CORRELATION BETWEEN OCULAR AXIAL LENGTH AND BODY MASS INDEX IN A BLACK POPULATION

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Abstract

AIM: To determine the correlation between Ocular axial length (AL) and body mass index (BMI) in a black population.

METHOD: This was a descriptive cross sectional study carried out in Port Harcourt City LGA, Nigeria. Subjects were selected using multistage random sampling with inclusion criteria of Visual Acuity > 6/18, age greater than 18 years with no history of past ocular surgeries or trauma. Socio demographic data was obtained through an interviewer based structured proforma. Data obtained included age, sex, tribe, occupation and level of education. Weight, height and Body Mass Index (BMI) were measured using a standard height and weight automated scale (SECA 769,220). Ocular examinations done included visual acuity, applanation tonometry and ophthalmoscopy. Axial length (AL) and Anterior Chamber Depth (ACD) were measured using Amplitude (A) scan ultrasonography (SONOMED PACSCAN 300AP). Data obtained from one eye of the subjects were analyzed using SPSS (Version 17), and p value was set at ≤ 0.05.

RESULTS: Four hundred and sixty six (466) subjects participated in the study made up of two hundred and twelve (212) males (45.5%) and two hundred and fifty four (254) females (54.5%) with M: F ratio of 1:1.2. The age range was 18-92 years and mean age of the subjects studied 43.0±14.2 years. Findings revealed mean AL, Body Mass Index, Height and Weight to be (23.2±1.0mm), (26.9±6.2kg/m^2), (162.5±9cm) and (70.5±14.8kg) respectively. The mean AL was greater in males than females. There was no statistically significant relationship between age and axial length. There was a statistically significant relationship between height and AL in both gender with AL increasing by 0.035mm (p=0.001, r=0.261) with one centimeter change in height in males and 0.025mm (p=0.001, r=0.2680) in females and between AL and level of education (p=0.001). There was also a statistically significant (0.009mm) increase in AL per one kilogramme change in weight in females (p=0.0001, r=0.188). Males had longer AL than females

in all the BMI groups with a statistically significant difference found between the different BMI classes.

CONCLUSION: This study noted that although there is no statistically significant relationship between AL and BMI, there are significant relationships between AL and height and weight respectively. Estimated AL in mm= 16.91 + 0.039 (height in cm)

Keywords: Correlation, Ocular Axial Length, Body Mass Index, Black Population.

Please punctuate, italicise and justify the Keywords, using 10 font.

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Introduction

Axial Length (AL) is important biometric parameter in the eye, and its measurement is important in several conditions including the determination of the refractive status of the eye as well as determination of intraocular lens power for patients prior to cataract surgery. Several studies have also related it to other ocular parameters as well as anthropometric measurements like height, weight and Body Mass Index (BMI).[1] [1].

Axial length is defined as the distance between the anterior and the posterior poles of the eye or as the distance from the anterior curvature of the cornea to the retinal pigment epithelium in alignment along the optical axis of the eye.[2,3] [2,3]. At birth, the axial length is approximately 17-18mm; following which it increases by about 5mm (up to 23mm) from birth to age 3- 6years until it reaches an average of 24mm in adulthood.[3] [3]. Mean axial length in the Blue mountain eye study,[4] [4], was 23.44mm, values noted for the Tanjong Pagar study,[5] [5], in China was 23.23mm, while that gotten by Adio et al,[6] in Nigeria was 23.57mm±1.19 which is in agreement with previously documented literature. It has been found from previous studies, to be affected by age, sex and educational status,[7,8,9] including several ocular factors such as refractive error, anterior chamber depth, corneal curvature and central corneal thickness.[10,11,12,13]Previous studies have also shown a relationship between short axial length of the eye and an increased incidence of retinal vein occlusions,[14] primary angle closure glaucoma,[10] and hypermetropia; while longer axial lengths have been noted to be associated with an increased incidence of cataracts,[15] and myopia. Axial length is also said to have an influence on emmetropisation of the eye.[16] It is also the most important parameter in the calculation of intraocular lens power prior to cataract surgery, and helps in the diagnosis of pathological conditions like staphyloma and risk of retinal detachment.[7] Therefore there is a need to know the normal values of the axial length in our environment which can subsequently be used as a yardstick to detect those with abnormal values, and subsequently screen them for the associated pathological conditions.

Body Mass Index (BMI) is an anthropometric measurement used in determining the state of well-being of the body and it is also used as a measure of body size as it provides a crude index of the body's fat content.

The parameters used in its determination are weight in kilograms, and height in meters.[2, 16]It is defined as the individuals body weight divided by the square of their height.[17] Increased BMI has been known to be associated with several ocular pathological conditions,[18] such as cataract,[16] retinal vein occlusion,[19] age related macular degeneration,[18] reduction in retinal vascular caliber,[20] as well as raised intraocular pressure (IOP).[21]

There is a paucity or dearth of studies in our environment and Africa reporting the relationship of BMI and axial length although there are varying reports on the relationship between AL and BMI by several authors outside this continent.

