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The relationship between central corneal thickness and dioptric power of myopic eye

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Abstract
Background: This study aimed to assess the relationship between central corneal thickness (CCT) and the dioptric power of myopic eyes among a selected patient population. Given the increasing prevalence of myopia, understanding biometric factors associated with refractive errors is essential.
Objective: This study aims to investigate the relationship between CCT and diopteric power of the myopic eye.
Methods: A cross-sectional study was conducted among 70 participants, with data collected on spherical (SPH) and cylindrical (CYL) dioptric power, CCT, and visual acuity. Statistical analysis was performed to determine correlations between these parameters.
Results: The majority of participants were female (57.15%), with the most common age group being 26-30 years (45.71%). Most individuals had a CCT between 501-550 µm, with a mean CCT of 532.58±4.67 µm. The distribution of spherical power showed a predominance in the 3.00 to -5.00 D range, and cylindrical power was primarily within the 0.00 to 0.50 D range. No statistically significant correlation was found between CCT and dioptric power.
Conclusion: Our study suggests that CCT is not a significant determinant of myopic refractive error. Other factors such as axial length and corneal curvature may play a more crucial role. Further research with a larger sample size and additional biometric parameters is recommended to explore the underlying mechanisms of myopia progression.

Keywords: Myopia, central corneal thickness, dioptric power, visual acuity, refractive error

Introduction

Central corneal thickness (CCT) is an important indicator of corneal health status. As an estimate of the corneal barrier and endothelial function, CCT is an essential tool in the assessment and management of corneal disease [1]. Moreover, CCT is a measure of corneal rigidity and consequently has an impact on the accuracy of intraocular pressure measurement by applanation tonometry [2]. Numerous studies have demonstrated that thicker corneas with greater rigidity may offer a greater resistance when subjected to applanation, resulting in artificially higher intraocular pressure readings [3, 4]. In addition, with the development of corneal refractive surgery procedures (LASIK) CCT values are of enormous importance during the pre-operative evaluation of the patients as they influence the decision whether or not to perform surgery, the type of recommended procedure, and rate of postoperative complications [5].

The true aetiology of myopia is still unknown, the cornea is responsible for approximately two-thirds of optical refraction and its role in myopia has consequently been studied intensely over the years [6]. Known possible changes in the highly myopic eye are all located in the posterior segment: staphyloma, myopic conus, choroidal atrophy, thinning of the retina and sclera. Changes in the anterior segment associated with myopia are still under debate [7]. The myopic cornea has a steeper central corneal curvature, no correlation between corneal curvature and central corneal thickness (CCT) [8]. The central cornea is not significantly involved in the process of myopic progression. The process by which the myopia progresses does not to a measurable degree influence the central cornea [9]. The myopic eye is known to be longer than the normal emmetropic eye. If this is the result of general growth, one might expect the cornea to have grown to be thinner than is normal, in which case a correlation with body mass index (BMI) might exist. If instead, the myopic eye is larger due to a mechanism similar to that of a balloon being inflated, one would expect the cornea to be thinner than normal, according to a simple ‘stretching theory’. An emmetropic eye could then be compared to a sphere and a myopic eye to a prolate spheroid [10].

Myopia is a common refractive error, especially in Asian countries undergoing rapid development [11]. Myopia prevalence could be as high as 95% in medical school students [12]. Studies that have attempted to investigate the effect of myopia on CCT have reported conflicting results. This study aims to investigate the relationship between CCT and the diopteric power of myopic eye.

Methods

Study Design and Population

This Cross-sectional study was conducted at the Department of Cornea, National Institute of Ophthalmology and Hospital Bangladesh Eye Hospital Malibagh Ltd in Bangladesh from January 2023 to December 2023. The study population consisted of 70 myopic patients aged 11 to 30 years who attended the outpatient department for refractive error correction. Patients were purposively selected based on the following inclusion criteria: spherical myopia between -0.50 and -15.00 diopters (D), cylinder of 4D or less, and no contact lens use. Exclusion criteria included keratoconus, suspected corneal dystrophy, any known ocular pathology, or previous ocular surgery.

