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FREQUENCY OF IRON DEFICIENCY WITHOUT ANEMIA IN FEMALES OF REPRODUCTIVE AGE GROUP

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Abstract

Background: Iron deficiency is the most common micronutrient deficiency worldwide and frequently affects females of reproductive age due to menstrual losses, pregnancy, and increased nutritional demands.

Objective: To determine the frequency of iron deficiency without anemia and identify associated demographic, reproductive, and clinical risk factors among females of reproductive age.

Methodology: This hospital-based descriptive cross-sectional study included 300 females aged 16–45 years who presented to Unit I, Department of Obstetrics and Gynecology, Sahiwal Teaching Hospital, Sahiwal, from July 2025 to October 2025. Demographic, obstetric, and clinical data were recorded using a structured proforma. Serum ferritin and hemoglobin levels were measured. Iron deficiency without anemia was defined as serum ferritin <16 µg/dL with hemoglobin >12 g/dL in non-pregnant and >11 g/dL in pregnant females. Data were analyzed using SPSS version 25.

Results: Iron deficiency without anemia was identified in 87 participants (29%). Affected females were younger (27.6 ± 6.5 vs 30.7 ± 7.4 years) with lower BMI (23.6 ± 3.8 vs 25.4 ± 4.2 kg/m²). Higher parity (2.6 ± 1.8 vs 1.9 ± 1.5) and pregnancy (41.4% vs 26.3%) were significantly associated. Smoking (24.1%) and low socioeconomic status (55.2%) were more common among deficient females. Serum ferritin was markedly reduced (11.8 ± 2.6 vs 33.9 ± 9.4 µg/dL) despite normal hemoglobin levels.

Conclusion: Iron deficiency without anemia is common among females of reproductive age and is strongly associated with younger age, multiparity, pregnancy, smoking, and socioeconomic disadvantage.

Keywords: Iron deficiency, Iron deficiency without anemia, Serum ferritin, Reproductive age women, Prevalence, Risk factors

INTRODUCTION

The most prevalent type of micronutrient deficiency in the world and a major global health issue is iron deficiency which affect women more than men; especially in the reproductive age due to menstrual bleeding, pregnancy and the high physiological requirements [1]. Almost a third of the world is subjected to anemia and the most severe cases occur in developing nations of up to 43% versus the the most developed of about 9 percent and the iron deficiency cases make up the majority of these cases [2]. Nevertheless, iron deficiency in the absence of anemia is becoming more common and only underdiagnosed [3]. It has been indicated that it at least twice as frequently evident as overt anemia, but it is usually undetected because screening programs are based on hemoglobin levels only [4]. Normal iron women can also have iron stores being depleted and present with nonspecific symptoms that include fatigue, weakness, loss of concentration, and poor functional capacity, which adversely impact quality of life and daily performance [5]. Iron deficiency diagnosis in the absence of anemia involves biochemical evaluation especially serum ferritin and transferrin saturation, as the iron bodies are depleted and the hemoglobin decreases [6]. The earliest and most trusty

indicator of iron depletion is deemed to be low ferritin levels [7]. Unmanaged iron deficiency can develop into anemia and is linked with poor maternal outcomes, immunosuppressed development, low cognitive abilities, and low productivity [810]. Research has indicated the prevalence of an overall iron deficiency of more than 20 percent in women with an approximate of 29 percent displaying an iron deficiency despite normal hemoglobin concentration [11].
Moreover, neurocognitive disturbances and psychiatric manifestations were also associated with subclinical iron deficiency and it further highlights the clinical importance of early detection and prompt treatment [12,13]. In spite of such implications, screening of iron deficiency without anemia is not widely done especially in low-resource environments [14]. Pakistan has limited local information on the occurrence of iron deficiency without anemia among the females of reproductive age. It is critical in establishing its magnitude within our population so as to do early diagnosis, management, and evidence-based development of screening strategies [15].

Objective

To determine the frequency of iron deficiency without anemia and identify associated demographic, reproductive, and clinical risk factors among females of reproductive age group.

METHODOLOGY

This was a hospital-based descriptive cross-sectional study conducted at Unit I, Department of Obstetrics and Gynecology, Sahiwal Teaching Hospital, Sahiwal, from July 2025 to October 2025, including 300 females of reproductive age group presenting to the outpatient department. The study aimed to determine the frequency of iron deficiency without anemia and to evaluate its association with demographic and clinical characteristics among females. All eligible women fulfilling the inclusion criteria during the study period were consecutively enrolled through non-probability purposive sampling and managed according to standard institutional protocols. Based on laboratory findings, participants were categorized into two groups:
Group A (Iron deficiency without anemia present): Females with serum ferritin level <16 µg/dL with normal hemoglobin level (>12 g/dL in non-pregnant and >11 g/dL in pregnant females)
Group B (Normal iron status): Females with normal ferritin and hemoglobin levels
Eligible participants included married or unmarried females aged 16–45 years presenting with symptoms such as weakness. Patients with liver impairment (ALT/AST >40 IU), renal impairment (creatinine >1.8 mg/dL), those taking iron or hemoglobin supplements, cardiovascular diseases, Cushing's disease, hypothyroidism (TSH >5 IU), autoimmune disorders, general infections, or those unwilling to participate were excluded.

