International Journal of Medicine
pISSN 1468-3814 | eISSN 2667-7008
https://theinternationalmedicine.com/

Original Researcher Article *DOI: 10.61336/im/26-11-10*

An Observational Study To Assess The Ophthalmic Manifestations In Patients With Iron Deficiency Anaemia.

Dr. Anupriya U Khatavkar[1], Dr. Satish C Shitole[2*], Dr. Radha S Dhote[3], Dr. Pallavi R Kolhe[4]

[1]Junior Resident, Ophthalmology Department, B.J.Medical.College and Sassoon General Hospital, Pune
[2]Associate Professor, Department of Ophthalmology, B.J.Medical and Sassoon General Hospital Pune.
[3]Junior Resident, Department of Ophthalmology, B.J.Medical and Sassoon General Hospital Pune.
[4]Junior Resident, Department of Ophthalmology, B.J.Medical and Sassoon General Hospital Pune.

Correspondence:
Dr. Satish C Shitole.
Associate Professor, Department of Ophthalmology, B.J. Medical and Sassoon General Hospital Pune.

Received: 25-08-2026
Revised: 29-09-2026
Accepted: 22-10-2026
Published: 06-11-2026

Abstract

Background: Iron is an essential micronutrient and integral to ocular physiology, supporting biochemical processes such as mitochondrial respiration, DNA synthesis and phototransduction. Ophthalmic manifestations of iron deficiency anemia (IDA) result from reduced oxygen delivery and vascular changes, commonly presenting as palpebral conjunctival pallor (pale inner eyelids), retinopathy, and decreased visual acuity. Key signs include retinal hemorrhages, cotton wool spots, optic disc edema, and vascular occlusion, which can be reversed by treating the anemia. Severe, untreated cases can lead to serious retinal vascular blockages or optic nerve swelling. With progression of the disease, hemorrhages, exudates, distended tortuous retinal veins and ultimately even papilledema may occur in ocular fundus. Aims and Objectives: To assess the Ophthalmic Manifestations of Iron Deficiency Anemia and assess the incidence of ocular manifestations in iron deficiency anemia and clinical presentation of ocular manifestations of iron deficiency anemia. ***Methods***: Study design: A hospital based cross-sectional, observational study. Study area: The study was done at our tertiary care centre in the department of Ophthalmology on attending OPD/IPD. Study population: All Patients between 18 years to 70 years of age admitted in Medicine ward at our Tertiary care Hospital with Hb < 10gm% who fulfilled the inclusion criteria. Sample size: 141 patients. ***Results***: Majority of patients (29.8%) belonged to the 41–50 years age group. 54 (38.3%) patients had mild anaemia, 63 (44.7%) patients had moderate anaemia and 24 (17.0%) patients had severe anaemia. The present study found Diminution of vision was significantly more prevalent in moderate (28.6%) and severe (50%) anaemia compared to mild anaemia (7.4%). Female patients had numerically higher rates of most ocular manifestations compared to male patients. ***Conclusion***: Retinal changes associated with anemia had a correlation with the severity of anemia.

Keywords: Iron Deficiency Anaemia, Retinal Hemorrhage, Ocular Manifestations, Anemic Retinopathy, Conjunctival Pallor, Visual Acuitys.

This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC-BY) license (http://creativecommons.org/licenses/by/4.0/).

INTRODUCTION

Iron is an essential micronutrient and integral to ocular physiology, supporting biochemical processes such as mitochondrial respiration, DNA synthesis and phototransduction. Ophthalmic manifestations of iron deficiency anemia (IDA) result from reduced oxygen delivery and vascular changes, commonly presenting as palpebral conjunctival pallor (pale inner eyelids), retinopathy, and decreased visual acuity. Reduced blood flow can trigger conditions like anterior ischemic optic neuropathy (AION) or nonarteritic ischemic optic neuropathy (NAION). Rare complications include central retinal vein occlusion (CRVO) or retinal artery occlusion. Anemias occur when the level of healthy red blood cells (RBCs) or hemoglobin (an iron-binding, oxygen carrying protein within RBCs) is too low. It serves as a key component of enzymes involved in critical metabolic functions, including oxygen transport, cellular energy production, and deoxyribonucleic acid (DNA) replication.1 However, imbalances in iron homeostasis, whether iron deficiency or overload, can profoundly affect multiple organ systems, including the eyes. In the retina and optic nerve, iron is indispensable for the phototransduction cascade, a process that converts light into neural signals, as well as for mitochondrial respiration, myelin maintenance, and neurotransmitter metabolism.2

