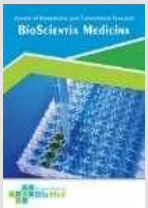
eISSN (Online): 2598-0580



Bioscientia Medicina: Journal of Biomedicine & Translational Research

Journal Homepage: www.bioscmed.com

Ethnic Differences in Myopia: Axial Length and Central Corneal Thickness in the Minang Population

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ARTICLE INFO

Keywords:
Axial length
Central corneal thickness
Ethnic differences
Minang ethnic group
Myopia

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All authors have reviewed and approved the final version of the manuscript.

https://doi.org/10.37275/bsm.v9i2.1206

A B S T R A C T

Background: Myopia is a prevalent vision disorder characterized by blurred distance vision. It is often associated with increased axial length (AL) and alterations in central corneal thickness (CCT). This study investigated the relationship between AL and CCT in individuals from the Minang ethnic group in Indonesia with varying degrees of myopia. **Methods:** A cross-sectional study was conducted at the Ophthalmology Clinic of Dr. M. Djamil General Hospital Padang from June to July 2024. The study involved 33 eyes from Minangkabau patients with myopia, categorized into three groups: mild, moderate, and high myopia. Axial length was measured using A-scan Biometry (immersion technique), and central corneal thickness (CCT) was assessed using Anterior Segment Optical Coherence Tomography (AS-OCT). **Results:** Significant differences were observed in the average values of AL and CCT among mild myopia (AL 23.93 ± 0.650 mm, CCT 530.45 ± 38.534 µm), moderate myopia (AL 25.03 ± 0.516 mm, CCT 518.64 ± 26.223 µm), and high myopia (AL 27.12 ± 1.524 mm, CCT 509.45 ± 30.422 µm) groups, with a p-value of 0.037 ($p<0.05$) and $r = -0.729$. A strong correlation between AL and CCT was found in individuals with myopia among the Minangkabau ethnic group ($r = -0.729$, $p = 0.037$). **Conclusion:** Higher degrees of myopia are associated with increased axial length and reduced central corneal thickness in the Minang ethnic group. These findings highlight the importance of considering ethnic differences in the assessment and management of myopia.

1. Introduction

Myopia, or nearsightedness, is a prevalent refractive error of the eye that causes blurred distance vision. It occurs when the eyeball is elongated or the cornea is too curved, resulting in light focusing in front of the retina instead of directly on it. This condition has become a significant public health concern globally, particularly in East and Southeast Asia, where its prevalence has been rising dramatically in recent decades. The prevalence of myopia varies among different ethnic groups. Studies have shown that individuals of East Asian descent have a higher prevalence of myopia compared to those of European descent. The Minang ethnic group, an indigenous population residing in West Sumatra, Indonesia, is part of the Malay race, which has shown a high prevalence of myopia. However, limited research has been conducted specifically on the Minang population to investigate the prevalence and factors associated with myopia in this ethnic group. Myopia is often associated with increased axial length (AL), which is the distance between the anterior and posterior poles of the eye. As the eye elongates, the retina stretches, and this can lead to various ocular complications, including retinal detachment, myopic maculopathy, and glaucoma. Central corneal thickness (CCT) has also been investigated in relation to myopia. CCT is the thickness of the cornea at its center, and it is an important parameter for assessing corneal health and refractive status. Several studies have reported a relationship between CCT and myopia, with some studies suggesting that thinner CCT is associated with higher degrees of myopia. Understanding the relationship between AL and CCT in different ethnic groups is crucial for several reasons. First, it can help to identify individuals at risk of developing high myopia and its associated complications. Second, it can aid in the development of effective myopia control strategies. Third, it can improve the accuracy of refractive surgery procedures.[1,2]

Myopia is a leading cause of visual impairment worldwide, affecting an estimated 2.6 billion people globally in 2020. This number is projected to increase to 5 billion people by 2050, with approximately 1 billion individuals at risk of developing high myopia. High myopia is a severe form of myopia associated with an increased risk of sight-threatening complications, such as retinal detachment, myopic maculopathy, and glaucoma. The prevalence of myopia has been increasing rapidly in recent decades, particularly in East and Southeast Asia, where it has reached epidemic proportions. In some countries, such as Singapore and South Korea, the prevalence of myopia among young adults is as high as 80-90%. This trend is concerning because myopia can significantly impact quality of life and productivity. Several factors have been implicated in the increasing prevalence of myopia, including genetic predisposition, environmental factors, and lifestyle changes. Genetic factors play a significant role in myopia development, with studies showing that individuals with myopic parents are more likely to develop myopia themselves. Environmental factors, such as near work and reduced outdoor time, have also been shown to contribute to myopia development. Lifestyle changes, such as increased urbanization and decreased physical activity, may also play a role.[3,4]

