

# A Comparative Study Of Corneal Parameters In Anaemic And Non-Anaemic Females And Its Correlation With CBC Parameters

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## ABSTRACT

### Background:

It is very vital for the cornea to have a transparent structure due to the pump and barrier functions performed by the corneal endothelium, which regulates stromal hydration in order to maintain corneal clarity. Some systemic diseases like anaemia that result in low blood oxygen levels and eventually cause tissue hypoxia might affect corneal endothelium structure and function. Posterior segment findings of anaemia have been thoroughly studied, but there has not been much research into the effects of anaemia on the corneal endothelium.

### Method:

A comparative study was performed among females recruited from NIMS Hospital. The study population was comprised of 100 subjects and grouped into two categories as anaemic and non-anaemic. Participants who were >18 years old were included in the study.

### Results:

According to the results obtained during this study, there were significant morphological changes found in corneal endothelium of anaemic patients in comparison with non-anaemic controls. Decrease in endothelial cell density and proportion of hexagonal cells and elevation of coefficient of variation indicated increased cellular polymorphism. Central corneal thickness varied among groups. In addition, there was a higher frequency of endothelial abnormalities among those with low haemoglobin levels. This implies that the level of severity of anaemia is correlated with the endothelial structure.

### Conclusion:

From the study, it is concluded that anaemia has an effect on the morphology of the corneal endothelial cells. With low haemoglobin levels and subsequent hypoxic state, the endothelial cells are affected, eventually leading to reduced corneal clarity.

**Keywords:** Corneal endothelium, Anaemia, Endothelial cell density (ECD), Central Corneal Thickness (CCT), Specular Microscopy, Complete Blood Count (CBC).

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## INTRODUCTION

The cornea is a transparent, avascular, dome-shaped structure forming the anterior one-sixth of the fibrous tunic of the eyeball. It acts as both a protective barrier and an optical medium. Anatomically, the cornea consists of six distinct layers: epithelium, Bowman's membrane, stroma, Dua's layer (Pre-Descemet's

Layer) Descemet's membrane, and endothelium. Each layer plays a specific role in maintaining corneal integrity and transparency; however, the corneal endothelium plays a critical role in maintaining corneal clarity. <sup>(1)</sup> The corneal endothelium is composed of a single layer of hexagonal cells lining the posterior surface of the cornea. These cells maintain corneal

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hydration through an active pump and barrier mechanism that regulates stromal hydration and transparency.<sup>(2)</sup> Proper endothelial function is essential for maintaining corneal clarity and perfect vision.<sup>(3)</sup> Unlike the corneal epithelium, endothelial cells have very limited regenerative capacity in living. Endothelial cell loss is permanent and is compensated by enlargement and migration of adjacent cells rather than mitotic division.<sup>(4)</sup> This functional adjustment leads to characteristic morphological changes such as polymegathism (variation in cell size) and pleomorphism (variation in cell shape).<sup>(5)</sup> Progressive endothelial cell loss and morphological changes reduce functional capacity of the corneal endothelium and increase the risk of corneal oedema and visual failure.<sup>(6)</sup> Evaluation of corneal endothelial morphology has therefore become an integral part of modern ophthalmic and optometric practice. Non-contact specular microscopy is a widely used, non-invasive technique that allows in direct visualization and quantitative analysis of corneal endothelial parameters.<sup>(7)</sup> These include endothelial cell density, coefficient of variation of cell size, percentage of hexagonal cells, and central corneal thickness.<sup>(8)</sup> Although the cornea is avascular, it depends on the aqueous humour, tear film, and limbal vasculature for oxygen and nutrient supply.<sup>(9)</sup> Systemic diseases affecting blood composition, oxygen-carrying capacity, and metabolic balance can indirectly influence corneal endothelial metabolism and morphology.<sup>(10)</sup> Several studies have shown corneal endothelial changes in systemic conditions such as diabetes mellitus, chronic kidney disease, and thyroid disorders.<sup>(11)</sup> Anaemia is one of the most common haematological disorders worldwide and represents a major public health problem, particularly in developing countries.<sup>(12)</sup> It is characterized by a reduction in haemoglobin concentration, red blood cell count, or oxygen-carrying capacity of blood.<sup>(13)</sup> According to the World Health Organization, anaemia in non-pregnant females is defined as haemoglobin levels below 12 g/dL.<sup>(14)</sup> Females suffer from anaemia because of reasons like loss of blood due to menstruation, malnutrition, physiological need and sociological aspects.<sup>(16)</sup> Iron deficiency anaemia is the commonest anaemia, whereas anaemia due to vitamin B12 and anaemia of cell division and tissue growth is the next one.<sup>(17)</sup> Persistent anaemia causes constant hypoxia in tissues, abnormal metabolism in cells, and excessive oxidative stress<sup>18</sup>. The organs which have higher demands for metabolism become more vulnerable to hypoxic Damage. Ocular abnormalities

