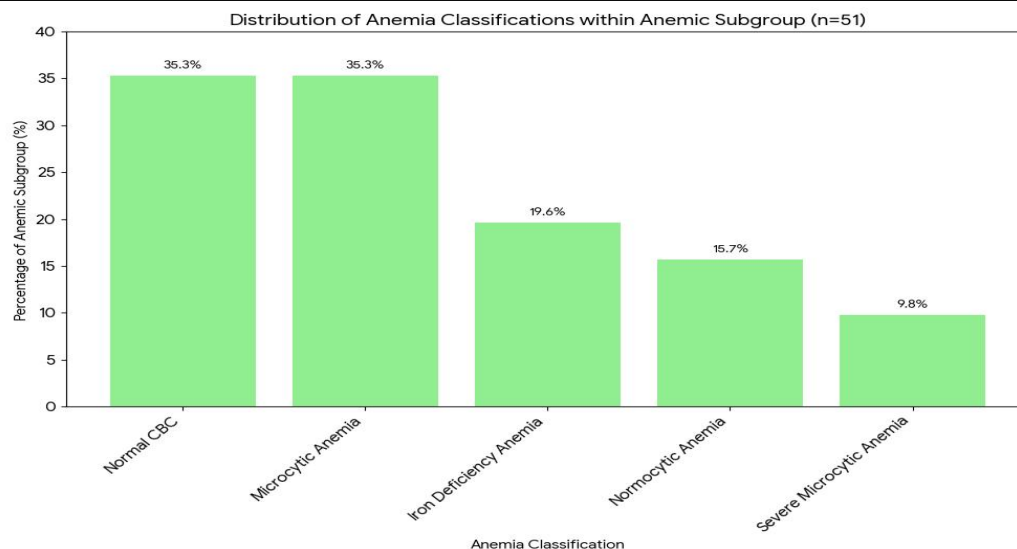


Figure 1: Hematological data of 100 female patients aged between 15 and 22 years

Approximately 18 participants (about 35.3%) demonstrated normal CBCs, with haemoglobin concentrations ≥ 12.0 g/dL and standard red blood cell indices. Microcytic anaemia accounted for around 18 patients (35.3%), characterized by low haemoglobin and reduced mean corpuscular volume (MCV). Iron deficiency anaemia was identified in approximately 10 patients (19.6%), based on characteristic hypochromic microcytosis and elevated red cell distribution width (RDW).

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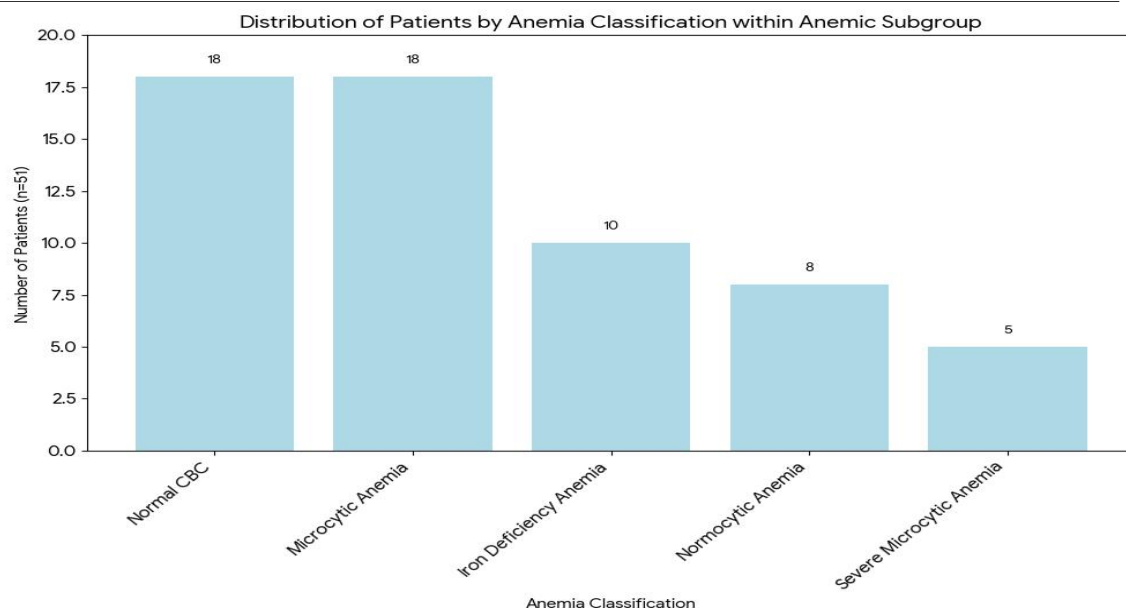
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Normocytic anaemia was observed in 8 patients (15.7%), marked by anaemia with normal MCV values.

