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IRON DEFICIENCY ANEMIA IN PATIENTS WITH INFLAMMATORY BOWEL DISEASE PRESENTING TO A TERTIARY CARE HOSPITAL

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ABSTRACT

Objective: To determine the frequency of iron deficiency anemia (IDA) in patients with inflammatory bowel disease (IBD) presenting to a tertiary care hospital in Faisalabad, Pakistan.
Study Design: Descriptive cross-sectional study.
Place and Duration of Study: Department of Medicine, Allied-II (DHQ) Hospital, Faisalabad, from November 2025 to March 2026.
Methodology: A total of 194 confirmed IBD patients aged 18–60 years were enrolled through non-probability consecutive sampling. IDA was defined using WHO sex-specific haemoglobin thresholds (<13 g/dL for males, <12 g/dL for females) combined with ECCO-recommended serum ferritin <30 ng/mL. Chi-square tests with crude odds ratios (OR) and 95% confidence intervals (CI) were computed for univariate analysis. Binary logistic regression was performed to identify independent predictors of IDA.
Results: Of 194 patients, 88 (45.4%) had IDA. The mean age was 37.3 ± 9.2 years with 110 (56.7%) males and 84 (43.3%) females. Ulcerative colitis was the predominant IBD type (112; 57.7%). On univariate analysis, female sex was significantly associated with IDA (54.8% vs 38.2%; OR=1.96, 95% CI: 1.10–3.49; p=0.022). On multivariate logistic regression, female sex remained the only independent predictor (adjusted OR=2.04, 95% CI: 1.12–3.69; p=0.019). Polypharmacy showed a borderline association (aOR=1.83, 95% CI: 0.97–3.44; p=0.062).
Conclusion: IDA is a frequent complication in IBD patients at this tertiary care centre, affecting nearly half the cohort. Female sex was the only independent predictor. Routine iron status screening using sex-specific haemoglobin thresholds and inflammation-adjusted ferritin criteria is recommended for all IBD patients.

KEYWORDS: Iron deficiency anemia, Inflammatory bowel disease, Ulcerative colitis, Crohn's disease, Ferritin, Haemoglobin.

INTRODUCTION

Anemia affects approximately two billion people worldwide and represents a major global public health burden.[1] Iron deficiency (ID) is the leading cause of anemia globally and, in its advanced stage, manifests as microcytic hypochromic iron deficiency anemia (IDA).[2,3] Inflammatory bowel disease (IBD), encompassing ulcerative colitis (UC) and Crohn's disease (CD), is a group of chronic relapsing inflammatory disorders of the gastrointestinal tract.[4] The global incidence of IBD has risen substantially over the past two decades, with accelerating rates now documented in newly industrialised countries including those in South Asia.[5]
Anemia is the most frequently encountered extraintestinal manifestation of IBD. A systematic review and meta-analysis of European cohorts reported a pooled anemia prevalence of approximately 24%, although the range varies widely from 9% in outpatient settings to 74% in hospitalised patients.[6] Among the various aetiologies, absolute and functional iron deficiency account for the majority of cases; the reported prevalence of iron deficiency in IBD ranges from 36% to 90%.[7,8] The pathophysiology of IDA in IBD is multifactorial, involving chronic intestinal blood loss through mucosal ulceration, impaired duodenal iron absorption, hepcidin-mediated sequestration of iron within macrophages and hepatocytes, and cytokine-driven suppression of erythropoiesis.[9,10]
Iron is an essential constituent of haemoglobin and myoglobin, accounting for approximately 80% of total body iron. It also serves critical roles in cellular respiration, energy metabolism, DNA synthesis, and cell proliferation.[11] Consequently, IDA in IBD substantially impairs quality of life, cognitive function, and work productivity, and is

associated with prolonged hospitalisation and increased healthcare costs.[12,13] The European Crohn's and Colitis Organisation (ECCO) consensus recommends routine screening for iron deficiency in all IBD patients, using serum ferritin <30 ng/mL in quiescent disease or <100 ng/mL in the presence of active inflammation, combined with transferrin saturation (TSAT) <20%, as diagnostic thresholds.[8] The World Health Organization (WHO) defines anemia using sex-specific haemoglobin thresholds: <13 g/dL for adult males and <12 g/dL for non-pregnant adult females.[1]