With advancing technology and improvement in eye care service delivery, cataract surgery with IOL insertion is now common place with an increased need for accurate IOL power calculation via biometry, resulting in less spectacle dependence by the patient post operatively.

The axial length (AL) is the most important biometric measurement in the eye and also the largest source of intraocular lens (IOL) calculation errors,[22] as 1mm error in its measurement will result in 2.5-3D error in spectacle correction postoperatively or a shift in refractive status of the patient post operatively.

There is also a need to know if there is any relationship between the stature of an individual and the size of their ocular components and determine if these relationships can be further explored with attendant formulae put to use in in the estimation of IOL power for cataract surgeries especially in resource challenged settings.

Methodology

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This is a community based descriptive cross sectional study carried out in Port Harcourt City LGA, Nigeria between the 6th of January and 31st of March 2014. Ethical clearance was obtained from the University of Port Harcourt Teaching Hospital Ethics Committee. Subjects were selected using multistage random sampling with inclusion criteria of Visual Acuity > 6/18, age greater than 18 years with no history of past ocular surgeries or trauma. Sociodemographic data was obtained through the administration of an interviewer based structured proforma. Data obtained included age, sex, tribe, occupation and level of education. Weight, height and Body Mass Index (BMI) were measured using a standard height and weight automated scale (SECA 769,220). Ocular examinations done included visual acuity, applanation tonometry, and ophthalmoscopy. Axial length (AL) was measured using Amplitude (A) scan ultrasonography (SONOMED PACSCAN 300AP). Data obtained from one eye of the subjects were analyzed using SPSS (Version 17), and p value was set at ≤ 0.05.

Results

Four hundred and sixty six (466) subjects from the general adult population were studied.

Axial Length (AL) values in one randomly selected eye of the population studied were analysed.

The mean age of the subjects studied was 43.0±14.2 years with the age distribution between 18 and 91 years, and a peak age group of between 31 and 40 years as shown in Figure 1.The mean age for males was 41.6 ±12.7 years and that for females 44.8+15.8 years.

There were two hundred and twelve (212) males (45.5%) two hundred and fifty four (254) females (54.5%) with male to female ratio of 1: 1.2. The gender distribution for different ages is shown in Table 1. About one quarter of the males in the population studied, (n=54; 25.5% of total male population) were within 41 and 50 years and majority of the female population (n=83; 32.6% of female population) were within 31 and 40 years. There was a significant difference between both genders at different age groups (p= 0.01)

The mean AL of the general adult population studied was 23.2 ±1.0 mm (range 20.5 – 30.0mm). The mean distribution of AL in males was 23.6 ±1.2 mm (21.2 to 30.0 mm) and in females 22.9 ±0.7 mm (20.5 to 25.2mm). The mean difference between gender was 0.7±0.1 (95% C.I 0.5 to 0.8, t-value 7.0 and p= 0.0001). The mean distribution in different age group between genders is shown in Figure 2. The longest mean AL in males was seen among age group 51 and 60 years

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and that for females was seen in age group 41 and 50 years after which in both gender there was noticed to be a decline in mean axial lengths.

Figures 3 and 4 show the relationship between age and AL on bivariate linear regression between genders and it showed that there was no statistically significant relationship between age and axial length in both genders (p >0.05).

Obesity was found to be higher in females (n=97; 78.2%) compared to the males among those with BMI >30Kg/m^2 and this was found to be statistically significant (p=0.0001). A larger proportion of subjects with normal BMI and overweight BMI 25-29.5 Kg/m^2 were males as shown in Table 2.

The distribution of axial length with BMI groups among different gender is shown in Table 2. The males had higher mean axial lengths than the females in all the BMI groups as shown in Table 3 and a statistically significant difference in axial length between the genders were found in those with normal BMI, overweight and obesity respectively.

Figure 5 shows that there is no statistically significant relationship between BMI and AL in the general population (p-value >0.05) and a similar finding was also obtained controlling for gender (p-values >0.05) as shown in Figures 6 and 7 respectively.