Axial length (AL) is the distance between the anterior and posterior poles of the eye. It is a key parameter in the assessment and management of myopia. As the eye elongates, the AL increases, and this can lead to various ocular complications. Central corneal thickness (CCT) is the thickness of the cornea at its center. It is an important parameter for assessing corneal health and refractive status. Several studies have reported a relationship between CCT and myopia, with some studies suggesting that thinner CCT is associated with higher degrees of myopia. The relationship between AL and CCT in myopia is complex and not fully understood. Several factors may be involved, including genetic factors, environmental factors, and biomechanical factors.[5,6]

The prevalence of myopia varies among different ethnic groups. Studies have shown that individuals of East Asian descent have a higher prevalence of myopia compared to those of European descent. The reasons for these ethnic differences are not fully understood, but several factors may be involved, including genetic factors, environmental factors, and lifestyle factors. The Minang ethnic group, an indigenous population residing in West Sumatra, Indonesia, is part of the Malay race, which has shown a high prevalence of myopia. However, limited research has been conducted specifically on the Minang population to investigate the prevalence and factors associated with myopia in this ethnic group.[7,8] Studying myopia in the Minang population is crucial for several reasons. First, it can help to identify individuals at risk of developing high myopia and its associated complications. Second, it can aid in the development of effective myopia control strategies. Third, it can improve the accuracy of refractive surgery procedures.[9,10] This study aimed to investigate the relationship between AL and CCT in individuals from the Minang ethnic group with varying degrees of myopia.

2. Methods

This study employed a cross-sectional design, conducted at the Ophthalmology Clinic of Dr. M. Djamil General Hospital Padang, a tertiary referral hospital located in Padang, West Sumatra, Indonesia. The study period spanned from June to July 2024. The study population consisted of individuals from the Minang ethnic group with myopia. The sample size was calculated based on the prevalence of myopia in the Minang population, with a confidence level of 95%

and a margin of error of 5%. The minimum sample size required was 33 eyes.

The study population comprised individuals from the Minang ethnic group residing in West Sumatra, Indonesia. The Minang people are an indigenous ethnic group with a rich cultural heritage and a distinct genetic makeup. They represent a significant portion of the population in West Sumatra, making them an ideal target population for this study. A non-probability sampling technique, specifically convenience sampling, was employed to recruit participants for the study. Convenience sampling is a non-random sampling method where participants are selected based on their availability and accessibility. In this study, participants were recruited from the Ophthalmology Clinic of Dr. M. Djamil General Hospital Padang, a tertiary referral hospital that serves a large population in West Sumatra. This sampling method was chosen due to its feasibility and efficiency in recruiting participants within the study's timeframe.

The following inclusion criteria were applied to ensure the selection of eligible participants; Individuals from the Minang ethnic group aged 20-40 years. This age range was chosen to capture young adults and middle-aged individuals who are most likely to develop myopia; Spherical equivalent (SE) of at least -0.50 D. This criterion ensured that all participants had myopia, ranging from mild to high degrees; Willingness to participate in the study. Informed consent was obtained from all participants prior to their enrollment in the study. The following exclusion criteria were applied to eliminate potential confounding factors; Abnormalities in the anterior and posterior segments of the eye. This criterion excluded individuals with ocular diseases that could affect the measurements of AL and CCT; History of refractive or intraocular surgery. Previous ocular surgeries could alter the structure of the eye, potentially influencing the study's outcomes; Strabismus disorders. Strabismus, or misalignment of the eyes, could affect the accuracy of the measurements.