Key signs include retinal hemorrhages, cotton wool spots, optic disc edema, and vascular occlusion, which can be reversed by treating the anemia. Severe, untreated cases can lead to serious retinal vascular blockages or optic nerve swelling. The whites of the eyes may develop a blue color, the inside of the lower eyelids may become pale, and the retina may become damaged due to a lack of oxygen and leaking blood vessels. Anemic retinopathy is usually observed in around 20%–25%

of patients with iron deficiency anemia. However, the prevalence of retinopathy may vary with the severity of anemia. With hemoglobin (Hb) levels < 8 g/dl (moderate to severe anemia), the prevalence of anemic retinopathy has been noted to be as high as 70%.3-5

Pallor of palpebral conjunctiva is the constant ophthalmological finding in anemia and inspection of this tissue has provided a time honored, although not highly accurate index of severity of anemia. The retinal metabolism is unable to tolerate its deprivation of essential supplies falling prey to hypoxic damage in end. Anemic damage can be thus an indicator for retinal damage manifesting as hemorrhage or pallor.

With progression of the disease, hemorrhages, exudates, distended tortuous retinal veins and ultimately even papilledema may occur in ocular fundus. In iron deficiency anemia along with routine changes central retinal vein occlusion and artery occlusion, disc oedema, and anterior ischemic optic neuropathy can occur. Fundus changes in anemia was observed in literature but ocular manifestations in anemia as a whole are poorly studied, and various reports indicate that their indeed exist a link between anemia and ocular manifestations.

In a very recent comparative cross sectional study Rajan AR et al6 found Peripapillary RNFL thickness in anemia group was significantly thinner than controls, the change more pronounced in severe anemia than other groups. CDR was significantly high in severe anemia than others and concluded that Retinal changes in anemia has a correlation with the severity of anemia. RNFL and CDR changes can predispose to serious visual defects in future. Hence, anemia screening and correction along with frequent clinical and OCT evaluation in such patients can be useful in early detection and prevention of anemic retinopathy.

AIMS & OBJECTIVES

To assess the Ophthalmic Manifestations of Iron Deficiency Anemia and assess the incidence of ocular manifestations in iron deficiency anemia and clinical presentation of ocular manifestations of iron deficiency anemia.

MATERIALS AND METHODS

A hospital based cross-sectional, observational study was conducted with 141 patients to assess the ophthalmic manifestations of iron deficiency anaemia.

Study design: A hospital based cross-sectional, observational study
Study Duration: 18 months
Study area: The study was done at our tertiary care centre in the department of Ophthalmology on attending OPD/IPD.
Study population: All Patients between 18 years to 70 years of age admitted in Medicine ward at our Tertiary care Hospital with Hb < 10gm% who fulfilled the inclusion criteria.
Sample size: 141 patients

Inclusion criteria

a) Age 18 to 70 years
b) Patients admitted in Medicine ward
c) Hb < 10gm%
d) Iron Deficiency Anaemia diagnosed by Medicine dept

Exclusion criteria:

- Age <18 years
- Non-Consenting patients
- Patients with co-existing ocular pathology like corneal pathologies, cataract, Glaucoma, Uveitis, Tumours.
- Patients with recent intraocular surgery.
- Patients with other retinal disorders
- Co-existing Systemic illnesses diabetes, hypertension, HIV

METHODOLOGY

The study was done at our tertiary care centre in the department of Ophthalmology after due permission from the Institutional Ethics Committee and Review Board and after taking Written Informed Consent from the patients.

After approval from the Institutional Ethics Committee a valid informed consent was taken. Once the patients were enrolled for the study, a thorough history and physical examination was done as per proforma. An informed consent was taken in written from patients or patient's attendant.
Patient selection for the study was one as per the inclusion criteria. The study protocol was explained to the patient and written informed consent was obtained.

