ORIGINAL ARTICLE

Oral Iron Absorption Test as a Predictor of Response to Oral Iron Therapy and Gastrointestinal Malabsorption Syndromes in Iron Deficiency Anemia

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Abstract

Background: Iron deficiency anemia (IDA) affects approximately 2 billion individuals globally, yet optimal response to oral iron supplementation remains unpredictable. The oral iron absorption test (OIAT) represents a potentially valuable diagnostic tool for predicting therapeutic response and identifying underlying gastrointestinal malabsorption syndromes.

Materials and methods: This prospective study enrolled 190 IDA patients at a tertiary care center. After collecting baseline hematological parameters, participants underwent OIAT by receiving 60 mg of elemental iron, with serum iron levels measured at baseline and after 2 hours. Patients with abnormal OIAT results underwent additional investigations to identify underlying malabsorption syndromes.

Results: Among the participants (mean age 32.34 ± 11.84 years, 90.5% female), 34.2% demonstrated abnormal OIAT results. Malabsorption was diagnosed in 19.5% of subjects, with *Helicobacter pylori* infection (54.1%), autoimmune gastritis (27.0%), and celiac disease (18.9%) as the predominant etiologies. OIAT showed excellent sensitivity (89.2%), good specificity (79.1%), and exceptional negative predictive value (97.6%) for identifying malabsorption syndromes.

Conclusions: OIAT demonstrates robust diagnostic performance for predicting response to oral iron therapy and identifying malabsorption syndromes in IDA. The high negative predictive value positions OIAT as an effective first-line screening tool, potentially reducing the need for invasive investigations in patients with normal test results.

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Introduction

The World Health Organization (WHO) projects that almost 2 billion people, or 25% of the world's population, are anemic, with roughly half of them having iron deficiency anemia (IDA).[1] In India, according to the National Family Health Survey-5 (2019–2021), anemia affects 63.1% of minors and 57% of women of reproductive age (15–49 years).[2] Iron deficiency contributes significantly to impaired cognitive performance in children, adverse pregnancy outcomes, diminished physical capabilities in adults, and cognitive decline in elderly individuals.[3]

As a leading cause of years lived with disability among women, IDA represents a substantial health burden, particularly in developing nations.[4] Iron, an essential micronutrient, plays crucial roles in cellular growth and differentiation, oxygen transport, enzymatic reactions, immune function, and cognitive development. Its primary function involves the hemoglobinization of erythrocytes, with deficiency resulting in reduced hemoglobinization and subsequent anemia.[5,6]

Oral iron supplementation represents the cornerstone of IDA treatment due to its accessibility, cost-effectiveness, and general safety profile. However, therapeutic response varies considerably among patients, with approximately 72.8% showing positive responses to oral iron therapy while the remainder manifest as nonresponders.[7] Multiple factors influence this variability, including physiological demands, dietary restrictions, chronic blood loss, and reduced iron absorption.[8,9]

The oral iron absorption test (OIAT) has emerged as a potentially valuable tool for assessing intestinal iron absorption and identifying underlying malabsorption syndromes in IDA patients. This simple, noninvasive procedure involves oral administration of a standardized iron dose followed by measurement of serum iron levels at specific intervals. Despite its potential clinical utility, the role of OIAT in guiding therapeutic decisions for IDA management remains underexplored.

This study aimed to investigate the utility of OIAT in predicting response to oral iron therapy and identifying gastrointestinal malabsorption syndromes in patients with IDA, with the goal of enhancing diagnostic efficiency and therapeutic precision in clinical practice.

Materials and Methods

Study Design and Setting

This prospective study was conducted at the department of general medicine in a tertiary care teaching hospital from February 2023 to February 2024. The study received approval from the institutional ethics committee (Ref. No. 544, MC/EC/2023), and written informed consent was obtained from all participants.

Study Population

A total of 190 patients diagnosed with IDA were included based on hemoglobin <13 gm/dL for men and postmenopausal women, <12 gm/dL for premenopausal women, and serum ferritin <15 µg/mL. Exclusion criteria comprised pregnancy, elevated inflammatory markers, gastrointestinal symptoms, evidence of gastrointestinal bleeding, preexisting celiac disease or inflammatory bowel disease, and ongoing iron therapy or packed red cell transfusions within the previous 3 months.