Data Collection

Data were recorded using a structured proforma after obtaining informed consent. Demographic variables included age, BMI, marital status, parity, residence, education, occupation, and socioeconomic status. Clinical variables included primary complaint, duration of symptoms, history of diabetes, hypertension, smoking status, and pregnancy status. A 3 cc venous blood sample was collected under aseptic conditions and sent to the hospital laboratory for assessment of serum ferritin and hemoglobin levels. Diagnosis of iron deficiency without anemia was made according to predefined operational criteria. Patients identified with deficiency were managed as per standard treatment protocols.

Statistical Analysis

Data were entered and analyzed using SPSS version 25. Shapiro–Wilk test was applied to assess normality. Quantitative variables such as age, BMI, serum ferritin, hemoglobin level, and duration of symptoms were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Stratification was performed for potential effect modifiers, and chi-square test was applied to assess associations. A p-value ≤ 0.05 was considered statistically significant.

RESULTS

The mean age of participants was 29.8 ± 7.2 years. Females with iron deficiency without anemia were significantly younger (27.6 ± 6.5 years) compared to those with normal iron status (30.7 ± 7.4 years; p=0.002). Similarly, BMI was lower in the deficient group (23.6 ± 3.8 kg/m²) versus the normal group (25.4 ± 4.2 kg/m²; p=0.001). Most participants were married (66.0%), although marital status showed no significant association with deficiency (p=0.160). Urban residence was slightly more common overall (57.3%), with comparable distribution between groups (p=0.220).

Table 1. Baseline Demographic and Anthropometric Characteristics (n = 300)

Variable	Total (n=300)	Iron Deficiency Without Anemia (n=87)	Normal Iron Status (n=213)	p-value

Age (years, mean ± SD)	29.8 ± 7.2	27.6 ± 6.5	30.7 ± 7.4	0.002
BMI (kg/m², mean ± SD)	24.9 ± 4.1	23.6 ± 3.8	25.4 ± 4.2	0.001
Married	198 (66.0%)	52 (59.8%)	146 (68.5%)	0.160
Unmarried	102 (34.0%)	35 (40.2%)	67 (31.5%)	0.160
Urban residence	172 (57.3%)	45 (51.7%)	127 (59.6%)	0.220
Rural residence	128 (42.7%)	42 (48.3%)	86 (40.4%)	0.220

The mean parity was 2.1 ± 1.6 and was significantly higher among deficient females (2.6 ± 1.8) compared to normals (1.9 ± 1.5; p=0.004). Multiparity was more frequent in the deficient group (79.3%) than the normal group (67.1%; p=0.030). Pregnancy was also significantly associated, with 41.4% of deficient women being pregnant versus 26.3% of non-deficient women (p=0.010). Duration of symptoms was longer among deficient participants (4.5 ± 2.1 vs 3.5 ± 1.8 months; p=0.001).

Table 2. Obstetric and Reproductive Profile (n = 300)

Variable	Total (n=300)	Iron Deficiency Without Anemia (n=87)	Normal Iron Status (n=213)	p-value
Parity (mean ± SD)	2.1 ± 1.6	2.6 ± 1.8	1.9 ± 1.5	0.004
Nulliparous	88 (29.3%)	18 (20.7%)	70 (32.9%)	0.030
Multiparous	212 (70.7%)	69 (79.3%)	143 (67.1%)	0.030
Pregnant	92 (30.7%)	36 (41.4%)	56 (26.3%)	0.010
Non-pregnant	208 (69.3%)	51 (58.6%)	157 (73.7%)	0.010
Duration of symptoms (months, mean ± SD)	3.8 ± 1.9	4.5 ± 2.1	3.5 ± 1.8	0.001

Diabetes (21.8% vs 13.6%; p=0.080) and hypertension (23.0% vs 16.9%; p=0.210) showed no significant association. However, smoking was significantly higher among deficient females (24.1% vs 10.8%; p=0.003). Low socioeconomic status was also strongly associated (55.2% vs 34.7%; p=0.002).

Table 3. Clinical and Lifestyle Risk Factors (n = 300)

Variable	Total (n=300)	Iron Deficiency Without Anemia (n=87)	Normal Iron Status (n=213)	p-value
Diabetes mellitus	48 (16.0%)	19 (21.8%)	29 (13.6%)	0.080
Hypertension	56 (18.7%)	20 (23.0%)	36 (16.9%)	0.210
Smoking	44 (14.7%)	21 (24.1%)	23 (10.8%)	0.003
Low socioeconomic status	122 (40.7%)	48 (55.2%)	74 (34.7%)	0.002
Middle socioeconomic status	128 (42.7%)	30 (34.5%)	98 (46.0%)	0.080
High socioeconomic status	50 (16.6%)	9 (10.3%)	41 (19.3%)	0.060

Serum ferritin levels were markedly reduced in the deficient group (11.8 ± 2.6 µg/dL) compared to normals (33.9 ± 9.4 µg/dL; p<0.001). Hemoglobin remained within normal limits but was slightly lower among deficient women (12.3 ± 0.6 vs 12.7 ± 0.8 g/dL; p=0.001).