EVALUATION included the following:

- Detailed clinical history
- Examination
- General
- Systemic
- Ocular
- Visual acuity testing
- Slit lamp biomicroscope
- Fundoscopic examination using direct & indirect ophthalmoscopy with 20 DS.

STUDY INSTRUMENTS:

1. Snellen chart
2. Direct ophthalmoscope
3. Indirect ophthalmoscope
4. Slit lamp biomicroscope

As per inclusion and exclusion criteria, 96 patients with iron deficiency anemia were selected and visual acuity, slit lamp examination and fundus examination was recorded for these patients. Patients proforma was duly filled and records were kept for all patients.

All included patients were subjected to detailed ocular history and examination including visual acuity with and without pinhole by Snellen's chart, slit-lamp examination for anterior segment, fundus examination by direct and indirect ophthalmoscopy after full mydriasis. Fundus photography and FFA documentation was done with fundus camera. Complete haematological investigation was done. Severity of anaemia was graded according to haemoglobin levels with 10 mg% as mild, 6-10 mg% as moderate and less than 6 as severe. The details of the patient, type and severity of anaemia along with ocular manifestations with anaemia were recorded.

Statistical Analysis

Sample size was calculated by following formula:

$n = [DEFF*Np(1-p)]/ [(d2/Z21-\alpha/2*(N-1) +p*(1-p)]$

Where

n = Sample size

N = Population size (for finite population correction factor or fpc): 100,000

p = Hypothesized % frequency of outcome factor in population = 25%

d = Confidence limits as % of 100 (absolute ± %) = 6%

DEFF = Design effect (for cluster surveys) = 1

Confidence Level (%) = 90%

Hence a sample size of 141 patients was considered adequate for our study.

RESULTS

Majority of patients (29.8%) belonged to the 41–50 years age group, followed by 31–40 years (26.9%), 18–30 years (19.9%), 51-60 years (17.1%) and 61-70 years (6.3%). The mean age of the group was 35.2±12.4 years. Most of the patients 89 (63.1%) patients were female while male patients constituted 36.9% of the study population. 54 (38.3%) patients had mild anaemia, 63 (44.7%) patients had moderate anaemia and 24 (17.0%) patients had severe anaemia. Rajan AR et al6 comparative case control cross sectional study assessing retinal changes in various grades of anemia and analysing the peripapillary RNFL (retinal nerve fibre layer) thickness and CDR (cup-disc ratio) in OCT found mean age in anemia group was 39.97 ± 12.71 years and in control group was 42.4 ±12.12 years. The number of females and males were 35 (79.55%) and 9 (20.45%) in anemic group, 21 (47.73%) and 23 (52.27%) in control group with female predominance in anemic group. Mittal S et al9 observational cross-sectional study found 138 (46%) males and 162 females (54%) of the study population. Kumar J et al8 prospective study assessing ophthalmic manifestations of anemia found 45(30%) cases were <15 years of age and 105(70%) were above 15 years. 68(45.33%) cases were male and 82(54.67%) were female. Coskun M et al10 prospective study assessing whether there are differences in the central corneal thickness (CCT), retinal nerve fiber layer (RNFL), and ganglion cell-inner plexiform layer (GC-IPL) in women with iron deficiency anemia (IDA) and vitamin B12 deficiency anemia (B12DA) found mean age was 37.85 ±11.06 years in group 1, 34.54 ± 7.44 years in group 2, and 33.48± 9.03 years in group 3. CCT was observed as median value of 534± (minimum, 477; maximum, 599) in group 1, 514 ± (minimum, 473; maximum, 610) in group 2, and 532 ± (minimum, 489; maximum, 598) in group 3.