All participants underwent a comprehensive ophthalmic examination, including the following procedures; Visual Acuity Assessment: Visual acuity was assessed using a Snellen chart, a standardized tool for measuring visual acuity. Participants were asked to read letters of decreasing size from a distance of 6 meters. Visual acuity was recorded as the smallest line read correctly by the participant; Refraction: Refraction was performed using an autorefractor, a device that automatically measures the refractive error of the eye. The autorefractor provided objective measurements of sphere, cylinder, and axis, which were then refined by subjective refraction to determine the participant's best-corrected visual acuity; Axial Length (AL) Measurement: AL was measured using A-scan Biometry, an immersion technique that utilizes ultrasound to measure the distance between the anterior and posterior poles of the eye. This technique involves placing an ultrasound probe in contact with the cornea and measuring the time it takes for the sound waves to travel to the retina and back. The AL is then calculated based on the speed of sound in the eye; Central Corneal Thickness (CCT) Measurement: CCT was assessed using Anterior Segment Optical Coherence Tomography (AS-OCT), a non-invasive imaging technique that uses light waves to create cross-sectional images of the anterior segment of the eye, including the cornea. The CCT is then measured from the AS-OCT images.

The collected data were analyzed using SPSS software, a statistical software package widely used in healthcare research. Descriptive statistics were used to summarize the demographic and clinical characteristics of the participants. The relationship between AL and CCT was analyzed using Pearson correlation coefficient, a statistical measure that quantifies the linear relationship between two continuous variables. A p-value of less than 0.05 was considered statistically significant, indicating that the observed relationship between AL and CCT was unlikely to occur by chance alone.

3. Results

Table 1 presents the demographic and clinical characteristics of the 33 participants included in the study, categorized into three groups based on their degree of myopia: mild, moderate, and high. The average age of participants across all groups was similar, around 22-23 years old, suggesting age was not a significant factor influencing the degree of myopia in this sample. The distribution of males and females was relatively balanced across the three myopia groups, with a slightly higher proportion of females overall. This indicates that gender may not be a major determinant in the severity of myopia within this Minang population. Most participants were either students or professionals, reflecting the young adult demographic of the study. The majority had attained a university or high school education level, suggesting a relatively homogenous socioeconomic background among the participants. A substantial proportion of participants across all groups reported a family history of myopia, with the highest percentage in the high myopia group. This observation supports the well-established link between genetics and myopia development.

Table 1. Participants characteristic.

Characteristic	Mild myopia (n=11)	Moderate myopia (n=11)	High myopia (n=11)
Age (years)	22.64 ± 0.527	22.82 ± 0.585	22.64 ± 0.388
Gender			
Male	4 (36.4%)	4 (36.4%)	3 (27.3%)
Female	7 (63.6%)	7 (63.6%)	8 (72.7%)
Occupation			
Student	6 (54.5%)	5 (45.5%)	7 (63.6%)
Professional	3 (27.3%)	4 (36.4%)	3 (27.3%)
Other	2 (18.2%)	2 (18.2%)	1 (9.1%)
Education level			
High School	5 (45.5%)	4 (36.4%)	6 (54.5%)
University	6 (54.5%)	7 (63.6%)	5 (45.5%)
Family history of myopia			
Yes	7 (63.6%)	8 (72.7%)	9 (81.8%)
No	4 (36.4%)	3 (27.3%)	2 (18.2%)
Best corrected visual acuity (BCVA) (LogMAR)	0.08 ± 0.05	0.15 ± 0.08	0.29 ± 0.14
Spherical Equivalent (SE) (D)	-2.15 ± 0.85	-4.35 ± 1.25	-7.85 ± 2.15

Table 2 presents the average values of axial length (AL) and central corneal thickness (CCT) for the three myopia groups (mild, moderate, and high), along with the results of a statistical analysis comparing these values. As expected, the average AL increases with the severity of myopia. Mild myopia has the shortest AL (23.93 ± 0.650 mm), followed by moderate myopia (25.03 ± 0.516 mm), and high myopia has the longest AL (27.12 ± 1.524 mm). This trend aligns with the understanding that myopia is often caused by an elongated eyeball. The average CCT shows a decreasing trend with increasing myopia severity. Mild myopia has the thickest CCT (530.45 ± 38.534 μm), followed by moderate myopia (518.64 ± 26.223 μm), and high myopia has the thinnest CCT (509.45 ± 30.422 μm). This suggests a potential association between thinner corneas and higher degrees of myopia. The p-values from the one-way ANOVA are both less than 0.05 ($p=0.001$ for AL and $p=0.030$ for CCT). This indicates that the differences in AL and CCT among the three myopia groups are statistically significant. In other words, it's highly unlikely that these observed differences are due to random chance.