Despite the recognised burden of IDA in IBD, data from Pakistan remain limited. Awan et al. reported a 44.5% frequency of IDA among 200 IBD patients at a military hospital in Rawalpindi, with long disease duration and polypharmacy as significant correlates.[14] Aslam and Mehmood conducted a case-control study in Peshawar documenting significantly lower haemoglobin and iron levels in anemic IBD patients.[15] Qaisar et al. observed a 51.2% prevalence of anemia among UC patients in remission.[16] However, these studies used varying diagnostic criteria, and no data exist from the Faisalabad region, which serves a large catchment population through its District Headquarters Hospital. This study was designed to determine the frequency of IDA among IBD patients using WHO sex-specific haemoglobin thresholds and ECCO-aligned ferritin criteria, and to identify demographic and clinical predictors of IDA.

METHODOLOGY

This descriptive cross-sectional study was conducted at the Department of Medicine, Allied-II (DHQ) Hospital, Faisalabad, from November 2025 to March 2026, after approval from the Institutional Ethical Review Committee (Ref. No. IRB/2024/Allied-II/053). Informed written consent was obtained from all participants. The sample size of 194 was calculated using the WHO sample size formula ($n = Z^2p(1-p)/d^2$) at 95% confidence level, anticipated proportion of 44.5%[14], and absolute precision of 7%, yielding $n \approx 194$. Non-probability consecutive sampling was employed.

Patients aged 18–60 years, of both sexes, with IBD confirmed by a consultant medical specialist or gastroenterologist were included. IBD diagnosis was established on the basis of clinical evaluation (abdominal tenderness, weight loss, fatigue persisting for ≥6 weeks), supported by colonoscopic and histopathological findings. UC was defined as inflammation limited to the mucosa and submucosa with cryptitis, crypt abscesses, and basal plasmacytosis. CD was defined as transmural inflammation with non-caseating granulomas, fissures, ulcers, and lymphoid aggregates. Patients who were pregnant or breastfeeding, had documented vitamin B12 or folate deficiency or replacement therapy, had undergone recent surgery, had NSAID abuse, or had a concurrent autoimmune disorder were excluded.

Venous blood samples were collected between 09:00 and 11:00 hours after a 12-hour fast. Complete blood count, serum ferritin, and transferrin saturation were measured. IDA was defined as haemoglobin below the WHO sex-specific threshold (<13 g/dL for males, <12 g/dL for females)[1] combined with serum ferritin <30 ng/mL, in accordance with ECCO recommendations for quiescent inflammatory disease.[8] Demographic data (age, sex, residence, educational status, socioeconomic status) and clinical data (IBD type, disease duration in months, polypharmacy status) were recorded on a pre-designed proforma.

Data were analysed using SPSS version 25.0. Quantitative variables were expressed as mean ± standard deviation. Categorical variables were presented as frequency and percentage. Pearson chi-square test (without continuity correction) was used for univariate comparison of IDA across subgroups, with crude odds ratios (OR) and 95% confidence intervals (CI) calculated for binary variables. Mann-Whitney U test was used to compare laboratory parameters between IDA and non-IDA groups, as these variables were not normally distributed. Binary logistic regression was performed to identify independent predictors of IDA, entering sex, age, residence, socioeconomic status, IBD type, disease duration (>24 months), and polypharmacy as covariates. Adjusted odds ratios (aOR) with 95% CI were reported. A p-value ≤0.05 was considered statistically significant.

RESULTS

A total of 194 patients with confirmed IBD were enrolled. The mean age was 37.3 ± 9.2 years, with the largest proportion (33.5%) in the 31–40 years age group. There were 110 (56.7%) males and 84 (43.3%) females. Urban residents comprised 125 (64.4%) of the study population. The predominant socioeconomic stratum was middle (94; 48.5%) followed by low (76; 39.2%). Ulcerative colitis was the more common IBD subtype (112; 57.7%). Mean disease duration was 29.3 ± 29.2 months and polypharmacy was present in 66 (34.0%) patients. The demographic and clinical characteristics are summarised in Table I.