All patients had conjunctival pallor. Anterior segment changes (dryness, pallor) were noted in 38 (26.9%) patients. Diminution of vision was recorded in 34 (24.1%) patients. Lid oedema and Retinal haemorrhage was observed in 28

(19.9%) and 19 (13.5%) patients respectively followed by disc pallor in 16 (11.3%) patients. Retinal vascular changes were present in 8 (5.7%) patients. Papilloedema was the least common, noted in 3 (2.1%) patients. Garg P et al11 observational study determining various ocular manifestations in different types of anaemia and various fundus abnormalities in different grades of anaemia found out of 294 patients of nutritional anaemia, iron deficiency was seen in 156 (53.06%) patients, megaloblastic anaemia was seen in 43 (14.62%) patients and dimorphic anaemia was seen in 95 (32.31%) patients.

Visual acuity was assessed using Snellen's chart for both eyes. Normal visual acuity (6/6–6/12) was present in 68 (48.2%) right eyes and 65 (46.1%) left eyes. Mild impairment (6/18–6/36) was seen in 40 (28.4%) right eyes and 42 (29.8%) left eyes. Moderate impairment (6/60–CF 3m) was noted in 25 (17.7%) right eyes and 27 (19.1%) left eyes. Severe impairment (CF 3m–PL) was present in 8 (5.7%) right eyes and 7 (5.0%) left eyes. There was no statistically significant difference in visual acuity between the two eyes. The present study observed 54 (38.3%) patients had mild anemia, 63 (44.7%) patients had moderate anemia and 24 (17.0%) patients had severe anemia.

Slit-lamp biomicroscopic examination revealed conjunctival pallor in all 141 (100%) patients. Lid oedema was noted in 28 (19.9%) patients. Conjunctival dryness or xerosis was observed in 22 (15.6%) patients while early lens changes were present in 16 (11.3%) patients. Superficial corneal changes (superficial punctate keratopathy) were found in 8 patients (5.7%).

Fundoscopic examination using direct and indirect ophthalmoscopy with a 20 D lens revealed normal fundus in 95 (67.4%) patients. Among the 46 patients with fundus changes, the most common finding was disc pallor in 16 (11.3%) patients followed by flame-shaped retinal haemorrhage in 11 (7.8%) patients and dot and blot haemorrhages in 8 (5.7%) patients. Papilloedema was found in 3 (2.1%) patients while retinal vascular changes (venous dilatation and tortuosity) were noted in 8 (5.7%) patients. Roth spots were observed in 4 (2.8%) patients. Cotton wool spots were seen in 2 (1.4%) patients.

DISCUSSION

The present study found Diminution of vision was significantly more prevalent in moderate (28.6%) and severe (50%) anaemia compared to mild anaemia (7.4%). The incidence of retinal haemorrhage increased from 3.7% in mild to 12.7% in moderate and 37.5% in severe anaemia. Retinal vascular changes and disc pallor similarly showed a significant increase with severity. A statistically significant increase in the frequency and severity of ocular manifestations was observed with worsening grade of anemia. Rajan AR et al 6 comparative cross-sectional study showed diminution of vision was most common symptom noticed -23(26.13%). The symptoms were more in severe anemia group (50%) compared to moderate, severe and control groups. Diminution of vision with floaters was seen only in severe anemia group (33.33%) and pallor was found in moderate and severe anemia group only. All the patients in severe anemia group had pallor. Mittal S et al9 observational cross-sectional study assessing ocular manifestation of Anemia found 138 (46%) males and 162 females (54%) of the study population. Kumar J et al8 prospective study assessing ophthalmic manifestations of anemia found 45(30%) cases were <15 years of age and 105(70%) were above 15 years. 68(45.33%) cases were male and 82(54.67%) were female.

Coskun M et al10 prospective study assessing whether there are differences in the central corneal thickness (CCT), retinal nerve fiber layer (RNFL), and ganglion cell-inner plexiform layer (GC-IPL) in women with iron deficiency anemia (IDA) and vitamin B12 deficiency anemia (B12DA) found mean age was 37.85 ±11.06 years in group 1, 34.54 ± 7.44 years in group 2, and 33.48± 9.03 years in group 3. CCT was observed as median value of 534± (minimum, 477; maximum, 599) in group 1, 514 ± (minimum, 473; maximum, 610) in group 2, and 532 ± (minimum, 489; maximum, 598) in group 3. Garg P et al11 observational study determining various ocular manifestations in different types of anaemia and various fundus abnormalities in different grades of anaemia found out of 294 patients of nutritional anaemia, iron deficiency was seen in 156 (53.06%) patients, megaloblastic anaemia was seen in 43 (14.62%) patients and dimorphic anaemia was seen in 95 (32.31%) patients.