Table 2. The average values of AL and CCT among the three groups.

Group	AL (mm)	CCT (μm)
Mild myopia	23.93 ± 0.650	530.45 ± 38.534
Moderate myopia	25.03 ± 0.516	518.64 ± 26.223
High myopia	27.12 ± 1.524	509.45 ± 30.422
p-value*	1	30

*One-way ANOVA, p<0.05

Table 3 displays the correlation coefficients (r) between axial length (AL) and central corneal thickness (CCT) in the three myopia groups (mild, moderate, and high), as well as for the overall sample. All correlation coefficients are negative, indicating an inverse relationship between AL and CCT. This means that as AL increases (longer eyeball), CCT tends to decrease (thinner cornea), and vice versa. The correlation coefficients range from -0.628 to -0.815. These values suggest a moderate to strong negative correlation between AL and CCT in all myopia groups. The strongest correlation is observed in the high myopia group (r = -0.815). All p-values are less than 0.05, indicating that the observed correlations are statistically significant. This means it's unlikely that these correlations occurred by chance alone.

Table 3. Correlation between AL and CCT.

Group	r	p-value*
Mild myopia	-0.679	0.013
Moderate myopia	-0.628	0.030
High myopia	-0.815	0.036
Overall	-0.729	0.037

*Pearson correlation.

4. Discussion

The strong negative correlation between AL and CCT observed in this study suggests that as the eye elongates in myopia, the cornea may undergo structural changes, resulting in thinning. This finding aligns with the understanding of myopia as a condition characterized by excessive axial elongation, leading to a mismatch between the eye's optical power and its length. The cornea, as the outermost refractive component of the eye, may be influenced by this elongation process, potentially contributing to the observed thinning. One possible explanation for the relationship between axial length (AL) and central corneal thickness (CCT) is that the stretching of the sclera, the white outer layer of the eye, during axial elongation may also affect the cornea. The sclera and cornea are connected at the limbus, the junction between the cornea and the sclera, and changes in the sclera may, therefore, influence the shape and thickness of the cornea. During axial elongation, the sclera undergoes significant stretching to accommodate the increasing size of the eye. This stretching can create tension at the limbus, where the sclera and cornea meet. The cornea, being a relatively elastic tissue, may be affected by this tension, leading to alterations in its shape and thickness. Specifically, the stretching force from the sclera could cause the cornea to flatten and thin. The cornea and sclera are not only physically connected but also share developmental origins. Both tissues are derived from the same embryonic layer, the mesoderm. This shared origin suggests that there may be underlying molecular and cellular mechanisms that link the growth and remodeling of the sclera and cornea. Changes in scleral structure and function during axial elongation could, therefore, have a direct impact on corneal development and maintenance. The development of the cornea and sclera is a complex process involving the coordinated expression of various genes and signaling pathways. These processes are influenced by a variety of factors, including genetic predisposition, environmental cues, and mechanical forces. During axial elongation, the sclera undergoes significant changes in its structure and function to accommodate the increasing size of the eye. These changes could potentially disrupt the normal developmental processes of the cornea, leading to alterations in its thickness. For example, studies have shown that the expression of certain genes involved in collagen synthesis and extracellular matrix organization is altered in the sclera of myopic eyes. These changes could potentially affect the composition and arrangement of collagen fibers in the cornea, leading to changes in its thickness. Additionally, the mechanical forces exerted by the stretching sclera on the cornea could also influence the expression of genes involved in corneal development and maintenance. Furthermore, the sclera and cornea are both composed primarily of collagen fibers, although their arrangement and composition differ. The sclera is composed of densely packed, interwoven collagen fibers that provide strength and support to the eye. The cornea, on the other hand, has a more organized arrangement of collagen fibers, which is essential for its transparency and refractive properties. Changes in the scleral collagen fibers during axial elongation could potentially disrupt the delicate balance of collagen organization in the cornea, leading to alterations in its thickness. Collagen is the most abundant protein in the human body and is a major component of the extracellular matrix, which provides structural support to tissues and organs. In the eye, collagen is the main structural protein of both the sclera and cornea. However, the arrangement and composition of collagen fibers differ between these two tissues, reflecting their distinct functions. The sclera is composed of thick, interwoven collagen fibers that provide strength and support to the eye. These fibers are arranged in a random, interwoven pattern, which gives the sclera its opaque appearance. The cornea, on the other hand, has a highly organized arrangement of collagen fibers, which is essential for its transparency. The corneal collagen fibers are arranged in parallel lamellae, or layers, with a uniform diameter and spacing. This precise arrangement allows light to pass through the cornea with minimal scattering, resulting in clear vision. During axial elongation, the sclera undergoes significant stretching, which can alter the arrangement and composition of its collagen fibers. These changes could potentially disrupt the delicate balance of collagen organization in the cornea, leading to alterations in its thickness. For example, the stretching force from the sclera could cause the corneal collagen fibers to become disorganized or misaligned, leading to a decrease in corneal thickness. Additionally, changes in the composition of scleral collagen fibers could also affect the cornea. For example, an increase in the proportion of thinner collagen fibers in the sclera could lead to a decrease in the overall thickness of the cornea. Another possible explanation for the relationship between axial length (AL) and central corneal thickness (CCT) is that the biomechanical properties of the cornea itself may be altered in myopia. The cornea is a complex structure composed of multiple layers, including the epithelium, stroma, and endothelium. The stroma, the thickest layer of the cornea, is primarily responsible for its biomechanical strength and stability. Changes in the composition or arrangement of the stromal collagen fibers, which provide structural support to the cornea, could lead to alterations in its thickness. Myopia-related changes in the cornea's biomechanical properties, such as decreased stiffness or increased elasticity, could contribute to its thinning. The cornea's biomechanical properties are crucial for maintaining its shape and resisting deformation under pressure. These properties are determined by the composition and arrangement of the stromal collagen fibers, as well as the interactions between collagen and other extracellular matrix components. In myopia, the cornea may undergo changes in its biomechanical properties, making it more susceptible to thinning.