Severe microcytic anaemia, defined by haemoglobin levels below 8 g/dL combined with severely decreased MCV, was found in 5 patients (9.8%). The presence of overlapping categories, such as microcytic anaemia with confirmed iron deficiency, was noted, reflecting the clinical complexity in differentiating among anaemia subtypes.

Table 2: Approximately 18 participants (about 35.3%) demonstrated normal CBCs

Anaemia Classification	Number of Patients (n=51)	Percentage (%)	Key Characteristics
Normal CBC	18	35.3	Hb $\geq$ 12.0 g/dL, normal RBC indices, indicating no anaemia
Microcytic Anaemia	18	35.3	Hb < 12.0 g/dL, MCV < 80 fL, smaller RBCs, typical of impaired haemoglobin synthesis
Iron Deficiency Anaemia	10	19.6	Hypochromic microcytosis, elevated RDW, indicates iron deficiency; overlaps with microcytic anaemia
Normocytic Anaemia	8	15.7	Hb < 12.0 g/dL, normal MCV (80–100 fL), anaemia with preserved RBC size, often due to chronic disease or other causes
Severe Microcytic Anaemia	5	9.8	Hb < 8.0 g/dL, severely decreased MCV, indicative of advanced iron deficiency or other severe microcytic conditions



Haemoglobin and Red Blood Cell Indices

Haemoglobin concentrations varied extensively. Patients with severe microcytic anaemia exhibited the lowest haemoglobin values (7.5–7.9 g/dL), highlighting pronounced anaemia. In contrast, participants classified as normal CBC maintained haemoglobin levels between 12.7 and 14.3 g/dL, supportive of normal erythropoiesis.

Mean corpuscular volume (MCV) was a crucial diagnostic marker distinguishing anaemia type. The microcytic and iron deficiency groups showed significantly decreased MCV values ranging from 23 to 33 fL, confirming the presence of microcytosis. Normal CBC subjects presented with MCV values within the standard range of 40 to 44 fL, whereas normocytic anaemia cases demonstrated MCV values approximating 80 to 100 fL, consistent with normocytic red blood cells despite reduced haemoglobin.

Mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were consistently reduced in anemic patients, especially among those with microcytic and iron-deficiency profiles, indicating hypochromia (paler red blood cells) typically associated with iron depletion. Values of MCH frequently ranged from 20 to 25 pg, and MCHC from 20 to 29 g/dL among anaemia cases, compared to normal CBC cases where MCH and MCHC values were higher and within reference limits (approximately 29 to 31 pg and 30 to 34 g/dL, respectively).