In the present study, 54 (38.3%) patients had mild anaemia, 63 (44.7%) patients had moderate anaemia and 24 (17.0%) patients had severe anaemia. This is comparable to the studies of Rajan AR et al6, Satish C et al7, Mittal S et al9 and Kumar J et al.8

Rajan AR et al6 comparative cross-sectional study showed diminution of vision was most common symptom noticed 23(26.13%). The symptoms were more in severe anemia group (50%) compared to moderate, severe and control groups. Diminution of vision with floaters was seen only in severe anemia group (33.33%) and pallor was found in moderate and severe anemia group only. All the patients in severe anemia group had pallor.

Satish C et al7 non-interventional study found 48 patients with nutritional anaemia iron deficiency was seen in 26(54.16%) patients, megaloblastic anaemia was seen in 8(16.66%) patients and dimorphic anaemia was seen in 14(29.16%) patients.

Mittal S et al9 observational cross-sectional study found 46% (15.3) had mild anaemia, 124 (41.3%) had moderate anaemia and 130 (43.3) patients had severe anaemia. Kumar J et al.8 prospective study showed 21(14%) of the admitted cases had anemia of mild grade, 63(42%) moderate grade and 66(44%) were of severe grade.

In the present study, all patients had conjunctival pallor. Anterior segment changes (dryness, pallor) were noted in 38 (26.9%) patients. Diminution of vision was recorded in 34 (24.1%) patients. Lid oedema and Retinal haemorrhage was observed in 28 (19.9%) and 19 (13.5%) patients respectively followed by disc pallor in 16 (11.3%) patients. Retinal vascular changes were present in 8 (5.7%) patients. Papilloedema was the least common, noted in 3 (2.1%) patients. This is concordant to the studies of Garg P et al11, Mittal S et al9, Kumar J et al8 and Satish C et al.7

Garg P et al11 observational study found conjunctival pallor was the commonest ocular manifestation in anaemia and was present in all cases. Diminution of vision was noticed in 72% (n=31) of megaloblastic anaemia and 56% (n=54) patients of dimorphic anaemia. Patients with iron deficiency anaemia did not show visual impairment. Lid oedema was observed in 21.15% (n=33) patients with iron deficiency anaemia and not seen in patients with megaloblastic and dimorphic anaemia. Subconjunctival haemorrhage was seen in 13.95% (n=6) patients of megaloblastic anaemia and 12.63% (n=12) patients of dimorphic anaemia and was not seen in patients with iron deficiency anaemia. Disc pallor was noted in the 9.61% (n=15) of iron deficiency anaemia, 41.86% (n=18) of megaloblastic and 21.05% (n=20) of dimorphic anaemia. Retinal haemorrhages were also seen all types of anaemia 10.89% (n=17) in iron deficiency anaemia, 53.48% (n=23) in megaloblastic and 68.4% (n=65) in dimorphic anaemia. The vascular changes were in the form of venous dilatation and tortuosity and were present in 1.2% (n=2) of iron deficiency anaemia, 76.7% of (n=33) megaloblastic and 40.0% of (n=38) dimorphic anaemia. The macular oedema was not seen in iron deficiency anaemia, whereas in megaloblastic, the results were 2.3% (n=1) and 10.5% (n=10) in dimorphic anaemia which was highly significant and diminution of vision, lid oedema, subconjunctival haemorrhage, disc pallor, retinal haemorrhage or vascular changes and macular oedema were also present. Mittal S et al9 observational cross-sectional study found Conjunctival paleness was the commonest visual indication of paleness found in all 98% cases followed by Retinal hemorrhagic anomalies as second commonest visual indication seen in 35.33% cases. Diminution of vision was viewed as the third commonest visual appearance seen in 34.0% of the cases which was significant. Kumar J et al8 prospective study assessing ophthalmic manifestations of anemia found conjunctival pallor was the commonest ocular manifestation of anaemia seen in 125 out of 150 cases (83.33%). Retinal abnormalities were the second commonest ocular manifestation seen in 35 out of 150 cases (23.33%), followed by posterior pole pallor as the third commonest ocular manifestation seen in 25 patients out of 150 (16.67%). Satish C et al7 non-interventional study found conjunctival pallor was the commonest ocular manifestation in anaemia and was present in all cases. Diminution of vision was noticed in 4 out of 8 patients (50%) of megaloblastic anaemia and 9 out of 15 (64.28%) patients of dimorphic anaemia. Patients with iron deficiency anaemia did not show visual impairment. Lid edema was observed in 4 out of 26 (15.38%) patients with iron deficiency anaemia. It was not seen in patients with megaloblastic and dimorphic anaemia. Subconjunctival haemorrhage was seen in 1 out of 8 (12.5%) patients of megaloblastic anaemia and 2 out of 14 (14.28%) patients of dimorphic anaemia and not seen in patients with iron deficiency anaemia.