Laboratory Investigations and Oral Iron Absorption Test Protocol

Full blood counts were conducted on EDTA anticoagulated blood samples using an automated Coulter Hematology Analyzer. Serum iron and ferritin levels were measured in all participants. After an overnight fast, baseline blood samples were collected to measure serum iron levels. Participants then received a single oral dose of 60 mg elemental iron as ferrous sulfate. A second blood sample was obtained 2 hours after iron administration. An increase in serum

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iron by at least 100 µg/dL from baseline was considered indicative of adequate iron absorption (normal OIAT), while an increase below this threshold was classified as abnormal.

Follow-up Investigations

Patients with abnormal OIAT results underwent additional investigations, including antitissue transglutaminase (anti-TTG) IgA antibody testing and upper gastrointestinal endoscopy with biopsy to assess for underlying pathologies affecting iron absorption. All endoscopic procedures were performed by an experienced gastroenterologist. Anti-TTG IgA antibody levels were measured using enzyme-linked immunosorbent assay (ELISA), with titers exceeding 15 IU/mL considered positive for potential celiac disease.

Statistical Analysis

Data were analyzed using SPSS software version 24.0 (Chicago, Illinois). Descriptive statistics were calculated for categorical variables (frequencies) and continuous variables (measures of central tendency and dispersion). Chi-square tests were used to analyze categorical variables. Receiver operating characteristic (ROC) curves were generated to calculate the accuracy of OIAT in detecting malabsorption. A p-value < 0.05 was considered statistically significant.

Results

Demographic, Clinical Characteristics, and Laboratory Parameters

The study enrolled 190 participants with a mean age of 32.34 ± 11.84 years (range: 14–60 years) and a strong female predominance (90.5%, n = 172). Baseline laboratory investigations revealed a mean hemoglobin level of 7.71 ± 1.82 gm/dL, mean MCV of 71.17 ± 6.61 fL, and mean ferritin of 4.45 ± 2.57 ng/mL. The mean baseline serum iron was 26.89 ± 24.99 µg/dL, with a post-OIAT mean serum iron of 210.07 ± 86.85 µg/dL after 2 hours (Table 1).

OIAT Results and Malabsorption

Of the 190 participants, 125 (65.8%) demonstrated normal OIAT results, while 65 (34.2%) showed abnormal results. Malabsorption was confirmed in 37 participants (19.5% of the total study population). Among these, *Helicobacter pylori* infection was the most common etiology (54.1%, n = 20), followed by autoimmune gastritis (27.0%, n = 10) and celiac disease (18.9%, n = 7) (Table 2).

Age and Gender Distribution in Malabsorption

In the malabsorption group, the majority (45.9%) were aged 31–40 years, compared to 33.3% in the nonmalabsorption group. Participants aged 51–60 years represented 27.0% of the malabsorption group but only 7.2% of the nonmalabsorption group, suggesting a trend toward increased malabsorption with advancing age, although this difference did not reach statistical significance (p = 0.101). Regarding gender distribution, men represented 21.6% of the malabsorption group compared to 6.5% of the nonmalabsorption group, a trend that approached but did not reach statistical significance (p = 0.079) (Table 3).

Diagnostic Performance of OIAT

Analysis revealed that 33 out of 37 participants (89.2%) with malabsorption had abnormal

Table 1: Demographic and laboratory characteristics of study participants (N = 190)

Characteristic	*Value*
Demographics	
Age (years), mean ± SD	32.34 ± 11.84
Age distribution, *n* (%)	
≤20 years	23 (12.1)
21–30 years	69 (36.3)
31–40 years	68 (35.8)
41–50 years	9 (4.7)
51–60 years	21 (11.1)
Gender, *n* (%)	
Female	172 (90.5)
Male	18 (9.5)
Laboratory parameters	
Hemoglobin (gm/dL), mean ± SD	7.71 ± 1.82
MCV (fL), mean ± SD	71.17 ± 6.61
Serum ferritin (ng/mL), mean ± SD	4.45 ± 2.57
Baseline serum iron (µg/dL), mean ± SD	26.89 ± 24.99
Post-OIAT serum iron (µg/dL), mean ± SD	210.07 ± 86.85
OIAT results and malabsorption	
Normal OIAT, *n* (%)	125 (65.8)
Abnormal OIAT, *n* (%)	65 (34.2)
Malabsorption present, *n* (%)	37 (19.5)
Malabsorption absent, *n* (%)	153 (80.5)