caused due to anaemia include conjunctival pallor, retinal haemorrhages, cotton wool spots, dilatation of veins and edema of the optic disc.<sup>(19)</sup> According to Duke-Elder, ocular tissues having higher metabolism are highly susceptible to hypoxic Damage. Even though the back segment manifestation of anaemia is well known, there is limited knowledge on anterior segment changes, especially corneal endothelium, with anaemia.<sup>(20)</sup>

Complete Blood Count (CBC) is a routinely performed haematological investigation that provides essential information regarding blood components and red cell indications.<sup>(21)</sup> Parameters such as haemoglobin concentration, total red blood cell count, mean corpuscular volume, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration, red cell distribution width, and erythrocyte sedimentation rate are important in diagnosing and classifying anaemia.<sup>(22)</sup> Correlation of CBC parameters with corneal endothelial morphology may provide valuable understanding into the relationship between systemic haematological status and corneal health.<sup>(23)</sup> Previous studies have demonstrated associations between haemoglobin levels and ocular structural parameters, suggesting a systemic-ocular relationship.<sup>(24)</sup> Despite the high prevalence of anaemia among females, limited studies have evaluated its impact on corneal endothelial cell morphology. Most available literature focuses on endothelial changes associated with metabolic disorders such as diabetes mellitus. Comparative studies assessing corneal endothelial morphology in anaemic and non-anaemic females and correlating these findings with CBC parameters are uncommon.<sup>(25)</sup> Therefore, the present study is undertaken to assess and compare corneal endothelial cell morphology in anaemic and non-anaemic female subjects using non-contact specular microscopy and to analyse its correlation with complete blood count parameters. The findings of this study may enhance understanding of systemic-ocular interactions and highlight the importance of routine ocular evaluation in patients with anaemia.

### **METHODOLOGY:**

A cross-sectional study was carried out comparatively between the patient's receiving services in NIMS Hospital (Ophthalmology and Medical Laboratory Technology Department) in this article. The study involved 100 people (including 50 anemic and 50 non-anemic females). Individually, the participants were given the information on the goals and the methods of the study and informed consent was taken in writing before carrying out the clinical and laboratory tests. All

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of them over the age of 18 years were enrolled and divided into anaemic and non-anaemic groups based on the parameters of Complete Blood Count (CBC), in which haemoglobin less than 12 g/dL was regarded as anaemia. Every respondent was comprehensively clinically evaluated within a session. A short history about age, medical history and eye complaints was taken. An automated hematology analysis machine was used to analyze hematological data by taking 2-3 mL of venous blood collected under aseptic conditions. Snellen chart was used to measure visual acuity at 6 meters distance vision and Jaeger chart at near vision. Objective refraction was carried out by a retinoscope and then subjective refraction with a view to getting the final prescription. Non-contact tonometry (NCT) was used to measure intraocular pressure and slit lamp examined to assess anterior segment and make certain that corneal clarity was present. Specular microscopy was used to measure corneal endothelial parameters. The parameters measured would be endothelial cell density (ECD), coefficient of variation (CV), hexagonality, polymegathism, pleomorphism and central corneal thickness (CCT). This was done by correctly positioning the eye, centering on the corneal endothelium and recording clear images which were analyzed with automated software. Patients who had corneal disease history, ocular operation, diseases that impact more on cornea (like diabetes or autoimmune diseases), pregnancy, lactation experience, extreme refractive error, or recent contact lenses were not included in the study. Data collected were entered and the data analyzed through (Z-test) comparison of anaemic and non-anaemic groups was carried out. A **p-value <0.05** was considered statistically significant.