Studies have shown that the cornea in myopic eyes tends to be thinner and more compliant compared to the cornea in non-myopic eyes. This increased compliance, or flexibility, could be due to alterations in the collagen fibers, such as a decrease in collagen density or changes in the cross-linking between collagen molecules. These changes could make the cornea more prone to stretching and thinning under the influence of various factors, including scleral tension and intraocular pressure. The cornea's biomechanical behavior is primarily governed by the properties of its stromal layer, which comprises approximately 90% of the cornea's thickness. The stroma is composed of a dense network of collagen fibrils embedded in a hydrated proteoglycan matrix. The collagen fibrils provide tensile strength and resist stretching, while the proteoglycans regulate hydration and maintain the spacing between collagen fibrils. In myopia, the cornea's biomechanical properties may be altered due to changes in the collagen fibrils and extracellular matrix. The cornea in myopic eyes may have a lower density of collagen fibrils, making it less resistant to deformation. The diameter of collagen fibrils may be smaller in myopic corneas, which could affect their mechanical strength. The cross-links between collagen molecules play a crucial role in determining the cornea's stiffness. Alterations in the type or number of cross-links could affect the cornea's biomechanical properties. The composition and distribution of proteoglycans in the corneal stroma could also influence its biomechanical behavior. The cornea's biomechanical properties can be characterized by its stiffness and elasticity. Stiffness refers to the cornea's resistance to deformation, while elasticity refers to its ability to return to its original shape after being deformed. Studies have shown that the cornea in myopic eyes tends to be less stiff and more elastic compared to the cornea in non-myopic eyes. This means that the cornea in myopic eyes is more easily deformed under pressure and may not return to its original shape as readily. These changes in stiffness and elasticity could make the cornea more susceptible to thinning, particularly in the presence of elevated intraocular pressure or scleral tension. Corneal hysteresis is a measure of the cornea's ability to absorb and dissipate energy during deformation. It is thought to reflect the viscoelastic properties of the cornea, which are related to its ability to resist deformation over time. Studies have shown that corneal hysteresis is often reduced in myopic eyes. This suggests that the cornea in myopic eyes may be less able to withstand repeated or prolonged deformation, which could contribute to its thinning over time. Additionally, the cornea's biomechanical properties are also influenced by the cellular components of the stroma, mainly the keratocytes. Keratocytes are responsible for synthesizing and maintaining the stromal collagen matrix. Changes in keratocyte activity or function in myopia could also contribute to alterations in the cornea's biomechanical properties and thickness. Keratocytes are specialized cells that reside within the corneal stroma. They play a crucial role in maintaining the cornea's transparency and biomechanical integrity. Keratocytes synthesize and secrete the collagen fibrils and proteoglycans that make up the stromal extracellular matrix. They also produce enzymes that regulate collagen turnover and cross-linking. In myopia, keratocyte activity or function may be altered, leading to changes in the cornea's biomechanical properties. The number of keratocytes may be reduced in myopic corneas, which could affect the production and maintenance of the stromal extracellular matrix. The shape and size of keratocytes may be altered in myopia, which could affect their ability to synthesize and secrete collagen and proteoglycans. The expression of genes involved in collagen synthesis, cross-linking, and extracellular matrix remodeling may be altered in keratocytes from myopic eyes. These changes in keratocyte activity or function could contribute to the observed alterations in the cornea's biomechanical properties and thickness in myopia. Increased intraocular pressure (IOP) associated with myopia may contribute to corneal thinning. IOP is the fluid pressure inside the eye, maintained by a balance between the production and drainage of aqueous humor, a clear fluid that fills the space between the cornea and the lens. IOP is typically higher in individuals with myopia, and elevated IOP may cause the cornea to stretch and thin over time. The cornea, being