Table 2: Analysis of malabsorption status by demographics and OIAT results

Characteristic	*Malabsorption present, n = 37*	*Malabsorption absent, n = 153*	*p-value*
Age group			0.101
≤20 years	4 (10.8%)	19 (12.4%)	
21–30 years	4 (10.8%)	65 (42.5%)	
31–40 years	17 (45.9%)	51 (33.3%)	
41–50 years	2 (5.4%)	7 (4.6%)	
51–60 years	10 (27.0%)	11 (7.2%)	
Gender			0.079
Female	29 (78.4%)	143 (93.5%)	
Male	8 (21.6%)	10 (6.5%)	
OIAT results			< 0.0001
Abnormal	33 (89.2%)	32 (20.9%)	
Normal	4 (10.8%)	121 (79.1%)	
Etiology of malabsorption (n = 37)			
H. pylori infection	20 (54.1%)	–	
Autoimmune gastritis	10 (27.0%)	–	
Celiac disease	7 (18.9%)	–	

Table 3: Diagnostic performance of OIAT for detecting malabsorption

Parameter	*Value*	*95% confidence interval*
Sensitivity	89.2%	74.6–97.0%
Specificity	79.1%	71.8–85.2%
Positive predictive value	50.0%	39.7–62.7%
Negative predictive value	97.6%	93.1–99.2%
Accuracy	84.2%	78.2–89.1%
AUC for serum ferritin	0.707	0.615–0.800

OIAT results, compared to 32 out of 153 participants (20.9%) without malabsorption. This difference was statistically significant ($p < 0.0001$), demonstrating the strong association between abnormal OIAT results and underlying malabsorption syndromes. The diagnostic performance metrics of OIAT for identifying malabsorption were impressive, with a sensitivity of 89.2%, specificity of 79.1%, positive predictive value (PPV) of 50.0%, negative predictive value (NPV) of 97.6%, and overall accuracy of 84.2%.

Receiver operating characteristic (ROC) curve analysis demonstrated that serum ferritin exhibited moderate discriminative ability for detecting malabsorption, with an area under the curve (AUC) of 0.707 (standard error = 0.047, $p < 0.001$, 95% CI: 0.615–0.800).

Discussion

This study evaluated the utility of the OIAT in predicting response to oral iron therapy and identifying gastrointestinal malabsorption syndromes in patients with IDA. Our findings demonstrate that OIAT represents a valuable diagnostic tool with excellent sensitivity and exceptional negative predictive value for detecting underlying malabsorption in IDA patients.

The demographic profile of our study population, with a mean age of 32.34 years and female predominance (90.5%), reflects the epidemiological pattern of IDA, which disproportionately affects women of reproductive age. This pattern aligns with recent research by Yaman et al., who reported a similar gender distribution (92.6% female) in their study of iron absorption in IDA patients.[10]

Our study revealed that 34.2% of participants demonstrated abnormal OIAT results, indicating impaired iron absorption. This prevalence is comparable to the findings of Loveikyte et al., who reported abnormal OIAT in 59% of their cohort.[11] The difference in prevalence rates may reflect variations in study populations, methodological differences, or regional factors affecting iron absorption patterns.

A key finding from our investigation was the identification of malabsorption in 19.5% of the total study population, with *H. pylori* infection (54.1%), autoimmune gastritis (27.0%), and celiac disease (18.9%) as the predominant etiologies. These findings expand upon the work of Islam et al., who reported similar but not identical prevalence rates for these conditions (*H. pylori* 62%, celiac disease 7.5%, autoimmune gastritis 9.4%).[12] The higher prevalence of autoimmune gastritis and celiac disease in our cohort may reflect regional variations in disease patterns or differences in diagnostic approaches.

The diagnostic performance of OIAT in our study was exceptional, with a sensitivity of 89.2%, specificity of 79.1%, and a notably high negative predictive value of 97.6%. These metrics position OIAT as an excellent first-line screening tool for malabsorption in IDA patients. The high NPV indicates that a normal OIAT result virtually excludes significant malabsorption as a contributing factor to IDA, potentially sparing patients from unnecessary invasive investigations. This aligns with the findings of Gardyn et al., who emphasized OIAT's utility in determining the need for oral versus intravenous iron therapy and further gastrointestinal evaluations.[13]

Although not statistically significant, our data suggested trends toward increased malabsorption in older age groups and among male participants. This observation partially corroborates the findings of Yaman et al., who reported significantly lower iron absorption in male patients ($p = 0.04$) and those of increasing age ($p = 0.02$).[10] Similarly, Silay et al. demonstrated significantly lower OIAT values in older patients compared to younger individuals, suggesting age-related changes in iron absorption capacity.[14]

The moderate discriminative ability of serum ferritin for detecting malabsorption (AUC = 0.707) in our study provides an interesting contrast to the work of Wolff et al., who found that baseline hepcidin levels exhibited a strong negative correlation with transferrin saturation increase following OIAT.[15] These complementary findings suggest that combining multiple biomarkers may enhance diagnostic precision in assessing iron absorption capacity.