### **RESULT:**

**Participant Overview and Group Categorization:** A total of 100 participants (all females) aged above 18 years were included in this study. The participants were recruited from NIMS Hospital and were assessed for both hematological and corneal parameters. The mean age of participants was within the adult age group. To evaluate the effect of anaemia on corneal endothelial characteristics, participants were divided into two groups based on their haemoglobin levels obtained from Complete Blood Count (CBC) analysis. The anaemic group consisted of individuals with haemoglobin levels less than 12 g/dL, while the non-anaemic group included individuals with haemoglobin levels within the normal range ( $\geq 12$  g/dL). Each group comprised 50 participants, allowing a comparative

analysis of corneal morphology and endothelial cell parameters between anaemic and non-anaemic subjects.

**TABLE. 1 Basic characteristics of IOP (NCT) in anaemic and non-anaemic patients**

IOP (NCT)		Range (Min. - Max.)	Median (IQR)	Mean $\pm$ SD	Z-test	P-Value
O D	Anaemic	3 - 33.5	16.1 (14.13-17.5)	16.04 $\pm$ 4.13	1.361	0.1767
	Non-Anaemic	10 - 19.4	15.4 (14-16.7)	15.15 $\pm$ 2.11		
O S	Anaemic	10 - 23	15.2 (13.8-17.38)	15.61 $\pm$ 2.64	0.047	0.9628
	Non-Anaemic	10.1 - 23.2	15.6 (13.9-17)	15.59 $\pm$ 2.97		

Table 1 Compares the intraocular pressure (IOP) between anaemic and non-anaemic patients in both eyes.

The mean IOP for OD eyes was higher among patients with anaemia (16.04  $\pm$  4.13 mm Hg) than those without anaemia (15.15  $\pm$  2.11 mm Hg), though the difference was not statistically significant (p = 0.1767). For OS eyes, the means of IOP were almost the same in both groups – for patients with anaemia, it was 15.61  $\pm$  2.64 mm Hg; for those without anaemia, it was 15.59  $\pm$  2.97 mm Hg (p) = 0.962.

**TABLE.2 Basic characteristics of CD (cell/mm<sup>2</sup>) in anaemic and non-anaemic patients**

CD (cell/mm <sup>2</sup> )		Range (Min.- Max.)	Median (IQR)	Mean $\pm$ SD	Z-test	P-Value
O D	Anaemic	739-3252	2512 (2319-2787)	2425 $\pm$ 586	-4.34	< 0.001
	Non-Anaemic	2210-3750	2758 (2604-3115)	2844 $\pm$ 352		
O S	Anaemic	889-3610	2691 (2378-2840)	2516 $\pm$ 565	-2.94	0.0404
	Non-	1131-	2838	2819		

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	<b>Anaemic</b>	3650	(2561-3186)	± 458.3		
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Table 2 comparative analysis of corneal endothelial cell density (CD) among anaemia and non-anaemia subjects for each eye. The average CD in the right eye (OD) was smaller in anemic individuals (2425 ± 586 cells/mm<sup>2</sup>) relative to those who did not have anaemia (2844.4 ± 352 cells/mm<sup>2</sup>). The result was determined to be extremely significant (p < 0.0001). Likewise, the average CD in the left eye (OS) was lower in anaemic subjects (2516 ± 565 cells/mm<sup>2</sup>) than non-anaemic subjects (2819 ± 458.3 cells/mm<sup>2</sup>). This difference was also considered statistically significant (p = 0.00404).

**TABLE.3 Basic characteristics of CT (µm) in anaemic and non-anaemic patients**

CT (µm)		Range (Min.-Max.)	Median (IQR)	Mean ± SD	Z-test	P-Value
<b>O D</b>	<b>Anaemic</b>	422-585	498 (473-516)	498 ± 31.3	- 6.74	< 0.001
	<b>Non-Anaemic</b>	474-614	537 (523-551)	537 ± 25.5		
<b>O S</b>	<b>Anaemic</b>	439-557	497 (483-522)	503 ± 29	- 6.67	< 0.001
	<b>Non-Anaemic</b>	477-621	537 (521-560)	542 ± 29.8		

Table 3 Compares the corneal thickness (CT) between anaemic and non-anaemic subjects on both sides. The mean CT of the right eye (OD) was found to be lower in anaemic subjects (498 ± 31.3 µm) when compared to non-anaemic subjects (537 ± 25.5 µm), which was highly statistically significant (p < 0.0001). Similarly, in the left eye (OS), the mean CT was lower in anaemic subjects (503 ± 29 µm) than non-anaemic subjects (542 ± 29.8 µm), which was also highly statistically significant (p < 0.0001).