It was observed in the present study that visual acuity as assessed using Snellen's chart for both eyes. Normal visual acuity (6/6–6/12) was present in 68 (48.2%) right eyes and 65 (46.1%) left eyes. Mild impairment (6/18–6/36) was seen in 40 (28.4%) right eyes and 42 (29.8%) left eyes. Moderate impairment (6/60–CF 3m) was noted in 25 (17.7%) right eyes and 27 (19.1%) left eyes. Severe impairment (CF 3m–PL) was present in 8 (5.7%) right eyes and 7 (5.0%) left eyes. There was no statistically significant difference in visual acuity between the two eyes ($p>0.05$). Coskun M et al10 noted similar observations in their study. Coskun M et al10 prospective study showed corneal endothelial cell density (CD) was higher in control group (2998 [2040–3100] cell/mm2) compared to the study groups (2939 [1836–3421] cell/mm2 in group 1 and 2669 [2236–3406] in group 2) with no statistically significant difference between the groups.

It was observed in the present study that slit-lamp biomicroscopic examination revealed conjunctival pallor in all 141 (100%) patients. Lid oedema was noted in 28 (19.9%) patients. Conjunctival dryness or xerosis was observed in 22 (15.6%) patients while early lens changes were present in 16 (11.3%) patients. Superficial corneal changes (superficial punctate keratopathy) were found in 8 patients (5.7%). Garg P et al11 observational study showed conjunctival pallor was the commonest ocular manifestation of anaemia seen in all 100% cases. Retinal haemorrhagic abnormalities were the second commonest ocular manifestation seen in 35% cases. Diminution of vision was seen as the third commonest ocular manifestation seen in 29% of the cases.

It was seen in the present study that fundoscopic examination using direct and indirect ophthalmoscopy with a 20 D lens revealed normal fundus in 95 (67.4%) patients. Among the 46 patients with fundus changes, the most common finding was disc pallor in 16 (11.3%) patients followed by flame-shaped retinal haemorrhage in 11 (7.8%) patients and dot and blot haemorrhages in 8 (5.7%) patients. Papilloedema was found in 3 (2.1%) patients while retinal vascular changes (venous dilatation and tortuosity) were noted in 8 (5.7%) patients. Roth spots were observed in 4 (2.8%) patients. Cotton wool spots

were seen in 2 (1.4%) patients. Similar findings were observed by Rajan AR et al6, Satish C et al7 and Coskun M et al.10 Rajan AR et al6 comparative cross-sectional study observed in right eye superior and inferior quadrant average RNFL thicknesses and left eye inferior quadrant RNFL thickness in anemia group were significantly thinner than the control group. The average, superior, temporal, inferior quadrant RNFL thickness of both eyes in the severe anemia group were thinner than the mild and moderate anemia groups. Nasal quadrant RNFL thickness in left eye was slightly lower in mild anemia group. Satish C et al7 non-interventional study found that retinal haemorrhage as the most common ocular manifestation in posterior segment due to anaemia. Flame shaped haemorrhage were seen in 18 cases out of 48 (37.50%), white centered haemorrhage was seen in 9 patients (18.75%), deep haemorrhages were seen in 15 patients (31.25%) and sub hyloid haemorrhages were seen in 4 patients (8.33%).