Data Collection Procedures: Informed written consent was obtained from each participant. After meeting the inclusion criteria, a detailed history was taken, and data was recorded in a pre-designed proforma. This structured questionnaire collected information on age, sex, duration of myopia, family history, and best-corrected visual acuity with spherical and cylindrical diopteric power. Central corneal thickness (CCT) was measured using ultrasonic pachymetry, and refractive error was assessed with a NIDEK A 310 auto refractometer. Refractive error was further verified by retinoscopy and subjective refraction.

Outcome Variables

The main outcome variables were

- Central corneal thickness (CCT) in micrometres (µm)
- Amount of myopia in diopters (D)
- Confounding variables included age, sex, and visual acuity.

Data Analysis

Data sheets were scrutinized to ensure data quality and identify and correct any errors. Descriptive analysis was performed for age, sex, and visual acuity. A correlation test was conducted between CCT and diopteric power. Statistical significance was set at a p-value of ≤ 0.05 with a 95% confidence level.

Results

Table 1 presents the distribution of the 70 study participants by age group and sex. The majority of the participants (57.15%) were female. The largest age group represented was 26-30 years, comprising 45.71% of the total study population. Notably, the 26-30 age group also had the largest proportion of female participants (28.57%). The smallest age group was 11-15 years, with only 5 participants (7.13% of the total).

Table 1: Distribution of study population according to the Age group. (n=70)

Age group	Male	Female
11-15	02(2.85%)	03(4.28%)
16-20	3(4.28%)	05(7.15%)
21-25	13(18.58%)	12(17.15%)
26-30	12(17.14%)	20(28.57%)
Total	30(42.85%)	40(57.15%)

Figure 1 presents the occupational distribution within the study population using a 3D exploded pie chart. The majority of participants (55%) are engaged in service-related professions, indicating a predominant representation from this sector. Business professionals constitute 30% of the population, followed by teachers at 10%. The remaining 5% fall under the "others" category, encompassing occupations not explicitly classified. This distribution suggests a diverse occupational background among the study participants, with a notable predominance of service professionals.

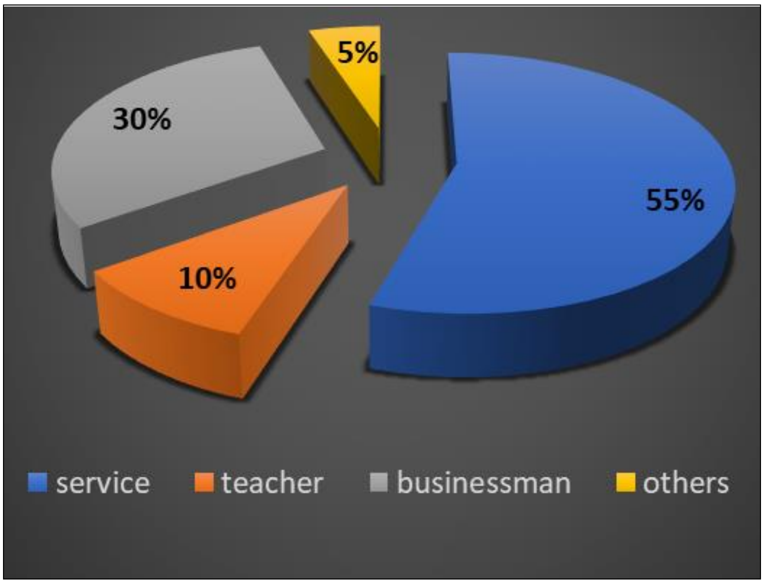

Fig 1: Distribution of occupation in the study population

Table 2 presents the distribution of diopteric power (SPH) among male and female participants. The majority of individuals fall within the 3.00-5.00 diopter range, with 20.00% of males and 28.57% of females affected. The 6.00-8.00 diopter range is the second most prevalent, observed in 14.28% of males and 20.00% of females. A smaller proportion of participants have higher diopteric power, with 7.14% of males and 4.29% of females in the 9.00-12.00 diopter range. The least common category, 13.00-15.00 diopters, includes 1.43% of males and 4.29% of females. These findings indicate that lower diopteric power is more prevalent among both genders, with a slightly higher percentage of females in the lower ranges compared to males.