The overall frequency of IDA, applying WHO sex-specific haemoglobin thresholds and ECCO ferritin criteria, was 88 out of 194 patients (45.4%) (Figure 1). Mean haemoglobin in IDA patients was 10.3 ± 1.5 g/dL versus 14.0 ± 1.2 g/dL in non-IDA patients. Mean serum ferritin was 14.9 ± 7.3 ng/mL in IDA versus 69.7 ± 28.2 ng/mL in non-IDA patients. Mean transferrin saturation was 13.9 ± 4.4% versus 30.8 ± 7.4%, respectively (all $p<0.001$ by Mann-Whitney U test) (Figure 2).

On univariate analysis, female sex was significantly associated with IDA (54.8% vs 38.2%; χ^2=5.283, p=0.022; crude OR=1.96, 95% CI: 1.10–3.49). Polypharmacy showed a trend towards higher IDA prevalence (54.5% vs 40.6%; χ^2=3.405, p=0.065; crude OR=1.75, 95% CI: 0.96–3.19). No significant associations were found for age group (p=0.845), residence (p=0.928), education (p=0.953), socioeconomic status (p=0.503), IBD type (p=0.954), or disease duration category (p=0.914) (Table II).

On multivariate binary logistic regression, female sex remained the only independent predictor of IDA (aOR=2.04, 95% CI: 1.12–3.69; p=0.019). Polypharmacy demonstrated a borderline independent association (aOR=1.83, 95% CI: 0.97–3.44; p=0.062). The remaining covariates—age, rural residence, low socioeconomic status, UC subtype, and prolonged disease duration—were not independently associated with IDA (all p>0.05) (Figure 3).

Table I: Demographic and Clinical Characteristics of Study Population (n=194)

Variable	n (%)	Mean ± SD
Age (years)		37.3 ± 9.2
18–30	53 (27.3%)	
31–40	65 (33.5%)	
41–50	62 (32.0%)	
51–60	14 (7.2%)	
Sex		
Male	110 (56.7%)	
Female	84 (43.3%)	
Residence		
Urban	125 (64.4%)	
Rural	69 (35.6%)	
Socioeconomic Status		
Low	76 (39.2%)	
Middle	94 (48.5%)	
Higher	24 (12.4%)	
Type of IBD		
Ulcerative Colitis	112 (57.7%)	
Crohn’s Disease	82 (42.3%)	
Duration of Disease (months)		29.3 ± 29.2
Polypharmacy		
Yes	66 (34.0%)	
No	128 (66.0%)	
Haemoglobin (g/dL)		12.3 ± 2.2
Serum Ferritin (ng/mL)		44.9 ± 34.6
Transferrin Saturation (%)		23.1 ± 10.5

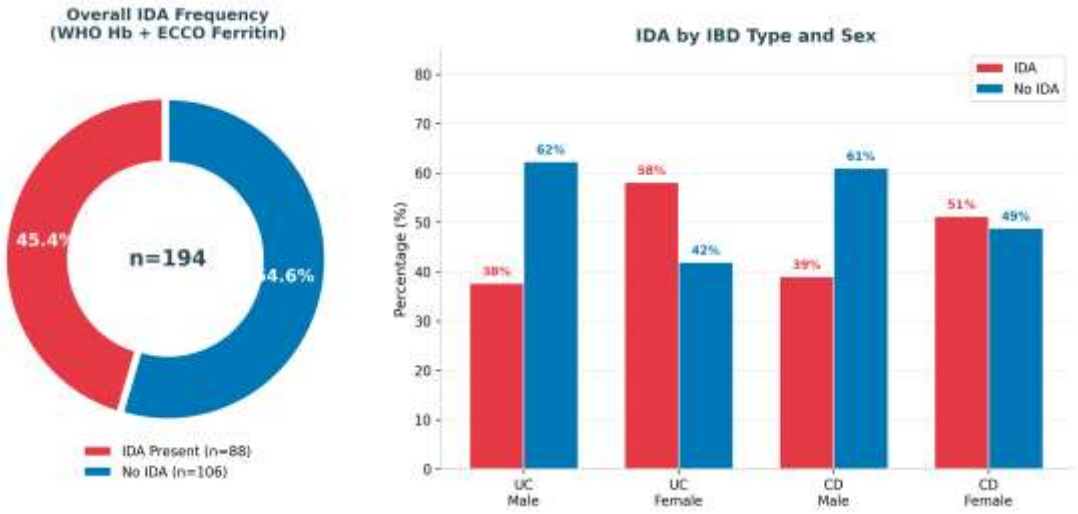

Figure 1: Overall frequency of IDA using WHO sex-specific Hb thresholds and ECCO ferritin <30 ng/mL (left), and distribution by IBD type and sex (right).