Coskun M et al.10 prospective study showed CV was observed 32% (23–42) in group 1, 31% (minimum, 26; maximum, 34) in group 2, and 28% (minimum, 24; maximum, 39) in group 3. Hexagonality (HEX) was observed 50% (20–75) in group 1, 54% (20–63) in group 2, and 59% (41– 66) in group 3. Superior RNFL (SRNFL) was found to be higher in control group (151 l [77–162]) compared to the study groups (113 l [84–153] in group 1 and 124 [44–149] in group 2. Inferior RNFL (IRNFL) was also higher in control group 144 l (118–180) (133 l [66–161] in group 1 and 133 l [86–167] in group 2). Nasal RNFL (NRNFL) was lower in the study groups (73 l [50–99] in group 1 and 69 [40–95] in group 2) compared to the control group (96 l [55–104]. Temporal RNFL (TRNFL) was also lower in the study groups (65 l [48–81] in group 1 and 70 l [50–88] in group 2) compared to the control group (98 l [55–118]. GC-IPL thickness was elevated in control group (92 l [81–98]) compared to the study groups (86 [54–97] and 82 [72–101], respectively.

In the present study that diminution of vision was significantly more prevalent in moderate (28.6%) and severe (50%) anaemia compared to mild anaemia (7.4%). The incidence of retinal haemorrhage increased from 3.7% in mild to 12.7% in moderate and 37.5% in severe anaemia ($p<0.05$). Retinal vascular changes and disc pallor similarly showed a significant increase with severity. A statistically significant increase in the frequency and severity of ocular manifestations was observed with worsening grade of anaemia. These findings were like the studies of Kumar J et al8 and Satish C et al.7

Kumar J et al8 showed in patients with severe anaemia and platelet count <50X103, number of patients with retinal haemorrhages were more as compared to patients with severe anaemia and platelet count >100x103 and retinal abnormalities were more in severe anaemia (40.9%) than in moderate anaemia (12.7%) and there has been no case of retinal abnormality in mild anemia. Satish C et al7 non-interventional study observed Fundal pallor as second most common retinal manifestation seen in 15 out of 48 patients (31.25%) with anaemia. Other retinal manifestation like papilledema (4.16% of patients), venous dilatation and tortuosity (4.16% of patients), retinal oedema (6.25% of patients), cotton wool spots (8.33% of patients) and macular star (2.06% of patients) were less commonly noticed on fundus examination.

In the present study, female patients had numerically higher rates of most ocular manifestations compared to male patients. However, these differences were not statistically significant ($p>0.05$) for any individual manifestation. This suggests that the ocular manifestations in IDA are primarily driven by the severity of anemia rather than by sex itself. Satish C et al7 non-interventional study observed patients with mild-moderate anemia showed retinal hemorrhages in 18.5% of patients. Patients with severe anemia showed retinal hemorrhages in 68.4% of patients and severity of retinopathy was more with higher grades of anemia. The association between anemia and retinal hemorrhage was statistically significant.

In the present study, retinal manifestations (haemorrhage, disc pallor, vascular changes) showed a trend towards higher frequency with increasing age, with the 41–50 years and 51–60 years age groups demonstrating the highest rates. Diminution of vision was most common in patients aged 41–60 years. Lid oedema was distributed across all age groups without a statistically significant age-specific pattern ($p>0.05$). The increase in posterior segment findings with age likely reflects cumulative vascular vulnerability, making older IDA patients particularly at risk for anaemic retinopathy. Similar observations were noted in the studies of Rajan AR et al6, Garg P et al11 and Kumar J et al.8

Rajan AR et al6 comparative cross-sectional study observed CDR was comparable between anemic group and control group. Among the anemic groups CDR was significantly high in the severe anemic group compared to moderate and mild anemia groups and fundus changes were seen only in the severe anemia group. Garg P et al11 observational study showed various fundus manifestations in different grades of anaemia was retinal vascular changes, pale disc, dot blot and flame-shaped haemorrhages all showed an increase with severity of anaemia. Kumar J et al.8 prospective study observed Retinal abnormalities mostly in patients with severe grade(<6g/dl) of anemia than in moderate anemia (12.7%) and there has been no case of retinal abnormality in mild anemia.