Table 4. Laboratory Parameters (n = 300)

Variable	Total (mean ± SD)	Iron Deficiency Without Anemia (mean ± SD)	Normal Iron Status (mean ± SD)	p-value
Serum ferritin (µg/dL)	27.6 ± 11.3	11.8 ± 2.6	33.9 ± 9.4	<0.001
Hemoglobin (g/dL)	12.6 ± 0.8	12.3 ± 0.6	12.7 ± 0.8	0.001
BMI (kg/m²)	24.9 ± 4.1	23.6 ± 3.8	25.4 ± 4.2	0.001
Age (years)	29.8 ± 7.2	27.6 ± 6.5	30.7 ± 7.4	0.002

Overall frequency of iron deficiency without anemia was 29ေဖ်.0% (87/300). Prevalence was highest in women ≤25 years (38.3%), followed by 26–35 years (28.3%), and lowest in those >35 years (17.6%; p=0.010). Deficiency was more common among women with BMI <25 (35.3%) compared to BMI ≥25 (22.2%; p=0.020). These results indicate younger and leaner females are at greater risk.

Table 5. Frequency and Stratified Distribution of Iron Deficiency Without Anemia (n = 300)

Variable	Total	Iron Deficiency Without Anemia n (%)	Normal Iron Status n (%)	p-value
Overall frequency	300	87 (29.0%)	213 (71.0%)	—
Age ≤ 25 years	94	36 (38.3%)	58 (61.7%)	0.010
Age 26–35 years	138	39 (28.3%)	99 (71.7%)	0.010
Age > 35 years	68	12 (17.6%)	56 (82.4%)	0.010
BMI < 25	156	55 (35.3%)	101 (64.7%)	0.020
BMI ≥ 25	144	32 (22.2%)	112 (77.8%)	0.020

DISCUSSION

This research compared how often females of reproductive age experience iron deficiency without anemia, and it proved that almost a third of them have this condition, and the prevalence of it is 29 in general. The finding indicates the high percentage of seemingly healthy women who carry depleted iron stores although the hemoglobin is normal, which underscores the fact that the burden of iron deficiency is underestimated when hemoglobin is used as the sole indicator. Similar prevalence has been observed in past studies with an estimated one-quarter to one-third of the females of reproductive age having iron deficiency and no anemia [16]. The age was also significantly related so that among younger females deficiency rates were greater (38.3% in ≤25 years) than in older age groups. This can be a manifestation of more menstrual bleeding and poor dietary consumption during the early reproductive years. Similar case studies in the past have also indicated higher depletion of iron in younger women and adolescents [17]. Deficiency was also strongly correlated with lower BMI, implying that there may be nutritional inadequacy, which is consistent with the previous studies that undernutrition is associated with decreased iron stores [18]. Reproductive variables had significant influence. More important ways iron was found to be deficient were higher parity and pregnancy, with multiparous and pregnant women demonstrating higher prevalence. Reduced iron reserves are likely to be a result of repeated pregnancies and augmented physiological requirements of iron. Similar relationships have been found between pregnancy, multiparty and the deficiency of iron in earlier studies [19].

Socioeconomic determinants and lifestyle were also apparent. Deficiency was closely related to smoking and low socioeconomic status, which may have been caused by the quality of diet and limited access to healthcare. The same trends have been observed in other studies that have found an increased rate of iron deficiency in women with a disadvantaged background [20]. The levels of ferritin were significantly lower in the deficient females with hemoglobin kept within normal ranges which proves the fact that iron depletion is a precursor of anemia. The earlier studies have continuously stressed on the use of ferritin as one of the early warning signs of iron deficiency [21]. On balance, these results highlight that iron deficiency in the absence of anemia is widespread and clinically significant in reproductive-aged women, which explains the need to screen women and prevent the condition early.

Limitations

This research was done on a single tertiary care hospital, which will not be a good generalization of the results to the larger community. The cross-sectional design cannot be friendly to determine the causal relationship between the risk and the iron deficiency without anemia. The non-probability purposive sampling can also create selection bias. The nutritional intake, menstrual blood loss, and the elaborate evaluation of nutrition was not studied, which may affect the iron status. Also, when ferritin was used independently of inflammatory markers, accuracy could have been compromised in some instances.

CONCLUSION

It is concluded that iron deficiency without anemia is a common yet frequently overlooked condition among females of reproductive age, affecting nearly one-third of women in this study. Younger age, lower BMI, higher parity, pregnancy, smoking, and low socioeconomic status were significantly associated risk factors. Despite normal hemoglobin levels, markedly reduced ferritin values indicated depleted iron stores, confirming that hemoglobin alone is insufficient for early detection. Routine screening using serum ferritin, particularly in high-risk groups, may facilitate timely diagnosis and management, thereby preventing progression to overt anemia and improving overall health outcomes in this population.

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