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Corneal Endothelial Changes in Myopic Eyes of Children Aged 6 -15 Years

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ABSTRACT

Background: Myopia, a form of refractive error, is a common pathologic change of the eye.

Objective: This study aimed to evaluate corneal endothelial cell density and morphological changes in moderate and high myopic eyes of children aged 6-15 years using specular microscopy.

Methods: This prospective cross-sectional study included 80 eyes of Egyptian children aged 6-15 years divided into 3 groups, group I: 40 emmetropic, group II: 20 moderate myopic and group III:20 high myopic eyes. The endothelial cell parameters (endothelial cell density: ECD, hexagonality: Hex, coefficient of variation: CV and central corneal thickness: CTT) were measured by Topcon SP-1P specular microscope for all participants. Cycloplegic refraction, corneal curvature readings and axial length measurement were also assessed.

Results: This study found a statistically significant difference in corneal endothelial parameters in children with different refractive errors. It showed a reduction in endothelial density (ECD) values in the high myopic group (mean =3069.7 ± 372.8) compared to moderate myopic (mean =3146.7 ± 274.7) and emmetropic groups (mean =3343.5 ± 167.3). It also showed a decrease in hexagonality (HEX) and increase of coefficient of variation (CV) in high myopic (mean HEX =65.5 ± 8.2% & mean CV=26.8 ± 3.6% respectively) and moderate myopic (HEX=64.4 ± 4.1% & CV=26.6 ± 2.9%) groups compared to the emmetropic group (HEX=69.7 ± 4.5% & CV=24.1 ± 1.6%).

Conclusion: There were significant changes in corneal endothelial morphology as myopic power increased. There were insignificant differences between high and moderate myopia groups as regards all corneal endothelial parameters. We described a normative endothelial cell parameters in Egyptian children aged 6-15 years that could serve as a valuable baseline for future reference.

Keywords: Cornea, Endothelial cell density, Morphology, Myopic children, Specular microscopy.

INTRODUCTION

The posterior surface of Descemet's membrane, which faces the anterior chamber, is covered by the human corneal endothelium. This monolayer, composed predominantly of non-regenerating hexagonal cells, is metabolically active and essential for maintaining corneal transparency. It achieves this by actively pumping water from the stroma into the aqueous humor, thereby regulating stromal hydration at approximately 70% [(1)].

In contrast to corneal epithelial cells, the corneal endothelial cells (CECs) exhibit a notable absence of mitotic activity, rendering them incapable of self-replication. Consequently, the population of these cells experiences a progressive decline over time, a phenomenon exacerbated by various factors including advancing age, surgical interventions, and traumatic injuries. Furthermore, research has indicated a susceptibility of CECs to alterations in individuals with myopia, particularly those exhibiting high refractive power, defined as less than -6.00 diopters [(2)].

Myopia, a prevalent refractive error characterized by the inability to focus distant objects clearly, represents a common pathological alteration of the eye. Notably, high degrees of myopia are associated with a significantly elevated risk of developing several sight-threatening ocular complications. These complications encompass cataract formation, posterior vitreous detachment, retinal tears and subsequent detachment, increased predisposition to choroidal neovascularization, and myopic macular degeneration. These pathological processes, if left unaddressed, can ultimately culminate in irreversible vision loss, underscoring the importance of understanding the impact of myopia on corneal endothelial cell integrity [(3)]. Despite extensive research, little is understood about how myopia affects the cornea, namely the corneal endothelium. As intra-ocular and refractive surgeries can cause significant corneal endothelial morphological changes. Therefore, preoperative assessment of corneal endothelium in myopic patients is crucial prior to refractive or intraocular surgical procedures. This evaluation enables clinicians to anticipate and mitigate potential postoperative corneal complications [(4)].