The occurrence of ocular abnormalities is always directly proportional with the severity of anemia and ocular changes in anemia are nonspecific and may closely resemble other conditions and it is important to rule out other ocular and systemic diseases. Normally, the ocular complications are usually reversible with the correction of anaemia. These patients should

be monitored frequently with 3 to 6 months follow-up re-evaluation. Small preretinal hemorrhage respond to blood transfusions, while large haemorrhage requires posterior hyaloidectomy or vitrectomy to prevent permanent macular damage. Fundus of eye, the columns of both arterial and venous blood lie exposed, so that they can be observed through the ophthalmoscope, examined in detail with convenient magnification.

Female patients had numerically higher rates of most ocular manifestations compared to male patients. However, these differences were not statistically significant for any individual manifestation. This suggests that the ocular manifestations in IDA are primarily driven by the severity of anemia rather than by sex itself. Retinal manifestations (haemorrhage, disc pallor, vascular changes) showed a trend towards higher frequency with increasing age, with the 41–50 years and 51–60 years age groups demonstrating the highest rates. Diminution of vision was most common in patients aged 41–60 years. Lid oedema was distributed across all age groups without a statistically significant age-specific pattern. The increase in posterior segment findings with age likely reflects cumulative vascular vulnerability, making older IDA patients particularly at risk for anemic retinopathy.

CONCLUSION

Retinal changes associated with anemia had a correlation with the severity of anemia. Anemia screening and correction along with frequent clinical evaluation in such patients can be useful in early detection and prevention of anemic retinopathy. Ocular abnormalities increase with the increasing severity of anaemia, so all the patients with moderate-to severe anaemia should always undergo complete eye checkup, so that early diagnosis and timely treatment can be done. Eye being a window to systemic diseases, regular fundus examination can help in judging the severity and gravity of anaemia.

Declaration by Authors
Ethical Approval: Approved
Acknowledgement: None
Source of Funding: None
Conflict of Interest: The authors declare no conflict of interest.

REFERENCES

1. Dev S, Babitt JL. Overview of iron metabolism in health and disease. Hemodial. Int. 2017;21:S6–S20.
2. Cheli VT, Correale J, Paez PM et al. Iron Metabolism in Oligodendrocytes and Astrocytes, Implications for Myelination and Remyelination. ASN Neuro. 2020;12:1759091420962681.
3. Carraro MC, Rossetti L, Gerli GC. Prevalence of retinopathy in patients with anemia or thrombocytopenia. Eur J Haematol. 2001;67:238–244.
4. Imai E, Kunikata H, Udono T et al. Branch retinal artery occlusion: A complication of iron-deficiency anemia in a young adult with a rectal carcinoid. Tohoku J Exp Med. 2004;203:141–144.
5. Aisen ML, Bacon BR, Goodman AM et al. Retinal abnormalities associated with anemia. Arch Ophthalmol. 1983;101:1049–1052.
6. Rajan AR, Arun S, Kakkanatt CVA et al. Retinal changes in anemia - A comparative cross sectional study using SD-OCT. Indian J Clin Exp Ophthalmol. 2024;10(2):379-386.
7. Satish CS, Tapan JP et al. Ocular manifestations in patients with nutritional anaemia. Indian Journal of Basic and Applied Medical Research; September 2014;3(4):89-94.
8. Kumar J, Singh S, Garg A et al. "Ophthalmic Manifestations of Anemia." IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), 2020;19(4):16-20
9. Mittal S, Mushtaque A, Chauhan M, et al. ocular manifestation of anemia in tertiary healthcare center. International Journal of Medical and Biomedical Studies, 2021;5(12):159-162..
10. Coskun M, Sevencan NO. The evaluation of ophthalmic findings in women patients with iron and vitamin B12 deficiency anemia. Trans Vis Sci Tech. 2018;7(4):16.
11. Garg P, Agrawal A. Ocular manifestations in patients with anaemia. J. Evid. Based Med. Healthc. 2017; 4(79):4646-4649.