**TABLE.4 Basic characteristics of CC (Diopter) OD in anaemic and non-anaemic patients**

CC (Diopter) OD	Range (Min.-Max.)	Median (IQR)	Mean ± SD	Z-test	P-Value
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<b>K 1</b>	<b>Anaemic</b>	39.5-47.9	43.6 (42.7-45)	43.8 ± 1.83	- 0.89	0.3741
	<b>Non-Anaemic</b>	35-49	44 (43-45.6)	44.17 ± 2.3		
<b>K 2</b>	<b>Anaemic</b>	41.6-48.9	44.4 (43.36-46.3)	44.8 ± 1.89	- 0.264	0.792
	<b>Non-Anaemic</b>	37-50	45 (43.5-46.5)	44.95 ± 2.26		

Table 4 determines the relationship between corneal curvature (CC) of OD among anaemic and non-anaemic subjects using K1 (flatter) and K2 (steeper) measurements. The mean measurement of the anaemic group for K1 was only slightly lower (43.8 ± 1.83 D) compared to the non-anaemic group (44.17 ± 2.3 D), but this difference is not statistically significant (p = 0.3741). In the case of K2, the mean values were almost similar for both the anaemic (44.84 ± 1.89 D) and non-anaemic subjects (44.95 ± 2.26 D), showing no statistical significance (p = 0.792).

**TABLE.5 Basic characteristics of CC (Diopter) OS in anaemic and non-anaemic patients**

CC (Diopter) OS		Range (Min.-Max.)	Median (IQR)	Mean ± SD	Z-test	P-Value
<b>K 1</b>	<b>Anaemic</b>	39-47.8	43.5 (42.7-44.7)	43.6 ± 1.65	- 1.564	0.12113
	<b>Non-Anaemic</b>	39-48.1	44.1 (43.1-45.6)	44.23 ± 1.89		
<b>K 2</b>	<b>Anaemic</b>	41.2-48.6	44.5 (43.6-46)	44.6 ± 1.57	- 2.127	0.0359
	<b>Non-Anaemic</b>	41.7-49.1	45.2 (44.2-46.7)	45.37 ± 1.82		

Table 5 Compares the corneal curvature (CC) in OS eye between anaemic and non-anaemic cases on the basis of K1 (flat meridian) and K2 (steep meridian) parameters. The mean value of K1 for anaemic participants (43.67 ± 1.65 D) was slightly smaller compared to that for the non-anaemic ones (44.23 ± 1.89 D), but the difference between them was not statistically significant (p = 0.12113). The mean value of K2 was also different for both groups – it was

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smaller for anemic individuals ( $44.65 \pm 1.57$  D) in comparison with non-anaemics ( $45.37 \pm 1.82$  D), and the difference between groups was statistically significant ( $p = 0.0359$ ).

**TABLE.6 Descriptive statistics of CBC parameters in anaemic and non-anaemic patients**

Variables		Mini mum	Maxi mum	Median (IQR)
Anaemic	Hb	6.90	11.9	10.5 (9.63-11.28)
	ESR	3	120	26 (12-51)
	RDW-CV	12.90	22.4	15.45 (14.6-17.1)
	MCH	15.9	33.2	26.9 (22.1-29)
	MCH C	22.40	35	31.35 (30.33-32.18)
	TRBC	2.08	6.3	4.02 (3.69-4.49)
Non-Anaemic	Hb	12.1	17.5	13.1 (12.8-14.18)
	ESR	0.5	72	10.5 (4-22.5)
	RDW-CV	0.117	41	13.95 (11.4-15.1)
	MCH	3	31.5	28.95 (27.5-30.53)
	MCH C	13	34.5	32 (31.5-32.68)
	TRBC	3.91	5.88	4.85 (4.57-5.06)