Specular microscopy offers a robust methodology for the analysis of corneal endothelial cell density and morphology. This technique, when employed with appropriately calibrated instrumentation, has demonstrated high reliability and reproducibility in assessing the corneal endothelium. Specifically, non-contact specular microscopy provides a non-invasive approach to visualize and quantify the morphological characteristics of the corneal endothelial cell layer. This method facilitates the precise measurement of mean cell density (MCD), the determination of the coefficient of variation (CV) in cell size, and the evaluation of the hexagonal cell distribution. These quantitative parameters collectively serve as a valuable index for assessing the functional integrity and overall health of the corneal endothelial layer [(5)]. Therefore, this study aimed to evaluate corneal endothelial cell density and morphological changes in moderate and high myopic eyes of children aged 6-15 years using specular microscopy.

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PATIENTS AND METHODS

A Prospective study was carried out at the department of ophthalmology at both Alzahraa and Bab-alshaarya, Al-Azhar University Hospitals. A total of 80 eyes of children aged 6 - 15 years old were recruited, 20 eyes were moderate myopic (-3.00 to -6.00) diopter, 20 eyes were high myopic (< -6.00) diopter, and 40 eyes were emmetropic (-0.50 to +0.50 diopter).

Exclusion criteria: Subjects with history of previous contact lens wear, ocular trauma or surgery, ocular diseases (corneal dystrophy, glaucoma, cataract) and systemic diseases like diabetes mellitus.

A comprehensive ophthalmological evaluation was performed for all participants, which included taking a detailed medical, surgical, and ocular history, measuring corneal curvature (Km) and cycloplegic refraction (spherical equivalent, SE) using an auto kerato-refractometer (Topcon KR-800, Tokyo, Japan), assessing best-corrected visual acuity (BCVA), performing a slit-lamp examination, which included fundus biomicroscopy using Volk + 90 D lens and measuring intraocular pressure using an air puff tonometer (Topcon CT-800, Tokyo, Japan). A-scan ultrasound biometry (VuPad, Sonomed Escalon, New York, USA) was used to assess axial length.

A single examiner performed all measurements in automatic mode using a non-contact specular microscope (Topcon SP-1P, Tokyo, Japan) to evaluate corneal endothelial morphology, including cell density (CD), percentage of hexagonality (HEX) & coefficient of variation (COV), and central corneal thickness (CCT). For each eye, three microphotographs were taken, and the average value was determined.

To ensure standardized and consistent visual input, participants were meticulously instructed to maintain sustained visual fixation on the designated object positioned within the confines of the experimental apparatus. This directive was coupled with specific instructions regarding head positioning, wherein subjects were required to comfortably situate their heads, minimizing extraneous movement and maximizing stability. This deliberate configuration aimed to optimize the conditions for accurate data acquisition by controlling for potential variations in visual perception that could arise from inconsistent head placement or fluctuating attentional focus.

In order to preserve a smooth tear film over the cornea and reduce blinking during picture capture, subjects were instructed to conduct quick complete blinking right before the measurements were recorded. Measurements were repeated until images of acceptable quality were obtained, discarding subpar scans caused by eye movement or blinking during the measurement. After automatically analyzing the collected region, the gadget determined the center corneal thickness (CCT) in µm and the average number of cells per 1 mm^2.

The endothelial cell density (ECD, cell/mm^2), population size, and the minimum, maximum, and average cell size of the chosen region were then determined by the microscope's histogram. Additionally, the pleomorphism of endothelial cells was assessed, revealing the percentage of cells that are hexagonal (% HEX) and the coefficient of variation in percentage (% COV). The process was carried out three times, and the ECD, CV, and hexagonality of cells were calculated using the mean of each variable from the three best central corneal images.

Ethical Approval: In adherence to the Declaration of Helsinki, this study received ethical approval from the Ethical Review Committee of Al Azhar University Faculty of Medicine for Girls, Cairo, Egypt. Parental informed consent was obtained from all subjects prior to their enrollment in the study.