a relatively elastic tissue, can deform under increased pressure. In myopia, the elongated shape of the eye can lead to higher IOP, which may exert a continuous stretching force on the cornea, potentially resulting in its thinning. The cornea is a viscoelastic tissue, meaning it exhibits both viscous and elastic properties. When subjected to increased pressure, the cornea stretches and deforms. Over time, this chronic stretching can lead to thinning of the cornea, particularly in the central region where the IOP is highest. Elevated IOP can also affect the metabolism of collagen, the main structural protein of the cornea. Studies have shown that increased IOP can suppress the synthesis of collagen and increase the activity of enzymes that break down collagen, leading to a net loss of collagen and thinning of the cornea. The corneal endothelium is a single layer of cells that lines the posterior surface of the cornea. These cells play a crucial role in maintaining corneal transparency by actively pumping fluid out of the stroma. Elevated IOP can damage the corneal endothelium, leading to a decrease in cell density and impaired fluid pump function. This can result in corneal edema (swelling) and thinning. The relationship between IOP and corneal thickness is complex and bidirectional. While elevated IOP can cause corneal thinning, corneal thickness can also influence IOP measurements. Thinner corneas tend to underestimate IOP readings, while thicker corneas tend to overestimate them. This interplay between IOP and corneal thickness is particularly important in myopia, where accurate IOP assessment is crucial for monitoring and managing glaucoma risk. Glaucoma is a group of eye diseases characterized by progressive damage to the optic nerve, which can lead to vision loss. Elevated IOP is a major risk factor for glaucoma. In myopia, the elongated shape of the eye can lead to higher IOP, increasing the risk of glaucoma. Therefore, accurate IOP measurement is essential in myopic individuals to detect and manage glaucoma early. However, measuring IOP accurately in myopic eyes can be challenging due to the influence of corneal thickness. Most tonometers, the instruments used to measure IOP, are calibrated based on the assumption of a certain average corneal thickness. When the cornea is thinner than average, as is often the case in myopia, the tonometer may underestimate the true IOP. Conversely, when the cornea is thicker than average, the tonometer may overestimate the true IOP. This discrepancy between measured IOP and true IOP can have significant clinical implications. Underestimating IOP in myopic individuals with glaucoma could lead to delayed diagnosis and treatment, potentially resulting in irreversible vision loss. On the other hand, overestimating IOP could lead to unnecessary treatment and anxiety. To address this issue, several methods have been developed to correct IOP measurements for corneal thickness. These methods typically involve using a correction factor based on the measured corneal thickness. However, the accuracy of these correction factors is still debated, and further research is needed to develop more reliable methods for measuring IOP in myopic eyes. Genetic and environmental factors may also play a role in the relationship between AL and CCT. Studies have shown that genetic factors can influence both AL and CCT, suggesting that there may be shared genetic pathways regulating these two parameters. Additionally, environmental factors, such as near work and outdoor exposure, have been implicated in myopia development, and these factors may also influence corneal thickness. Genetic factors are known to play a significant role in myopia development. Several genes have been identified that are associated with an increased risk of myopia. Some of these genes may also influence corneal development and thickness. For example, genetic variations in genes involved in collagen synthesis or extracellular matrix organization could potentially affect both AL and CCT. Environmental factors, such as near work and lack of outdoor exposure, have also been strongly linked to myopia development. Near work, such as reading and using electronic devices, requires the eye to focus on close objects for extended periods, which can lead to axial elongation. Lack of outdoor exposure has been shown to reduce the release of dopamine, a neurotransmitter that plays a role in regulating eye growth, which can also contribute to myopia progression. These environmental factors may also indirectly influence corneal thickness through their effects on axial elongation and IOP.[11-14]