Table 6 Descriptive statistics of CBC parameters in both anaemic and non-anaemic patients are shown here. Hemoglobin level in the anaemic group was significantly low, with a median of 10.5 g/dL, whereas the median for the other group was observed as 13.1 g/dL. Erythrocyte sedimentation rate (ESR) was comparatively high in the anaemic group, with a median of 26 mm/hr, whereas that for non-anaemic patients was recorded at 10.5 mm/hr. Moreover, anisocytosis in terms of variation of red blood cells (RDW) was comparatively more in the anemic group with a median of 15.45, whereas it was 13.95 for non-anaemic patients. Furthermore, MCH (Mean Corpuscular hemoglobin) and MCHC (Mean Corpuscular Hemoglobin Concentration) values in the anemic group were observed to be 26.9 and 31.35, respectively; the non-anaemic group had MCH of 28.95 and MCHC of 32. Total RBC count (TRBC) was

comparatively lower in the anaemic group, with a median of 4.02 million cells/ $\mu$ L, while the other group showed a median of 4.85 million cells/ $\mu$ L.

### **DISCUSSION:**

The objective of this study was to investigate the impact of anaemia on parameters concerning the cornea and the corneal endothelium of adult females. Results showed that anaemia had a significant effect on the corneal endothelial cell density (CD) and (CT), with little to no effect on the intraocular pressure (IOP) and CC parameters.

There were no statistically significant differences between IOPs of anaemic and non-anaemic participants in the current study. In the OD group, there was a slight increase in IOP of anaemic subjects (mean =  $16.04 \pm 4.13$  mmHg) compared to non-anaemics (mean =  $15.15 \pm 2.11$  mmHg). However, this difference was statistically insignificant ( $Z = 1.361$ ,  $p = 0.1767$ ). For the OS group, the difference in IOP of anemics ( $15.61 \pm 2.64$  mmHg) versus non-anemics ( $15.59 \pm 2.97$  mmHg) was again not statistically significant ( $Z = 0.047$ ,  $p = 0.9628$ ). From these results, we can conclude that anaemia has very little impact on aqueous humour production, drainage, and thus IOP. This is in accordance with what is stated in the standard ophthalmologic literature, as IOP depends more on aqueous humour dynamics and not on systemic hematologic conditions.<sup>25,26 & 3</sup>

The main conclusion of the current investigation is the statistically significant decrease in the corneal endothelial cell density (CD) among patients suffering from anaemia. Specifically, the mean CD in the right eye (OD) in anaemic patients was  $2425 \pm 586$  cells/ $\text{mm}^2$  while in non-anaemic subjects, the mean CD was  $2844.4 \pm 352$  cells/ $\text{mm}^2$ . There was a statistically highly significant difference in this respect ( $Z = -4.34$ ,  $p < 0.0001$ ). In the left eye (OS), the mean CD in anaemic patients was  $2516 \pm 565$  cells/ $\text{mm}^2$  while in non-anaemic subjects, it was  $2819 \pm 458.3$  cells/ $\text{mm}^2$  ( $p = 0.00404$ ). It seems that the decrease in the CD can be explained by hypoxia related to a reduction in hemoglobin levels. The corneal endothelium is characterized by metabolic activity and is required to maintain oxygen at sufficient levels for effective functioning (pumping/barring).<sup>21</sup> Thus, long-term hypoxia can result in the death of endothelial cells or their malfunctioning. Moreover, such a decrease in CD was reported in similar studies by.<sup>3,4</sup> Additionally, oxidative stress associated with anaemia may further contribute to endothelial damage.<sup>12</sup>

In addition, there was a statistically highly significant decrease in central corneal thickness (CT) among

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anaemic participants. For OD, CT is  $498 \pm 31.3 \mu\text{m}$  in anaemic subjects and  $537 \pm 25.5 \mu\text{m}$  in non-anaemic subjects ( $Z = -6.74$ ,  $p < 0.0001$ ). On the other hand, for OS, CT is  $503 \pm 29 \mu\text{m}$  in anaemic subjects and  $542 \pm 29.8 \mu\text{m}$  in non-anaemic subjects ( $Z = -6.67$ ,  $p < 0.0001$ ). It can be hypothesized that this change is caused by endothelial dysfunction of the cornea, which occurs due to hypoxia, resulting in alterations in the hydration of corneal stroma. The results obtained are consistent with the data obtained in previous research conducted by .<sup>5,3</sup> who showed that iron deficiency anemia led to decreased corneal thickness. Furthermore, found alterations in the structure of ocular tissues in anemic subjects.<sup>1</sup>