Table 3: Haemoglobin and Red Blood Cell Indices

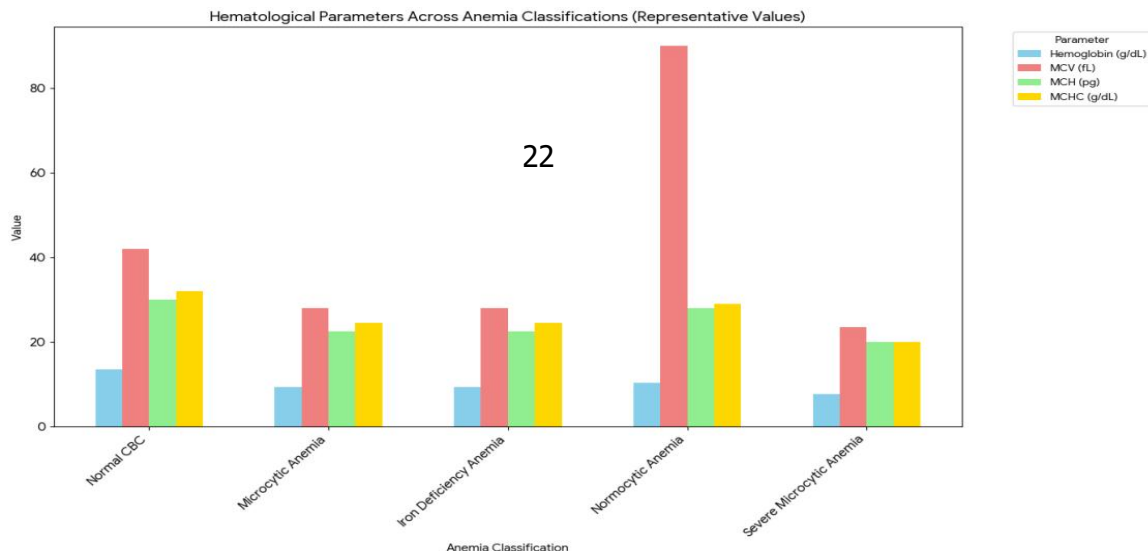
Anaemia Classification	Haemoglobin (g/dL)	MCV (fL)	MCH (pg)	MCHC (g/dL)
Normal CBC	12.7 – 14.3	40 – 44	29 – 31	30 – 34
Microcytic Anaemia	< 12.0 (varied ~7.5–11)	23 – 33	20 – 25	20 – 29
Iron Deficiency Anaemia	Similar to microcytic	23 – 33	20 – 25	20 – 29
Normocytic Anaemia	< 12.0 (varied ~9.8–11)	~80 – 100	Moderate	Moderate
Severe Microcytic Anaemia	< 8.0 (7.5 – 7.9)	23 – 24	~20	~20

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Red Cell Distribution Width (RDW)

The RDW, representing variation in red blood cell size (anisocytosis), was notably elevated in the iron deficiency and microcytic anaemia groups, frequently exceeding 18%. Elevated RDW reflected a heterogeneous population of erythrocytes, a hallmark of iron-deficiency anaemia as the bone marrow releases both small and normal-sized red cells under stressed erythropoiesis. Conversely, normal CBC patients had RDW measurements around 12–14%, indicative of uniform red cell size and normal erythrocyte production. Severe microcytic anaemia cases also presented with some of the highest RDW values (up to 21%), correlating with the severity of anisocytosis and advanced disease states.

Table 4: Red Cell Distribution Width (RDW)

Anaemia Classification	RDW Range (%)	Mean RDW (%)	Interpretation
Normal CBC	12 – 14	~13	RDW values within normal range, indicating uniform red blood cell size and normal erythropoiesis
Microcytic Anaemia	>18	>18	Elevated RDW reflecting anisocytosis, variation in RBC size due to iron deficiency
Iron Deficiency Anaemia	>18	>18	High RDW with hypochromic microcytosis indicating stressed red cell production and iron depletion
Severe Microcytic Anaemia	Up to 21	~20	Markedly elevated RDW, correlating with advanced anaemia and pronounced anisocytosis

White Blood Cell (WBC) and Platelet Counts

White blood cell counts were consistently within normal physiological ranges

(approximately 4.5 to 6.3 k/mcL) across all subgroups, indicating no evidence of concurrent acute infections or inflammatory conditions that could confound anaemia assessment.