Statistical Analysis

Version 24 of the Statistical Package for the Social Sciences (SPSS) was used to analyze the data. Frequencies and percentages are used to report qualitative data, which represent categorical variables. Continuous variables were represented by quantitative data, which were displayed as mean ± standard deviation (SD). By adding up all of the values in a dataset and dividing by the total number of values, the mean, also known as the arithmetic average, was determined. Data dispersion was measured by the standard deviation (SD), which shows how far each data point deviates from the mean. While a big SD denotes a wider range of data, a small SD shows that data points are closely concentrated around the mean. To find out if there were statistically significant differences between the genders in this study's primary variables, independent samples t-tests were employed. The means of several groups were compared using a one-way ANOVA. Then, post hoc analyses were carried out to pinpoint certain group differences. To measure the linear relationship between variables, Pearson's correlation coefficient (r) was computed. Statistical significance was established using a p-value of less than 0.05.

RESULTS

A total of 80 Egyptian children's eyes were examined for corneal endothelial cell characteristics. The average cycloplegic spherical equivalent (SE) was -3.5 ± 4.3D (range: -15.00 to +0.50 D), and the average age of all participants was 11.6 ± 2.8 years (range: 6 to 15 years). There were 49 female participants and 31 male participants. Age, spherical equivalent (SE), corneal curvature (Km), axial length (AL), corneal endothelial parameters (endothelial cell density (ECD), cell hexagonality (HEX) & coefficient of variation in cell size (COV)), and central corneal thickness (CCT) did not differ statistically significantly between the genders (Table 1).

Table (1): Participant demographic profile

Parameters		All participants (n = 80)	Male (n = 31)	Female (n = 49)	P-value
Age (years)	**Mean ±SD**	11.6 ± 2.8	11.1 ± 2.6	12 ± 2.9	0.176
	Range	6 – 15	6 – 15	6 - 15	
SE (D)	**Mean ±SD**	-3.5 ± 4.3	-3.1 ± 4.3	-3.8 ± 4.3	0.456
	Range	-15.00 - 0.5	-11.75 - 0.5	-15.00 - 0.5	
AL(mm)	**Mean ±SD**	23.9 ± 1.5	24 ± 1.7	23.9 ± 1.3	0.745
	Range	22.61 - 28.31	22.61 - 27.91	22.74 - 28.31	
CCT(um)	**Mean ±SD**	519.3 ± 39.5	514.8 ± 37.9	522.1 ± 40.6	0.423
	Range	403 - 592	429 – 592	403 - 578	
ECD Cell/mm^2	**Mean ±SD**	3225.8 ± 283.1	3200.9 ± 283.9	3241.5 ± 284.4	0.536
	Range	2347 - 3827	2347 – 3674	2680 - 3827	
CV %	**Mean ±SD**	25.4 ± 2.8	24.9 ± 2.3	25.7 ± 3.1	0.209
	Range	20 – 35	20 – 30	21 - 35	
HEX %	**Mean ±SD**	67.3 ± 6	68.8 ± 5.5	66.3 ± 6.2	0.072
	Range	50 – 79	55 – 79	50 - 79	
Km (D)	**Mean ±SD**	43.4 ± 1.9	42.9 ± 1.6	43.6 ± 2	0.102
	Range	40 – 48	40.75 - 47.5	40 - 48	

Independent sample t test. Data are expressed as Means ± standard deviation, D =dioptre, AL =axial length, CCT =central corneal thickness, ECD= endothelial cell density, HEX =hexagonality, CV =coefficient of variation, Km = corneal curvature, SE= spherical equivalent.

The mean spherical equivalent (SE) of emmetrope, moderate and high myope were -0.1 ± 0.4D, - 4.1 ± 1.1D and -9.8 ± 2.8 D respectively. There were significant changes in axial length (AL), corneal curvature (Km), corneal endothelial cells (CEC) parameters (ECD, HEX, COV) and central corneal thickness (CCT) between the three refractive groups (Table 2).