The findings of this study are consistent with previous studies conducted in other populations, which have also reported a negative correlation between AL and CCT in individuals with myopia. A meta-analysis of 15 studies, including over 30,000 participants, found a consistent inverse relationship between AL and CCT across different ethnicities and age groups. This suggests that the relationship between AL and CCT is a general phenomenon in myopia, not limited to specific populations. However, the strength of the correlation between AL and CCT may vary among different ethnic groups. Some studies have reported a stronger correlation in East Asian populations compared to Caucasian populations. This highlights the importance of considering ethnic differences in the assessment and management of myopia. Numerous studies conducted in East Asian populations, such as Chinese, Japanese, and Korean, have consistently reported a negative correlation between AL and CCT in individuals with myopia. These studies have generally found a moderate to strong correlation, with correlation coefficients ranging from -0.5 to -0.8. This suggests that the relationship between AL and CCT is particularly pronounced in East Asian populations, which have a high prevalence of myopia. Studies conducted in Caucasian populations have also reported a negative correlation between AL and CCT in myopia, but the strength of the correlation has generally been weaker than in East Asian studies. Correlation coefficients in Caucasian studies have typically ranged from -0.3 to -0.5. This suggests that the relationship between AL and CCT may be less pronounced in Caucasian populations, which have a lower prevalence of myopia compared to East Asian populations. Studies investigating the relationship between AL and CCT in other ethnic groups, such as African, Hispanic, and Middle Eastern populations, have also reported a negative correlation. However, the strength of the correlation has varied across studies, and more research is needed to draw definitive conclusions about the relationship between AL and CCT in these populations. Several factors may contribute to the observed ethnic differences in the strength of the correlation between AL and CCT. Genetic factors are known to play a significant role in myopia development, and different ethnic groups may have different genetic predispositions to myopia. Some genes that have been associated with myopia may also influence corneal development and thickness. Therefore, genetic differences between ethnic groups could contribute to the observed variation in the relationship between AL and CCT. Environmental factors, such as near work and outdoor exposure, have also been implicated in myopia development. Different ethnic groups may have different environmental exposures, which could influence the relationship between AL and CCT. For example, East Asian populations tend to have higher levels of near work and lower levels of outdoor exposure compared to Caucasian populations. These environmental factors could contribute to the stronger correlation between AL and CCT observed in East Asian populations. Lifestyle factors, such as diet and physical activity, may also play a role in myopia development. Different ethnic groups may have different lifestyle habits, which could influence the relationship between AL and CCT. For example, East Asian populations tend to consume a diet that is lower in vitamin D and higher in carbohydrates compared to Caucasian populations. These dietary factors could contribute to the higher prevalence of myopia and the stronger correlation between AL and CCT observed in East Asian populations. The observed ethnic differences in the strength of the correlation between AL and CCT highlight the importance of considering ethnic differences in the assessment and management of myopia. Clinicians should be aware of these differences when interpreting AL and CCT measurements in patients from different ethnic backgrounds. Additionally, future research should focus on investigating the underlying mechanisms responsible for these ethnic differences. Understanding the factors that contribute to ethnic differences in the relationship between AL and CCT could lead to the development of more targeted interventions to prevent or slow the progression of myopia in different populations. For example, public health campaigns aimed at increasing outdoor exposure may be particularly beneficial in East Asian populations, where the prevalence of myopia is high and the correlation between AL and CCT is strong.[15-17]

