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Association Of Axial Length And Corneal Power With Refractive Status Of Young Adults In Nigeria

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Abstract:
Background: *Axial length and corneal power constitute the principal ocular biometric determinants of refractive status. The association between these biometric parameters and refractive error in Nigerian young adult populations remains inadequately characterized. This study investigated the association of axial length and corneal power with the refractive status of young adults at Abia State University, Uturu, Nigeria.*
Materials and Methods: *A descriptive cross-sectional study was conducted involving 150 participants aged 18-35 years (71 males, 79 females). Axial length was measured using A-scan ultrasonography, corneal power via automated keratometry, and refractive status through autorefraction. Data were analyzed using Pearson correlation, independent t-tests, ANOVA, and multiple regression at $p<0.05$.*
Results: *Mean axial length was 23.46±0.76 mm (right eye) and 23.59±1.06 mm (left eye), with males exhibiting significantly longer axial lengths than females (23.72 mm vs 23.38 mm, $p=0.02$). Mean corneal power was 43.33±1.12 D (right eye) and 43.34±1.12 D (left eye), with females demonstrating significantly steeper corneas than males (43.52 D vs 43.12 D, $p=0.03$). Strong negative correlations were found between axial length and refractive error ($r=-0.62$ to -0.65, $p<0.001$), while corneal power showed weaker positive correlations ($r=0.26$ to 0.28, $p<0.002$). Multivariate regression confirmed axial length as the dominant predictor of refractive error ($\beta=-0.58$, $p<0.001$), with corneal power as a secondary contributor ($\beta=0.21$, $p=0.002$).*
Conclusion: *Axial elongation constitutes the primary anatomical determinant of myopia among young Nigerian adults, while corneal power plays a secondary compensatory role. Gender did not significantly influence refractive status distribution despite biometric differences, indicating compensatory emmetropization mechanisms.*
Keywords: *Axial Length; Corneal Power; Refractive Error; Myopia; Young Adults; Nigerian Population*

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I. Introduction

Refractive errors represent a predominant cause of vision impairment globally, creating a substantial public health challenge[1]. The refractive status of the eye is determined by the complex interplay of axial length, corneal power, and lens power[2]. Understanding the association of axial length and corneal power with refractive status is crucial for accurate diagnosis and management of refractive errors and for predicting the risk of ocular conditions linked to extreme refractive states[3].

The human eye's final refractive state is a product of precise anatomical and biometric interplay. Emmetropization is the active developmental process that reduces refractive errors in infancy and childhood[3,4]. The young adult population represents a crucial stage in this interplay, marking the relative stabilization of ocular growth after the adolescent surge[5].

Axial length is the primary determinant of the eye's refractive state. An elongated axial length causes myopia, while a shorter length leads to hyperopia[6]. The cornea serves as the eye's principal refractive element, contributing approximately two-thirds of its total focusing power[7]. In Nigeria, Mahmud et al. (2024) reported strong inverse correlations between axial length and refractive status ($r=-1.7$, $r^2=56.8\%$, $p<0.0001$)[8].

This study aims to determine the association of axial length and corneal power with the refractive status of young adults in Abia State University, Uturu, Nigeria.

II. Materials And Methods

Study Design and Population

This descriptive cross-sectional study was carried out at the Optometry Clinic, Abia State University, Uturu, Nigeria, from November 2024 to February 2025.

Sample Size Determination

Using Cochran's formula, a total of 150 participants were recruited.

Sampling Procedure

Inclusion criteria: (1) individuals aged 18-35 years; and (2) individuals who gave consent. Exclusion criteria: (1) individuals outside the age bracket; (2) individuals who had undergone eye surgery; and (3) individuals with pathological ocular conditions.

Research Equipment

1. A-Scan Ultrasonography (SW-1000 biometer)
2. Ophthalmoscope
3. AutoRef/Keratometer (Nidek TONOREF III)

Data Collection Procedures

Keratometry: Corneal power readings were taken using the automated keratometer. Three readings were taken for each eye, and the mean value was recorded.
Refraction: Refractive status was obtained using autorefraction. Spherical equivalent was calculated as: SE = Sphere + (Cylinder/2).
A-Scan Biometry: Axial length was measured using A-scan ultrasonography. Three measurements were taken for each eye.

Data Analysis Techniques

Data were analyzed using SPSS version 20. Independent t-test, paired t-test, one-way ANOVA, chi-square test, Pearson correlation, and multiple linear regression were employed at $p<0.05$.

Ethical Consideration

Ethical approval was obtained from the Research and Ethics Committee, Department of Optometry, Abia State University. Informed consent was obtained from all subjects.