Table (2): Comparison of corneal changes between studied groups

Parameters		High myopia (n = 20)	Moderate myopia (n = 20)	Emmetropia (n = 40)	P-value
CCT (µm)	**Mean ±SD**	502 ± 56.8	513.9 ± 40	530.7 ± 22.4	**0.021**
	Range	403 – 592	429 – 574	487 - 578	
ECD (cell/mm^2)	**Mean ±SD**	3069.7 ± 372.8	3146.7 ± 274.7	3343.5 ± 167.3	**< 0.001**
	Range	2347 – 3674	2851 - 3682	3037 - 3827	
CV (%)	**Mean ±SD**	26.8 ± 3.6	26.6 ± 2.9	24.1 ± 1.6	**< 0.001**
	Range	22 – 35	21 – 31	20 - 28	
Hex (%)	**Mean ±SD**	65.5 ± 8.2	64.4 ± 4.1	69.7 ± 4.5	**0.001**
	Range	50 – 77	56 – 72	61 - 79	
SE (D)	**Mean ±SD**	-9.8 ± 2.8	-4.1 ± 1.1	-0.1 ± 0.4	**< 0.001**
	Range	-15.00 : -6.25	-5.75 : -3.00	-0.5 : 0.5	
Km (D)	**Mean ±SD**	44.9 ± 1.9	44.2 ± 1.7	42.2 ± 1	**< 0.001**
	Range	41.5 – 48	41.5 - 47.5	40 - 44.25	
AL (mm)	**Mean ±SD**	26.1 ± 1.3	23.7 ± 0.4	22.9 ± 0.1	**< 0.001**
	Range	24.5 - 28.31	23.14 - 24.4	22.61- 23.12	

Table 2 (ANOVA test).

Table (3) showed no significant differences between high and moderate myopia groups as regards all corneal endothelial parameters, while there was a significant difference as regards axial length, as the more negative spherical equivalent, the longer axial length.

Table (3): Post-hoc test for multiple comparisons between high and moderate myopia groups as regards corneal changes

Parameters		High myopia	Moderate myopia	P-value
CCT(µm)	**Mean ±SD**	502 ± 56.8	513.9 ± 40	0.323
ECD (cell/mm^2)	**Mean ±SD**	3069.7 ± 372.8	3146.7 ± 274.7	0.35
CV %	**Mean ±SD**	26.8 ± 3.6	26.6 ± 2.9	0.758
Hex %	**Mean ±SD**	65.5 ± 8.2	64.4 ± 4.1	0.534
SE (D)	**Mean ±SD**	-9.8 ± 2.8	-4.1 ± 1.1	**< 0.001 ** **
Km (D)	**Mean ±SD**	44.9 ± 1.9	44.2 ± 1.7	0.138
AL(mm)	**Mean ±SD**	26.1 ± 1.3	23.7 ± 0.4	**< 0.001 ** **

Table (4) showed that there were significant differences between moderate myopia and emmetropia groups as regards corneal parameters and axial length except for central corneal thickness (CCT) values. The moderate myopic group had lower endothelial density (ECD), decreased hexagonality (HEX), increased coefficient of variation (CV) and corneal curvature (Km) and longer axial length (AL) compared to emmetropic group.

Table (4): Post-hoc test for multiple comparisons between moderate myopia and emmetropia groups as regards corneal changes

Parameters		Moderate myopia	Emmetropia	P-value
CCT (µm)	Mean ±SD	513.9 ± 40	530.7 ± 22.4	**0.112**
ECD (cell/mm^2)	Mean ±SD	3146.7 ± 274.7	3343.5 ± 167.3	**< 0.007 ***
CV (%)	Mean ±SD	26.6 ± 2.9	24.1 ± 1.6	**0.001 ****
Hex (%)	Mean ±SD	64.4 ± 4.1	69.7 ± 4.5	**0.001 ***
SE (D)	Mean ±SD	-4.1 ± 1.1	-0.1 ± 0.4	**< 0.001 ****
Km (D)	Mean ±SD	44.2 ± 1.7	42.2 ± 1	**< 0.001 ****
AL (mm)	Mean ±SD	23.7 ± 0.4	22.9 ± 0.1	**< 0.001 ****

Table (5) showed significant differences (P-value < 0.001) between high myopia and emmetropia groups as regards all corneal endothelial parameters and axial length. The high myopic had lower endothelial density (ECD), increased coefficient of variation (CV) and corneal curvature (Km), decreased hexagonality (HEX) and corneal thickness (CCT) and longer axial length (AL) compared to emmetropic group.