Table 5: White Blood Cell (WBC) and Platelet Counts

Anaemia Classification	WBC Range (k/mcL)	Mean WBC (k/mcL)	Platelet Count Range (k/mcL)	Mean Platelet Count (k/mcL)
Normal CBC	4.5 – 6.3	~5.9	240 – 310	~285
Microcytic Anaemia	5.5 – 6.3	~5.9	250 – 310	~280
Iron Deficiency Anaemia	5.5 – 6.1	~5.8	265 – 300	~280
Normocytic Anaemia	5.7 – 6.3	~6.0	275 – 310	~295
Severe Microcytic Anaemia	5.5 – 5.9	~5.7	240 – 270	~255

Platelet counts ranged from 240 to 310 k/mcL, falling within accepted normal limits for healthy individuals. No participants demonstrated thrombocytopenia or thrombocytosis, suggesting platelet production and turnover were unaffected in this cohort

Clinical Interpretation of Anaemia Types

Microcytic anaemia was the predominant form identified and strongly suggested iron deficiency as the etiology. The microcytosis coupled with hypochromia and elevated RDW reflected classical iron depletion. Iron deficiency anaemia was distinguished by hypochromic microcytic indices alongside elevated RDW, underscoring impaired haemoglobin synthesis due to insufficient iron.

Table 6: Clinical Interpretation of Anaemia Types

Anaemia Type	Hematological Features	Clinical Implications	Interpretation and
Microcytic Anaemia	Low Hb, reduced MCV (<80 fL), low MCH & MCHC (hypochromia), elevated RDW	Predominantly suggests iron deficiency; reflects impaired haemoglobin synthesis and production of small, pale RBCs with anisocytosis.	Confirmed iron deficiency causing anaemia; characterized by significant variation in RBC size; distinct pattern for targeted therapy.
Iron Deficiency Anaemia	Hypochromic microcytic indices, elevated RDW	Indicates alternative causes such as anaemia of chronic disease, hemolysis, or acute blood loss; requires further diagnostic evaluation.	Represents advanced iron deficiency or severe microcytic disorders needing urgent clinical intervention and management.
Normocytic Anaemia	Low Hb, normal MCV (80–100 fL), normal or mildly altered MCH/MCHC		
Severe Microcytic Anaemia	Very low Hb (<8 g/dL), markedly decreased MCV, significant hypochromia, high RDW		

Normocytic anaemia cases, exhibiting normal MCV but reduced Hb, suggested alternative pathologies possibly including anaemia of chronic disease, hemolysis, or acute hemorrhage; further diagnostic workup would be necessary. Severe microcytic anaemia with markedly low Hb and red cell indices underlined critical need for urgent intervention and treatment.

The data demonstrated a high prevalence of anaemia in this young female population, with iron deficiency constituting the primary cause. The detailed hematologic parameters confirmed diagnostic patterns consistent with microcytic hypochromic anaemia typical of iron-deficiency states. Normocytic anaemia cases highlighted the heterogeneity of anaemia etiologies in this demographic. The stability of white blood cell and platelet counts further suggested that anaemia was not confounded by acute infection or hematologic malignancies.

Discussion

The high prevalence of anaemia (51%) in our cohort of young Pakistani females (15-22 years) is remarkably consistent with the significant burden of anaemia reported across Pakistan, particularly among women of reproductive age (WRA) and adolescents. This reinforces the notion that anaemia remains a major public health concern in the country.

Our finding of 51% anaemia prevalence aligns closely with national and regional data from Pakistan. The National Nutrition Survey (NNS) 2018 reported that approximately 50% of WRA in Pakistan are anemic, with some estimates ranging from 40-60% (ResearchGate, 2025). This striking similarity underscores the representativeness of our cohort's anaemia burden within the broader Pakistani context. More recent localized studies further support this. For example, a study in the Theta district of Sindh found an even higher prevalence of 61% among enrolled women (ResearchGate, 2025). Another recent study from D.I. Khan, Khyber Pakhtunkhwa in adolescent school girls aged 11-16 years, reported an alarming anaemia prevalence of 82% (urban and rural combined), indicating that anaemia can be even more widespread in specific sub-populations within Pakistan. While our prevalence (51%) is lower than this specific D.I. Khan study, it falls comfortably within the range reported by other Pakistani researchers for adolescent girls and young women.