III. Results

Distribution of Refractive Status

Myopia was the most prevalent refractive error (48.0%), followed by emmetropia (30.7%) and hyperopia (21.3%).

Table 1: Distribution of Refractive Status (n=150)

Refractive Status	Frequency (n)	Percentage
Myopia	72	48.0
Emmetropia	46	30.7
Hyperopia	32	21.3
Total	150	100.0

Mean Axial Length

Mean axial length was 23.46±0.76 mm (right eye) and 23.59±1.06 mm (left eye), with no significant difference ($p=0.16$).

Table 2: Mean Axial Length by Gender

Gender	Mean Axial Length (mm)	SD	t-value	p-value
Male	23.72	0.81		
Female	23.38	0.89	2.45	0.02*

*Significant at $p < 0.05$

Mean Axial Length across Refractive Groups

Axial length differed significantly across refractive groups ($F=29.84$, $p<0.001$).

Table 3: Mean Axial Length across Refractive Groups

Refractive Status	Mean Axial Length (mm)	SD
Myopia	24.01	0.76
Emmetropia	23.32	0.64
Hyperopia	22.71	0.59

Mean Corneal Power

Mean corneal power was 43.33±1.12 D (right eye) and 43.34±1.12 D (left eye), with no significant difference (p=0.93).

Table 4: Mean Corneal Power by Gender

Gender	Mean Corneal Power (D)	SD	t-value	p-value
Male	43.12	1.09		
Female	43.52	1.14	-2.21	0.03*

*Significant at $p < 0.05$

Correlation Analysis

Axial length showed strong negative correlation with refractive error (r=-0.62 to -0.65, p<0.001). Corneal power showed weak positive correlation (r=0.26 to 0.28, p<0.002).

Table 5: Correlation between Axial Length and Refractive Error

Eye	Pearson r	p-value
Right Eye	-0.62	<0.001
Left Eye	-0.65	<0.001

Regression Analysis

Axial length was the strongest predictor (β=-0.58, p<0.001), followed by corneal power (β=0.21, p=0.002). Age and gender were not significant predictors.

Table 6: Multivariate Regression Analysis

Predictor	β	t-value	p-value
Axial Length	-0.58	-9.21	<0.001
Corneal Power	0.21	3.12	0.002
Age	-0.07	-1.08	0.28
Gender	0.04	0.63	0.53

IV. Discussion

This study investigated the association of axial length and corneal power with refractive status in 150 young adults. The mean age was 24.0 years, with near-equal gender distribution.

Axial Length and Its Determinants

Mean axial length (23.46-23.59 mm) is consistent with Mahmud et al. (2024) in Northern Nigeria[8] and Betiku et al. (2021) in Lagos[9]. However, it is lower than the 24.78 mm reported by Sun et al. (2021) in Chinese students[10], reflecting ethnic differences.

Males had significantly longer axial lengths than females (p=0.02), consistent with literature[8,11,12]. Axial length differed significantly across refractive groups (p<0.001), with myopes showing the longest axial lengths (24.01 mm) and hyperopes the shortest (22.71 mm). This aligns with Mahmud et al. (2024)[8] and Mekontso et al. (2024) in Cameroon[13].

The strong negative correlation (r=-0.62 to -0.65, p<0.001) is consistent with the Rotterdam Study[14] and Mutti et al. (2007)[15].

Corneal Power and Its Determinants

Mean corneal power (43.33-43.34 D) agrees with Mahmud et al. (2024)[8] and falls within the global norm of 43-44 D[16]. Females had significantly steeper corneas (p=0.03), in agreement with Aljarousha et al. (2021)[11] and Gessesse et al. (2020)[12].

The weak positive correlation (r=0.26-0.28) between corneal power and refractive error confirms corneal power as a secondary determinant, consistent with Mahmud et al. (2024)[8] and Gaurisankar et al. (2019)[17].

Combined Influence

The combined model explained 50% of refractive variance ($R^2=0.50$, p<0.001). Axial length was the dominant predictor (β=-0.58), followed by corneal power (β=0.21). This aligns with the hierarchical model described by Flitcroft et al. (2019)[18] and Tideman et al. (2016)[14].

V. Conclusion

Axial length is the dominant determinant of refractive status in young adults, with corneal power playing a secondary compensatory role. The combined model explained 50% of refractive variance. Gender differences in biometric parameters did not translate into refractive status differences, indicating compensatory emmetropization.

Recommendations

1. Routine axial length monitoring for myopic students at six-month intervals.
2. Mandatory vision screening for all newly admitted students.
3. Integration of outdoor activities and visual rest breaks in academic environments.

Limitations

Cross-sectional design prevents causal inference. Study population limited to university students. Environmental risk factors were not assessed.

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