Table (5): Comparison between high myopia and emmetropia groups as regard Corneal Changes

Parameters		High myopia	Emmetropia	P – value
CCT (µm)	Mean ±SD	502 ± 56.8	530.7 ± 22.4	**0.007 ***
ECD (cell/mm^2)	Mean ±SD	3069.7 ± 372.8	3343.5 ± 167.3	**< 0.001 ****
CV (%)	Mean ±SD	26.8 ± 3.6	24.1 ± 1.6	**< 0.001 ****
Hex (%)	Mean ±SD	65.5 ± 8.2	69.7 ± 4.5	**0.007 ***
SE (D)	Mean ±SD	-9.8 ± 2.8	-0.1 ± 0.4	**< 0.001 ****
Km (D)	Mean ±SD	44.9 ± 1.9	42.2 ± 1	**< 0.001 ****
AL (mm)	Mean ±SD	26.1 ± 1.3	22.9 ± 0.1	**< 0.001 ****

There is a significant correlation between corneal thickness (CCT) and both axial length (AL) and corneal curvature (Km). There is a significant correlation between ECD and both CV and HEX. As the endothelial density (ECD) decreased, the hexagonality (HEX) decreased and the coefficient of variation (CV) in cell size increased. The results also showed that high myopic group had the longest axial length (AL) (mean=26.1 ± 1.3 mm), followed by moderate myopic (mean=23.7 ± 0.4 mm) and emmetropic group (22.9 ± 0.1 mm). The participants with longer axial length were observed to have lower endothelial density (ECD) readings among all refractive groups. In a correlation study between axial length (AL) and other parameters in high myopia group, significant correlations between axial length (AL) with spherical equivalent (SE) and corneal thickness (CCT) were observed. As the more negative refractive error, the longer axial length, and the cornea tended to be thinner. In moderate, myopia group a statistically significant correlation between axial length (AL) and spherical equivalent (SE) was observed.

Table (6): Correlation study between corneal changes and other parameters in high myopia group

Parameters	CCT		ECD		CV		Hex	
	r	p-value	r	p-value	r	p-value	r	p-value
CCT	-----	-----	0.09	0.719	0.32	0.177	-0.13	0.578
ECD	0.09	0.719	-----	-----	**-0.50**	**0.026 ***	**0.49**	**0.029 ***
CV	0.32	0.177	**-0.50**	**0.026 ***	-----	-----	**-0.72**	**< 0.001 ****
Hex	-0.13	0.578	**0.49**	**0.029 ***	**-0.72**	**< 0.001 ****	-----	-----
SE	0.01	0.968	0.03	0.887	-0.27	0.258	0.22	0.351
AL	**0.61**	**0.005 ***	0.15	0.539	0.32	0.165	-0.06	0.815
Km	**-0.53**	**0.017 ***	-0.28	0.236	0.39	0.088	-0.24	0.304

(r): Pearson correlation coefficient.

Table (7) showed a significant correlation only between hexagonality (HEX) and both endothelial density (ECD) and coefficient of variation (CV) in moderate myopic group. In analysis of correlation study of corneal endothelial parameters in emmetropic group showed that there were no statistically significant correlations with regard to spherical equivalent and axial length. Sample of specular microphotographs of participants of the current study taken by specular microscope Topcon SP-1P.