Table II: Univariate Analysis of IDA by Demographic and Clinical Variables (n=194)

Variable	Total	IDA n(%)	No IDA n(%)	χ^2 (p)	OR (95%CI)	p-value
Sex				5.283		**0.022***
Male (ref)	110	42 (38.2)	68 (61.8)		1.00	
Female	84	46 (54.8)	38 (45.2)		1.96 (1.10–3.49)	
Age Group (years)				0.820		0.845
18–30	53	25 (47.2)	28 (52.8)		—	
31–40	65	31 (47.7)	34 (52.3)		—	
41–50	62	27 (43.5)	35 (56.5)		—	
51–60	14	5 (35.7)	9 (64.3)		—	
Residence				0.008		0.928
Urban (ref)	125	57 (45.6)	68 (54.4)		1.00	
Rural	69	31 (44.9)	38 (55.1)		0.97 (0.54–1.76)	
Education				1.113		0.953
Illiterate	33	16 (48.5)	17 (51.5)		—	
Primary	31	15 (48.4)	16 (51.6)		—	
Middle	25	10 (40.0)	15 (60.0)		—	
Matric	43	18 (41.9)	25 (58.1)		—	
Intermediate	28	12 (42.9)	16 (57.1)		—	
Graduate	34	17 (50.0)	17 (50.0)		—	
Type of IBD				0.003		0.954
UC	112	51 (45.5)	61 (54.5)		1.02 (0.58–1.80)	
CD (ref)	82	37 (45.1)	45 (54.9)		1.00	

Duration (months)				0.524		0.914
≤12	68	32 (47.1)	36 (52.9)		—	
13–24	43	19 (44.2)	24 (55.8)		—	
25–60	59	25 (42.4)	34 (57.6)		—	
>60	24	12 (50.0)	12 (50.0)		—	
SES				1.374		0.503
Low	76	38 (50.0)	38 (50.0)			
Middle	94	41 (43.6)	53 (56.4)			
Higher	24	9 (37.5)	15 (62.5)			
Polypharmacy				3.405		0.065
No (ref)	128	52 (40.6)	76 (59.4)		1.00	
Yes	66	36 (54.5)	30 (45.5)		1.75 (0.96–3.19)	

**Statistically significant (p ≤0.05). OR = Odds Ratio; CI = Confidence Interval; ref = reference category.*

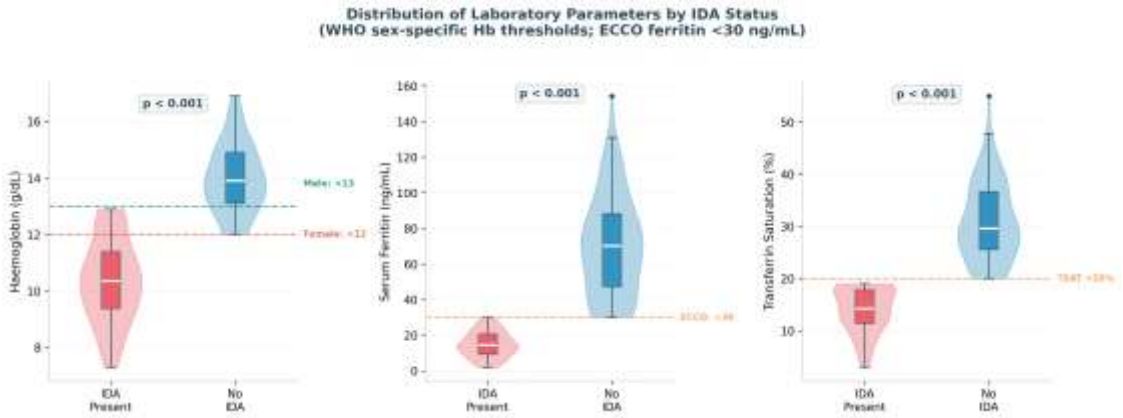

Figure 2: Distribution of laboratory parameters by IDA status. Violin plots with embedded box plots show haemoglobin (WHO sex-specific thresholds indicated), serum ferritin (ECCO threshold <30 ng/mL), and transferrin saturation. All differences significant at p<0.001 (Mann-Whitney U test).