Our study's identification of microcytic anaemia (35.3%) and iron deficiency anaemia (IDA) (19.6%) as the predominant forms, characterized by low Hb, significantly reduced MCV (23-33 fL), low MCH (20-25 pg), low MCHC (20-29 g/dL), and elevated RDW (>18%), strongly corroborates the findings of numerous Pakistani studies. Pakistani research consistently highlights iron deficiency as the leading cause of anaemia in the country due to inadequate dietary intake, poor absorption, and increased physiological demands (Research Gate 2025).

A study on engineering students in Nawab shah, Pakistan (ResearchGate, 2021), though a mixed-gender cohort, also reported significantly lower MCV (70.9 ± 10.3 fL)

and MCH (24.4 ± 4.2 pg) in anemic female students compared to non-anemic counterparts, mirroring our observations. Similarly, a study on women in Skardu, Gilgit-Baltistan (PAFMJ, 2024), found reduced Hb levels (mean 9.48 ± 1.59 g/dL) and MCV (79.97 ± 10.7 fL) in anemic women, with younger age groups (18–35 years) being more affected by IDA. The high RDW values (up to 21%) in our severe microcytic anaemia cases align with the understanding in Pakistani literature that elevated RDW is a key indicator of iron deficiency and heterogeneous red cell production (PJMD, 2020).

The presence of normocytic anaemia (15.7%) in our cohort also resonates with the diversity of anaemia etiologies recognized in Pakistan. While microcytic anaemia is dominant, other forms, potentially including anaemia of chronic disease or other nutritional deficiencies (e.g., B12 or folate), are also observed. The NNS 2018, for instance, also reported significant prevalence of vitamin B12 and folate deficiencies among WRA in Pakistan (ResearchGate, 2025), which can contribute to normocytic or macrocytic anaemias, though microcytic IDA remains the most prevalent. A study in Lahore found that 38% of anemic patients presented with normocytic normochromic blood picture (PJMHS, 2018), further emphasizing the importance of considering other etiologies beyond iron deficiency in the Pakistani context.

Our finding of consistently normal WBC and platelet counts across all subgroups is a crucial point of agreement with most Pakistani studies focusing on nutritional anaemias. Research on anaemia in various Pakistani populations, including pregnant women and children (e.g., Isra Medical Journal, 2019; PJMD, 2020), generally shows that uncomplicated iron deficiency or other nutritional anaemias do not significantly impact white blood cell or platelet production. This suggests that in our cohort, the anaemia is primarily related to erythropoiesis issues rather than underlying infections, inflammatory conditions, or hematologic malignancies that would manifest as abnormal WBC or platelet counts.

Our observation of severe microcytic anaemia (Hb < 8 g/dL) in 9.8% of the anemic subgroup highlights the critical severity of the problem in this vulnerable age group. This level of severe anaemia is consistently reported in various Pakistani studies, particularly in rural and underserved areas, and is often linked to significant morbidity and mortality (ResearchGate, 2025; PubMed, 2020). For instance, a Peshawar-based study (Entomoljournal, 2017) reported that 56.24% of their anemic patients had severe anaemia (though this was an older study and across a broader age range), and the D.I. Khan study found 13% severe anaemia in adolescent girls (JSOGP, 2025).

Conclusion

In summary, our findings are in strong agreement with the established research conducted by Pakistani scholars, collectively illustrating a significant prevalence of anaemia, particularly iron deficiency, among young females in the nation. The

specific hematological parameters identified in our research correspond with local results, highlighting the consistent manifestation of iron deficiency anaemia. The ongoing normal levels of WBC and platelet counts, as noted in Pakistani studies, further clarify the nature of this public health concern, emphasizing the need for a primary focus on nutritional interventions. These comparisons highlight the critical need for comprehensive, culturally appropriate, and sustainable public health initiatives throughout Pakistan to tackle this enduring and widespread challenge among its young population.

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