Table (7): Correlation study between corneal changes and other parameters in moderate myopia group

Parameters	CCT		ECD		CV		Hex	
	R	p-value	r	p-value	R	p-value	r	p-value
CCT	-----	-----	0.13	0.581	0.24	0.3	0.17	0.484
ECD	0.13	0.581	-----	-----	0.43	0.061	**-0.62**	**0.004 ***
CV	0.24	0.3	0.43	0.061	-----	-----	**-0.61**	**0.005 ***
Hex	0.17	0.484	**-0.62**	**0.004 ***	**-0.61**	**0.005 ***	-----	-----
SE	-0.02	0.947	-0.16	0.489	-0.37	0.107	0.01	0.955
AL	0.03	0.896	0.07	0.765	0.21	0.379	-0.07	0.784
Km	-0.15	0.543	-0.34	0.146	-0.02	0.931	0.25	0.279

(r): Pearson correlation coefficient.

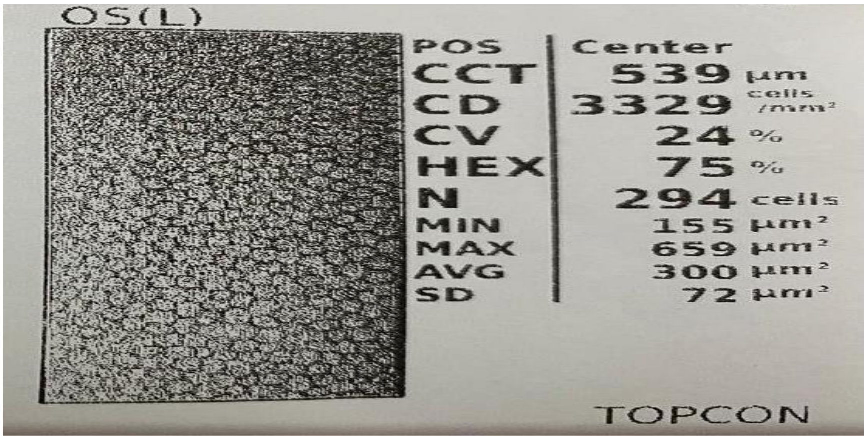

Figure (1): Specular photomicrograph of left eye of 11 years old boy emmetropic child, spherical equivalent + 0.50 D, taken by Topcon SP -1P specular microscope.

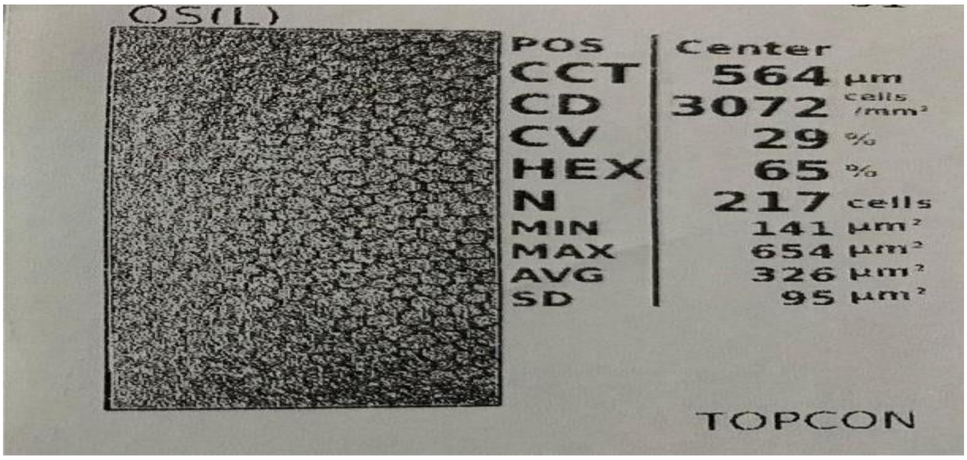

Figure (2): Specular photomicrograph of left eye of 15 years old girl moderate myopic child, spherical equivalent -3.25 D, taken by Topcon SP-1P.