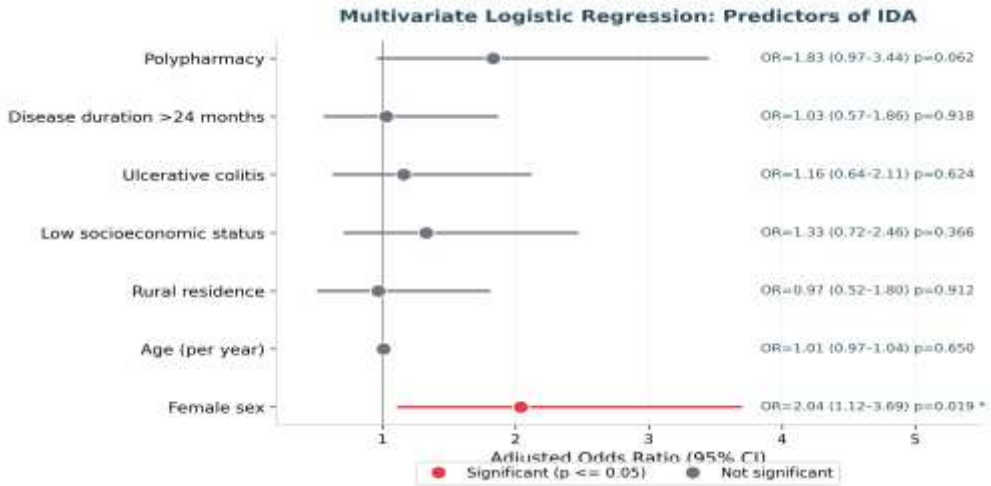

Figure 3: Forest plot of adjusted odds ratios (aOR) with 95% confidence intervals from multivariate binary logistic regression for predictors of IDA. Vertical line at OR=1.0 indicates null effect. Red markers denote statistical significance (p≤0.05).

DISCUSSION

The present study found an overall IDA frequency of 45.4% among IBD patients at a tertiary care hospital in Faisalabad, using WHO sex-specific haemoglobin thresholds and ECCO-recommended ferritin criteria. This figure is consistent with the 44.5% reported by Awan et al. at a military hospital in Rawalpindi[14] and falls within the range observed in other Pakistani studies.[15,16] In comparison, a European meta-analysis reported a pooled anemia prevalence of 24% across 2,192 IBD patients, though figures were substantially higher in hospitalised cohorts.[6] The comparatively elevated prevalence in Pakistani settings likely reflects late clinical presentation, limited specialist access, dietary patterns low in bioavailable iron, and suboptimal monitoring in resource-constrained healthcare systems.[17]

Female sex was the only independent predictor of IDA on multivariate logistic regression (aOR=2.04, 95% CI: 1.12–3.69; p=0.019). This finding aligns with the well-documented physiological susceptibility of premenopausal women to iron depletion due to menstrual losses, which compounds the chronic gastrointestinal blood loss inherent in IBD.[3] Importantly, the present study employed sex-specific haemoglobin thresholds, ensuring that the observed sex disparity reflects a genuine biological difference rather than diagnostic artefact from applying a uniform cut-off. Parra et al. similarly identified female sex as independently associated with IDA in a Brazilian IBD referral cohort.[18] Clinicians should maintain a particularly low threshold for investigating iron status in female IBD patients, and non-anemic iron deficiency in this subgroup warrants attention as a clinically relevant entity.[19]

Polypharmacy demonstrated a borderline independent association with IDA (aOR=1.83, 95% CI: 0.97–3.44; p=0.062), consistent with a biologically plausible mechanism whereby multiple concurrent medications—including corticosteroids, immunomodulators, and proton pump inhibitors—may impair iron absorption or exacerbate gastrointestinal blood loss. Awan et al. found a statistically significant association between polypharmacy and IDA in their larger cohort (n=200),[14] suggesting that our study may have been underpowered to detect this modest effect; the wide confidence interval (0.97–3.44) spanning unity supports this interpretation.