Table 2: Distribution of Diopteric Power (SPH)

Dioptoric Power	Male	Female
3.00-5.00	14(20.00%)	20(28.57%)
6.00-8.00	10(14.28%)	14(20.00%)
9.00-12.00	05(7.14%)	03(4.29%)
13.00-15.00	01(1.43%)	03(4.29%)

Table 3 illustrates the distribution of diopteric power (CYL) among the study population (N=70), categorized by gender. The majority of participants fall within the 0.00-0.50 diopter range, accounting for 17.15% of males and 25.72% of females, indicating a higher prevalence in females. The 0.51-1.00 diopter range follows, observed in 14.28% of males and 17.15% of females. A smaller proportion of individuals have higher cylindrical power, with 4.28% of males and 10.00% of females in the 1.01-1.50 diopter category. The 1.51-2.00 diopter range is the least common, affecting 7.14% of males and 4.28% of females. These findings suggest that lower cylindrical power is more prevalent among both genders, with a slightly higher proportion of females in the lower ranges.

Table 3: Distribution of Diopteric Power (CYL) N=70

Dioptoric Power	Male	Female
0.00-0.50	12(17.15%)	18(25.72%)
0.51-1.00	10(14.28%)	12(17.15%)
1.01-1.50	03(4.28%)	07(10.00%)
1.51-2.00	05(7.14%)	03(4.28%)

Table 4 presents the distribution of central corneal thickness (CCT) among the study participants (N=70), stratified by gender. The majority of participants exhibit a CCT within the 501-550 µm range, comprising 20.00% of males and 25.72% of females. This is followed by the 551-600 µm range, observed in 12.85% of males and 18.58% of females. A smaller proportion falls within the 451-500 µm category (8.57% of males and 10.00% of females), whereas the 401-450 µm range is the least prevalent, affecting 1.43% of males and 2.85% of females. The mean CCT for the study population is 532.58±4.67 µm, indicating relatively uniform corneal thickness across participants.

Table 4: Distribution of Central corneal thickness of the study patients. N=70

CCT µm	Male	Female
401—450	01(1.43%)	02(2.85%)
451—500	06(8.57%)	07(10.00%)
501—550	14(20.00%)	18(25.72%)
551—600	09(12.85%)	13(18.58%)
Mean CCT 532.58±4.67		

Table 5 presents the distribution of best corrected visual acuity (BCVA) among the study participants (N=70), categorized by gender. The majority of participants exhibit a BCVA of 6/6-6/5, comprising 34.29% of males and 47.15% of females, indicating a higher proportion of females with near-normal vision. This is followed by the 6/12-6/9 category, observed in 4.28% of males and 7.14% of females. A smaller proportion of participants fall within the 6/24-6/18 range (2.85% of males and 1.43% of females), while the 6/60-6/36 category is the least common, affecting 1.43% of both males and females. These findings suggest that a significant proportion of the study population maintains good visual acuity with appropriate correction.