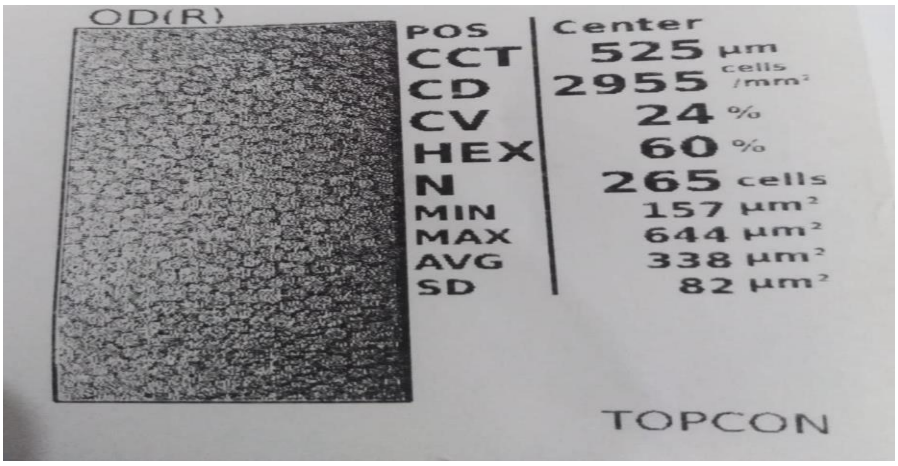

Figure (3): Specular photomicrograph of right eye of 15 years old girl high myopic child, spherical equivalent -8.50 D, taken by Topcon SP-1P specular microscope.

DISCUSSION

The primary objective of this study was to comprehensively analyze corneal endothelial cell parameters in Egyptian children with myopia. By characterizing endothelial cell count and morphology in this age group, we aimed to generate data that could enhance clinical decision-making regarding refractive surgery candidacy and long-term corneal health management in young myopic patients. The determination of clinically significant corneal endothelial cell changes in individuals with different types and degrees of refractive errors necessitates the application of population-specific normative data. This approach minimizes the potential for misinterpretation and ensures that clinical decisions are grounded in relevant demographic benchmarks.

The absence of a statistically significant difference in corneal endothelial cell morphology between genders (ECD, p = 0.536), as demonstrated in this study, is supported by previous research conducted by **Al Farhan *et al.*** [(6)], who found no significant gender-based variations in ECD values among children (p = 0.18).

Concerning corneal endothelial cell (CEC) morphology, we revealed a statistically significant disparity among children exhibiting varying refractive errors. Specifically, the findings demonstrated a notable reduction in endothelial cell density (ECD) within the high myopic group (mean = 3069.7 ± 372.8 cells/mm²) compared to both the moderate myopic group (mean = 3146.7 ± 274.7 cells/mm²) and the emmetropic group (mean = 3343.5 ± 167.3 cells/mm²). This observation aligns with the results reported by **Urban *et al.*** [(8)], who conducted a study on myopic participants aged 13-18 years, aimed at evaluating the potential influence of myopia on CEC characteristics. Their research corroborated the present findings, indicating a significant decrease in ECD in eyes with high myopia, suggesting a potential correlation between high myopia and reduced corneal endothelial cell count [(8)]. This reduction can be clinically significant, as reduced ECD is linked to increased risk of corneal decompensation post-operatively, and can be a predictor of corneal health [(9)]. **Norhani *et al.*** [(2)] documented a clear trend of decreasing endothelial cell density (ECD) with increasing severity of myopia, exhibited a striking resemblance to the observations made in the present study. Specifically, their research revealed that individuals with moderate myopia demonstrated a significantly lower mean ECD, recorded as 3101.24 ± 231.67 cells/mm², when compared to those with mild myopia, who showed a mean ECD of 3251.43 ± 219.88 cells/mm². Furthermore, the emmetropic group, serving as the control, displayed the highest mean ECD, measured at 3344.83 ± 206 cells/mm². This consistent pattern across both studies underscored the potential impact of myopia on corneal endothelial health, suggesting that even moderate levels of myopia may be associated with a measurable reduction in ECD. This observation is clinically significant, as a decrease in ECD can compromise the cornea's ability to maintain its transparency and integrity, potentially leading to complications in the long term, especially in patients undergoing intraocular procedures.