Ulcerative colitis was the predominant IBD subtype (57.7%), consistent with the epidemiology of IBD in South Asia where UC exceeds CD in frequency.[5,20] IDA rates were nearly identical between UC (45.5%) and CD (45.1%), yielding no significant association. This contrasts with some European data where CD patients demonstrate higher IDA rates due to proximal small bowel involvement affecting iron absorption.[7,9] The lack of differentiation may reflect the predominance of left-sided colonic UC in this population, which shares the mucosal bleeding mechanism with CD.

The use of ECCO-aligned ferritin criteria (<30 ng/mL) rather than the more conservative <15 ng/mL is a methodological strength of this study. Ferritin is an acute-phase reactant elevated by systemic inflammation; the ECCO consensus specifically cautions against using the conventional <15 ng/mL threshold in IBD, as it substantially underestimates iron deficiency in this population.[8] In active inflammation, ferritin levels up to 100 ng/mL may coexist with true iron depletion, and transferrin saturation <20% provides a more reliable complementary marker.[8,10] The mean ferritin of 14.9 ± 7.3 ng/mL in our IDA patients confirms significant iron store depletion, while the mean TSAT of 13.9 ± 4.4% corroborates restricted iron availability for erythropoiesis.

Widbom et al. demonstrated that iron deficiency and lower ferritin levels may precede the clinical diagnosis of IBD by several years, highlighting the chronicity of iron depletion in these patients and reinforcing the case for proactive screening from the point of diagnosis.[21] Hsiao et al. further showed that anemia during the disease course was independently associated with worse patient outcomes, including increased hospitalisation and surgery rates.[22]

This study has several strengths: it provides the first IDA prevalence data from the Faisalabad region, employs internationally recommended diagnostic thresholds (WHO haemoglobin, ECCO ferritin), and supplements univariate analysis with multivariate logistic regression. However, limitations must be acknowledged. The non-probability consecutive sampling and single-centre design limit generalisability, though this approach is standard for CPSP dissertation-based studies and reflects real-world tertiary care practice. The six-month recruitment window may not capture seasonal variation. The sample size (n=194), while adequate for the primary prevalence estimate, was likely underpowered for detecting modest associations in subgroup analyses (e.g. polypharmacy). A key methodological limitation relates to the ferritin threshold applied. We used ferritin <30 ng/mL (ECCO recommendation for quiescent disease) uniformly across the cohort; however, no formal disease activity assessment (CDAI, Mayo score, or CRP) was performed to confirm remission status. Per ECCO guidelines, patients with active inflammation require a higher threshold of ferritin <100 ng/mL, because ferritin as an acute-phase reactant is falsely elevated during inflammation. Consequently, the reported 45.4% IDA prevalence likely underestimates the true burden of iron deficiency in this unselected cohort, particularly among patients with active disease. Future studies should incorporate concurrent CRP measurement or validated disease activity indices to enable threshold stratification. Future multicentre studies with larger samples and longitudinal follow-up would further strengthen these findings.

CONCLUSION

Iron deficiency anemia is a frequent complication in IBD patients presenting to a tertiary care hospital in Faisalabad, affecting 45.4% of the cohort when assessed using WHO sex-specific haemoglobin thresholds and ECCO-recommended ferritin criteria. Female sex was the only independent predictor (aOR=2.04). The findings underscore the need for routine iron status screening in all IBD patients, with particular vigilance in female patients. Adoption of inflammation-adjusted ferritin thresholds and sex-specific haemoglobin criteria should be standard practice in this population.

Ethical Approval:

This study was approved by the Institutional Ethical Review Committee of Allied-II (DHQ) Hospital, Faisalabad (Ref. No. IRB/2024/Allied-II/053).

Patients' Consent:

Informed written consent was obtained from all participants.

Conflict of Interest:

The authors declared no conflict of interest.

Authors' Contribution:

MA: Conception, data collection, analysis, drafting. MA: Supervision, critical review, final approval.

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