The findings of this study have several clinical implications for the assessment, monitoring, and management of myopia, particularly within the Minang ethnic group. It is important to consider ethnic differences in the assessment and management of myopia. The Minang ethnic group may have unique characteristics that influence the relationship between AL and CCT. Studies have shown that AL can vary significantly among different ethnic groups. For example, East Asian populations tend to have longer AL compared to Caucasian populations, even in the absence of myopia. This suggests that ethnic differences in AL may be influenced by genetic factors or other factors related to ancestry. CCT has also been shown to vary among different ethnic groups. For example, African populations tend to have thinner CCT compared to Caucasian populations. This suggests that ethnic differences in CCT may be influenced by genetic factors, environmental factors, or other factors related to ancestry. The strength of the correlation between AL and CCT may also vary among different ethnic groups. Some studies have reported a stronger correlation in East Asian populations compared to Caucasian populations. This suggests that the interplay between AL and CCT in myopia development may be influenced by ethnic-specific factors. Clinicians should be aware of ethnic variations in AL and CCT when assessing patients for myopia. Reference ranges for AL and CCT may need to be adjusted based on the patient's ethnicity. Clinicians should monitor both AL and CCT in patients with myopia, as changes in these parameters may provide early indications of myopia progression or risk of complications. Clinicians should consider ethnic differences when developing myopia control strategies. For example, certain interventions, such as orthokeratology or multifocal contact lenses, may be more effective in certain ethnic groups than others. Monitoring both AL and CCT may be helpful in identifying individuals at risk of developing high myopia and its associated complications. High myopia is a severe form of myopia characterized by an AL of 26.0 mm or longer. The stretching of the retina in high myopia can lead to retinal tears or detachments, which can cause vision loss if not treated promptly. The thinning of the retina in high myopia can lead to myopic maculopathy, a degenerative condition that affects the macula, the central part of the retina responsible for sharp, detailed vision. High myopia is also a risk factor for glaucoma, a group of eye diseases that damage the optic nerve, which can lead to vision loss. AL is a strong predictor of myopia progression and the risk of developing high myopia. Studies have shown that children with longer AL are more likely to develop high myopia and its associated complications. CCT has also been shown to be associated with myopia progression and the risk of developing high myopia. Studies have shown that children with thinner CCT are more likely to develop high myopia and its associated complications. Monitoring AL and CCT can help clinicians identify individuals at high risk of developing high myopia and its associated complications. This allows for early intervention and closer monitoring to prevent or slow the progression of myopia. AL and CCT measurements can also be used to guide treatment decisions. For example, children with rapidly increasing AL or thinning CCT may benefit from more aggressive myopia control interventions. Understanding the relationship between AL and CCT may aid in developing effective myopia control strategies. Several interventions have been shown to be effective in slowing the progression of myopia. Atropine eye drops have been shown to be effective in slowing myopia progression. Atropine works by temporarily paralyzing the ciliary muscle, which reduces accommodation and may help to slow axial elongation. Orthokeratology (ortho-k) involves wearing rigid contact lenses overnight to reshape the cornea. This temporarily corrects myopia and has been shown to slow axial elongation. Multifocal contact lenses and eyeglasses have also been shown to be effective in slowing myopia progression. Increasing outdoor exposure and reducing near work have been shown to be protective against myopia development and progression. AL and CCT measurements can be used as outcome measures to evaluate the efficacy of myopia control interventions. Changes in AL and CCT can provide objective evidence of treatment success or failure. AL and CCT measurements can also be used to personalize treatment plans for individual patients. For example, patients with rapidly increasing AL or thinning CCT may benefit from more frequent monitoring or more aggressive interventions.[18-20]

5. Conclusion

In conclusion, this study investigated the relationship between axial length (AL) and central corneal thickness (CCT) in individuals from the Minang ethnic group in Indonesia with varying degrees of myopia. The study found a strong negative correlation between AL and CCT, indicating that as the degree of myopia increases, AL increases and CCT decreases. This finding is consistent with previous studies conducted in other populations, suggesting that the relationship between AL and CCT is a general phenomenon in myopia. The study also found that the strength of the correlation between AL and CCT may vary among different ethnic groups. This highlights the importance of considering ethnic differences in the assessment and management of myopia. Clinicians should be aware of these differences when interpreting AL and CCT measurements in patients from different ethnic backgrounds. The findings of this study have several clinical implications. Monitoring both AL and CCT may be helpful in identifying individuals at risk of developing high myopia and its associated complications. Understanding the relationship between AL and CCT may aid in developing effective myopia control strategies. AL and CCT measurements can also be used to guide treatment decisions. Further research is needed to investigate the underlying mechanisms responsible for the relationship between AL and CCT in myopia. This research may lead to the development of more targeted interventions to prevent or slow the progression of myopia.

6. References

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