In the present study, there was a decrease in hexagonality (HEX) and increase of coefficient of variation (CV) in high myopic (mean HEX =65.5 ± 8.2% & mean CV=26.8 ± 3.6% respectively) and moderate myopic (HEX=64.4 ± 4.1% & CV=26.6 ± 2.9%) groups compared to the emmetropic group (HEX=69.7 ± 4.5% & CV=24.1 ± 1.6%). The current study's findings are consistent with those of **Norhani *et al.*** [(2)], who examined the morphology of corneal endothelial cells in healthy Chinese-Malaysia children aged 8 to 9 who had mild to moderate myopia and emmetropia. They reported a decrease in hexagonality (HEX) and increase of coefficient of variation (CV) in mild (HEX=56.3 ± 10.86% & CV=43.81 ±8.37% respectively) and moderate myopic (HEX=54.78 ± 10.46% & CV=44.64 ±8.19%) group compared to the emmetropic group (HEX=64.08 ±7.03% & CV=36.58 ± 6.6%).

The results of current study showed a significant correlation between axial length (AL) and refractive error (SE), that high myopic participants had longer axial length, in other words the more myopia, the more association with increase in axial length of the eye. The current study found no correlation between axial length (AL) and endothelial density (ECD) both in moderate (P-value=0.765) and high (P-value 0.539) myopia. Also, there was no correlation between endothelial density (ECD) and refractive error (SE) i.e., degree of myopia (P-value =0.887&0.489) in moderate and high myopic groups respectively. This agrees with the results of **Urban *et al.*** [(7)] who reported same results in a study including myopic children. The results of present study disagree with that of **Norhani *et al.*** [(2)] who reported that there was a correlation (P-value =0.001) between axial length (AL) and both endothelial density (ECD) and degree of myopia (SE).

The current study's findings demonstrated that the central corneal thickness (CCT) values in the group with high myopia (mean =502 ± 56.8) were significantly lower compared to emmetropic group (mean=530.7 ± 22.4). While no significant difference (P-value = 0.112) between moderate myopic (mean =513.9 ± 40) and emmetropic groups.

Also, there was no correlation between refractive error (degree of myopia i.e.SE) and both axial length (AL) and corneal thickness (CCT, P-value =0.947) in moderate myopia. This result of the current study agrees with that of **Norhani *et al.*** [(2)] who reported that no significant correlation (P-value = 0.566) between corneal thickness (CCT) and both axial length (AL) and degree of myopia that observed in their Malaysian children. This finding agrees also with the study by **Tong *et al.*** [(10)] that was conducted among Singaporean children who stated that corneal thickness

(CCT) did not correlate (P-value=0.58) with degree of myopia i.e. refractive error.

In the current study, moderate (mean Km=44.2 ± 1.7) and high myopic (mean=44.9 ± 1.9) groups were observed to have significantly higher corneal curvature compared to emmetropic group (mean=42.2 ± 1). However, the corneal curvature (Km) showed a significant correlation (P-value=0.017) with corneal thickness (CCT) only in high myopic eyes and not in moderate myopia. Corneal curvature (Km) showed insignificant correlation with axial length (AL) and degree of myopia.

CONCLUSION

As the refractive power became more negative, there were notable alterations in the morphology of the corneal endothelium. The corneal endothelial layer in high myopic eyes had lower endothelial density, decreased cell hexagonality and increased variation in cell size compared to moderate myopic and emmetropic eyes. There were insignificant differences between moderate and high myopic groups as regards all corneal endothelial parameters. Additionally, we reported normative endothelium layer values in children from Egypt. The outcomes might be a useful starting point for further research. We suggest more research on how myopia affects the corneal endothelium layer. With a bigger sample size, a wider age range, and longer follow-up periods, future longitudinal research in other age groups and communities may eventually uncover more precise traits of endothelial cells.

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