Table 5: Distribution of best corrected visual acuity. N=70

Visual acuity	Male	Female
6/60 to 6/36	01(1.43%)	01(1.43%)
6/24 to 6/18	02(2.85%)	01(1.43%)
6/12 to 6/9	03(4.28%)	05(7.14%)
6/6-6/5	24(34.29%)	33(47.15%)

Table 6 illustrates the distribution of uncorrected visual acuity (UCVA) among the study participants (N=70), categorized by gender. The majority of individuals fall within the 6/60-6/36 visual acuity range, accounting for 20.00% of males and 25.72% of females, indicating a significant proportion with moderate visual impairment without correction. This is followed by the 6/24-6/18 category, observed in 17.14% of males and 22.86% of females. A smaller proportion of participants have UCVA in the 6/12-6/9 range (4.28% of males and 7.14% of females), while the 6/6-6/5 category is the least common, affecting only 1.43% of both males and females. These findings suggest that a considerable portion of the study population experiences reduced visual acuity in the absence of corrective measures**.**

Table 6: Distribution of un-corrected visual acuity. N=70

Visual acuity	Male	Female
6/60 to 6/36	14(20.00%)	18(25.72%)
6/24 to 6/18	12(17.14%)	16(22.86)
6/12 to 6/9	03(4.28%)	05(7.14%)
6/6-6/5	01(1.43%)	01(1.43%)

Discussion

This study aimed to evaluate the relationship between central corneal thickness (CCT) and the dioptric power of myopic eyes among a selected group of patients. Our findings indicate that while there were observable trends in the distribution of spherical and cylindrical dioptric power across different CCT ranges, no statistically significant correlation was found between these parameters. These results suggest that factors other than CCT may play a more dominant role in determining myopic refractive errors.

Our demographic analysis revealed that the majority of the study participants were female (57.15%), with the largest age group being 26-30 years (45.71%). These findings are in line with previous studies that have shown a higher prevalence of myopia among young adults, particularly females, which may be attributed to differences in genetic predisposition and environmental influences such as prolonged near-work and educational workload [13].

The distribution of spherical dioptric power (SPH) showed that most participants fell within the -3.00 to -5.00 D range, with a slightly higher prevalence among females. Similar patterns have been reported in studies conducted in South Asian populations, suggesting a tendency for lower myopic

power in these regions compared to more highly urbanized settings [14]. Cylindrical dioptric power (CYL) followed a similar pattern, with the majority of individuals having mild astigmatism (-0.00 to -0.50 D), a trend that has been consistently observed in other studies analyzing refractive errors among young adults [15].
In terms of CCT distribution, most participants had a corneal thickness within the 501-550 µm range, with a mean CCT of 532.58±4.67 µm. This finding is comparable to previous studies that reported average CCT values within a similar range in South Asian populations. Research by Hashemi *et al.* (2009) [13] and Wang *et al.* (2017) [14] also found no significant association between CCT and myopia severity, supporting our results. These studies suggest that while thinner corneas are often linked to conditions such as keratoconus, they may not be a primary determinant of myopic progression in otherwise healthy individuals.
Visual acuity analysis showed that a significant proportion of participants maintained good best-corrected visual acuity (BCVA) of 6/6-6/5, particularly among females. However, uncorrected visual acuity (UCVA) results indicated that many individuals experienced moderate visual impairment without correction, with a large proportion falling in the 6/60-6/36 range. This underscores the importance of timely refractive correction to prevent functional visual impairment [16].
Our study findings align with previous research suggesting that while CCT is an important biometric parameter, it does not have a significant impact on refractive error determination in myopic eyes. Similarly, a study found no significant correlation between CCT and spherical equivalent refraction in a large cohort of myopic patients [16].

Limitations and Future Directions
While our study provides valuable insights, certain limitations should be acknowledged. The relatively small sample size (N=70) may limit the generalizability of our findings. Additionally, other biometric factors such as axial length and anterior chamber depth were not assessed, which could have provided a more comprehensive understanding of refractive error development. Future studies with larger sample sizes and more extensive ocular biometric evaluations are needed to further investigate the role of CCT in myopia progression.

Conclusion
Our study found no statistically significant correlation between CCT and the dioptric power of myopic eyes. These findings suggest that other factors, such as axial length and corneal curvature, may play a more substantial role in determining refractive errors. Given the increasing prevalence of myopia, especially in younger populations, further research is needed to explore additional determinants influencing myopic progression and visual acuity outcomes.

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