Concerning the analysis on the corneal curvature (CC) measurement, it was observed that no statistically significant difference was seen between the anaemic and non-anaemic cases in most parameters. On OD, the K1 parameter value was  $43.8 \pm 1.83 \text{ D}$  for the anemic and  $44.17 \pm 2.3 \text{ D}$  for non-anaemic group with the Z-value and probability value at  $-0.89$ ,  $0.3741$  respectively. The K2 values on OD showed a value of  $44.84 \pm 1.89 \text{ D}$  for the anaemic group and  $44.95 \pm 2.26 \text{ D}$  for the non-anaemic group with a Z value of  $-0.264$  and probability value of  $0.792$ , thus showing that there is no statistically significant difference in values between the two. Similarly, on OS, K1 values did not show statistical significance at  $43.67 \pm 1.65 \text{ D}$  for the anaemic group and  $44.23 \pm 1.89 \text{ D}$  for the non-anaemic group with the Z-value and probability value of  $-1.564$  and  $0.12113$  respectively. On the other hand, K2 showed statistically significant results in OS with lower values in the anaemic case ( $44.65 \pm 1.57 \text{ D}$ ) compared to the non-anaemic case ( $45.37 \pm 1.82 \text{ D}$ ) ( $Z = -2.127$ ,  $p = 0.0359$ ). Overall, these findings suggest that anaemia has minimal influence on corneal curvature, which is consistent with studies by.<sup>4</sup>

The additional hematological indices further confirm the systemic differences between the two groups. In anaemic patients, the median hemoglobin concentration was  $10.5 \text{ g/dL}$  (IQR:  $9.63-11.28$ ), whereas for the non-anaemic group, it was  $13.1 \text{ g/dL}$  (IQR:  $12.8-14.18$ ). There is an increased erythrocyte sedimentation rate (ESR) in anaemic patients at  $26 \text{ mm/hr}$  compared to  $10.5 \text{ mm/hr}$  in non-anaemic individuals. Moreover, there is an increase in the red cell distribution width coefficient of variation (RDW-CV) in anaemic patients at  $15.45$  compared to  $13.95$  in non-anaemic people. Furthermore, the mean corpuscular volume (MCH) in anaemic patients was  $26.9$  versus  $28.95$  in non-anaemic patients MCHC ( $31.35$  vs  $32$ ), and TRBC ( $4.02$  vs  $4.85$  million

cells/ $\mu\text{L}$ ) were lower in anaemic individuals. These findings are consistent with classical hematological characteristics of anaemia.<sup>14,17,18</sup>

These observations may be attributed to the effect of hypoxia on metabolic function. This condition decreases the availability of oxygen to the endothelial cells, resulting in low CD and CT. In previous research, retinal and choroidal vascularity was found to be decreased in cases of anaemia.<sup>4,9</sup> It is known that hypoxia has an effect on molecular-level vascular and cellular reactions.<sup>20</sup>

However, anemia is still considered a significant problem for the entire world especially for women.<sup>22</sup> Anaemia and its various ocular symptoms, such as changes to the cornea and retina, indicate the need for proper diagnosis and treatment.<sup>11</sup> Thus, the results of the present study have shown the role of corneal endothelium in systemic health assessment.

In conclusion, results of the current study indicate that anaemia considerably affects the endothelial cells and the corneal thickness ( $p < 0.05$ ) but does not affect the intraocular pressure and corneal curvature parameters ( $p > 0.05$ ). The results of the current study are consistent with the results reported by earlier studies, which confirm the importance of hypoxia and oxidative stress in cases of anaemia.

### **CONCLUSION:**

The current investigation shows that corneal parameters are greatly affected by anaemia. Both eyes were observed to have a lower corneal thickness (CT), as well as an endothelial density (CD), in anaemic subjects, compared to non-anaemic subjects. The difference in corneal thickness and endothelial cell density was statistically highly significant ( $p < 0.0001$ ). Conversely, there was no significant difference of intraocular pressure between anaemic and non-anaemic individuals and corneal curvature parameters were more or less similar, except that there was a slight differentiation in one parameter. These results suggest that anaemia is related to structural alterations of the cornea, especially the corneal thickness and the density of endothelial cells but has no significant impact on the intraocular pressure and the cornea shape. This underscores the need to put into consideration hematological status when conducting ophthalmic examination.

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