Our study has several important clinical implications. First, the high NPV of OIAT suggests that patients with normal test results are unlikely to have significant malabsorption and can be confidently managed with standard oral iron therapy. Second, abnormal OIAT results should prompt further investigation for underlying gastrointestinal pathologies, particularly *H. pylori* infection, autoimmune gastritis, and celiac disease. Third, OIAT represents a cost-effective approach to evaluating iron absorption, potentially reducing the need for more invasive and expensive investigations.

Several limitations of our study warrant mention. The single-center design may limit the generalizability of our findings to other populations with different ethnic or geographic characteristics. The exclusion of patients with elevated inflammatory markers may have resulted in underestimation of malabsorption prevalence, as inflammation can impair iron absorption independent of structural gastrointestinal pathologies. Additionally, the lack of standardized criteria for defining normal versus abnormal OIAT results across studies complicates direct comparisons of diagnostic performance metrics.

Conclusions

The OIAT demonstrates robust diagnostic performance for predicting response to oral iron therapy and identifying gastrointestinal malabsorption syndromes in patients with IDA. The exceptional negative predictive value positions OIAT as an effective first-line screening tool, potentially reducing the need for invasive investigations in patients with normal test results. Among patients with abnormal OIAT and confirmed malabsorption, *H. pylori* infection, autoimmune gastritis, and celiac disease represent the predominant etiologies requiring targeted therapeutic approaches. Early identification of these conditions through OIAT-guided diagnostic algorithms can facilitate more precise treatment strategies, potentially improving outcomes in patients with IDA.

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References

1. Sharma J, Devanathan S, Sengupta A, et al. Assessing the prevalence of iron deficiency anemia and risk factors among children and women: a case study of rural Uttar Pradesh. Clin Epidemiol Glob Health 2024;26:101545.
2. Lopez A, Cacoub P, Macdougall IC, et al. Iron deficiency anaemia. Lancet 2016;387:907–916.

3. Vos T, Abajobir AA, Abate KH, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet 2017;390:1211–1259.
4. Anand T, Rahi M, Sharma P, et al. Issues in prevention of iron deficiency anemia in India. Nutrition 2014;30:764–770.
5. Camaschella C. Iron deficiency. Blood 2019;133:30–39.
6. World Health Organization. (2001). Iron deficiency anaemia: assessment, prevention and control. [online] Available from: https://www.who.int/publications/m/item/iron-children-6to23-archived-iron-deficiency-anaemia-assessment-prevention-and-control [Last accessed October, 2025].
7. Camaschella C. Iron-deficiency anemia. N Engl J Med 2015;372:1832–1843.
8. Johnson-Wimbley TD, Graham DY. Diagnosis and management of iron deficiency anemia in the 21st century. Ther Adv Gastroenterol 2011;4:177–184.
9. Talarico V, Giancotti L, Mazza GA, et al. Iron deficiency anemia in celiac disease. Nutrients 2021;13(5):1695.
10. Yaman S, Gümüşçubuk YK, Gümüşçubuk O, et al. Oral iron absorption test: myth or reality? Hematol Clin Pract 2023;14:36–40.
11. Loveikyte R, van den Berg Y, van der Meulen-de Jong AE, et al. The role of hepcidin and an oral iron absorption test in identifying the root cause of iron-restricted anemia. Acta Haematol 2024;147(4):402–412.
12. Islam MS, Dayley D, Thanigaikumar M. The cost-effective usefulness of oral iron absorption test: prospective evaluation in premenopausal women with newly diagnosed iron deficiency anemia. Ann Hematol Oncol 2018;5(4):1201.
13. Gardyn J, Chapal N, Floru S. Oral iron absorption test: a simple test with relevance in the clinical setting. Isr Med Assoc J 2021;23(10):662–664.
14. Silay K, Akinci S, Yalcin A, et al. The status of iron absorption in older patients with iron deficiency anemia. Eur Rev Med Pharmacol Sci 2015;19(17):3142–3145.
15. Wolff F, De Breucker S, Pepersack T, et al. Baseline hepcidin measurement in the differential diagnosis of anaemia for elderly patients and its correlation with the increment of transferrin saturation following an oral iron absorption test. Clin Chem Lab Med 2018;57(2):250–258.