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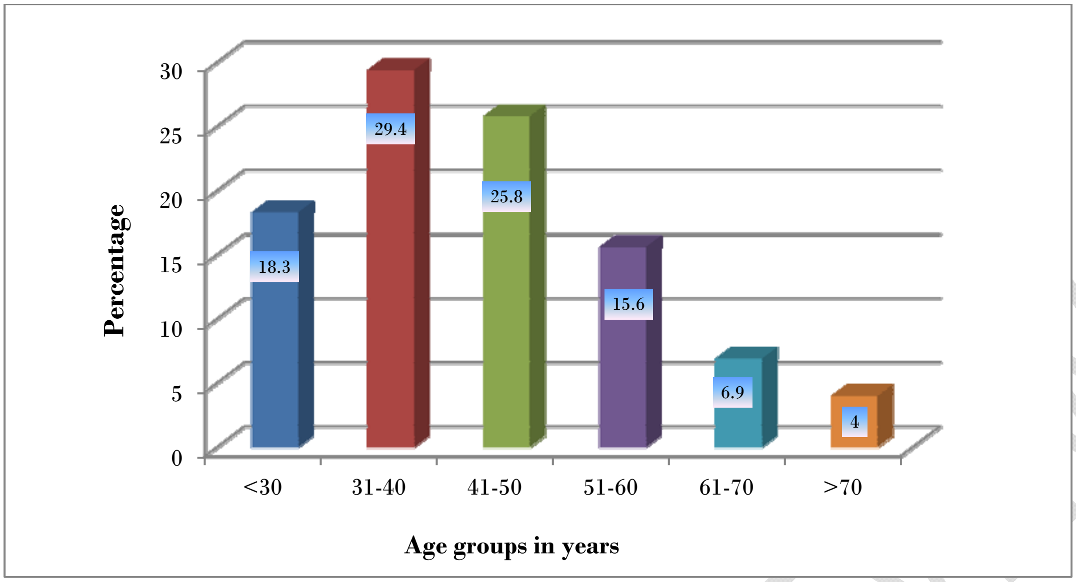

Figure 1: Age distribution of study population

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Table 1: Gender distribution of different age groups

Age groups / Gender	Male	Female	Total
	N (%)	N (%)	N (%)
<30 years	43(51.2)	41(48.8)	**84 (18.0)**
31 – 40 years	48 (36.6)	83 (63.4)	**131 (28.1)**

41 – 50years	54 (43.5)	70 (56.5)	**124 (26.6)**
51 – 60 years	38 (50.7)	37 (49.3)	**75 (16.1)**
61 – 70 years	14 (42.4)	19 (57.6)	**33 (7.1)**
>70 years	15 (78.9)	4(21.1)	**19 (4.1)**
Total	**212 (45.5)**	**254 (54.5)**	**466 (100.0)**

X^2 = 6.52, df=1, p-value 0.01

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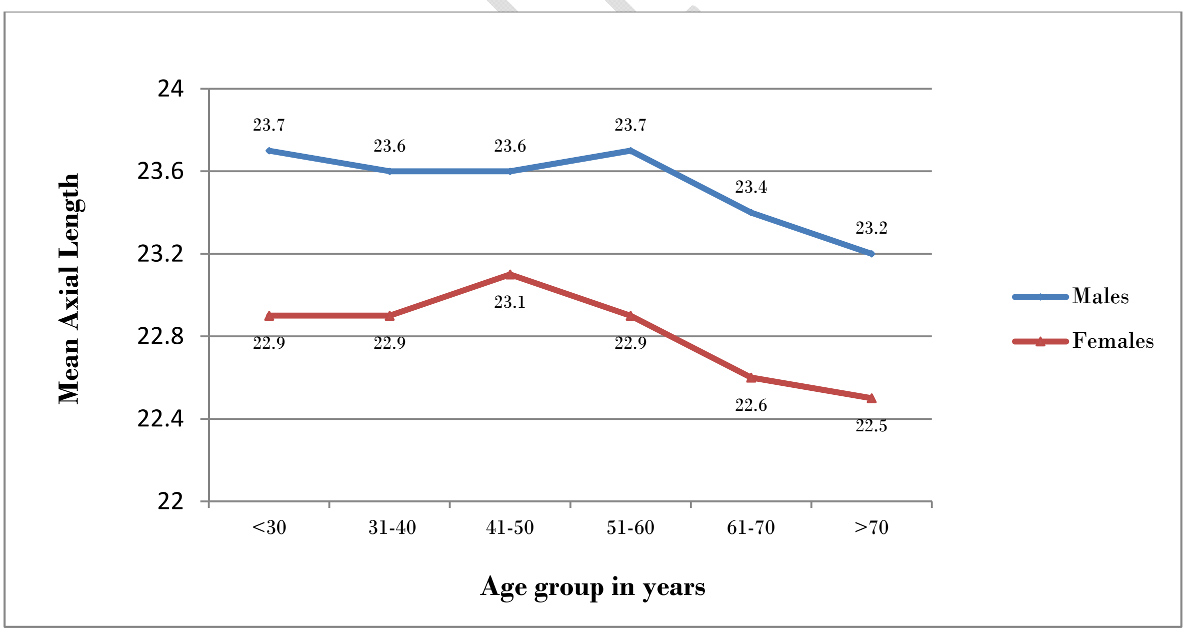
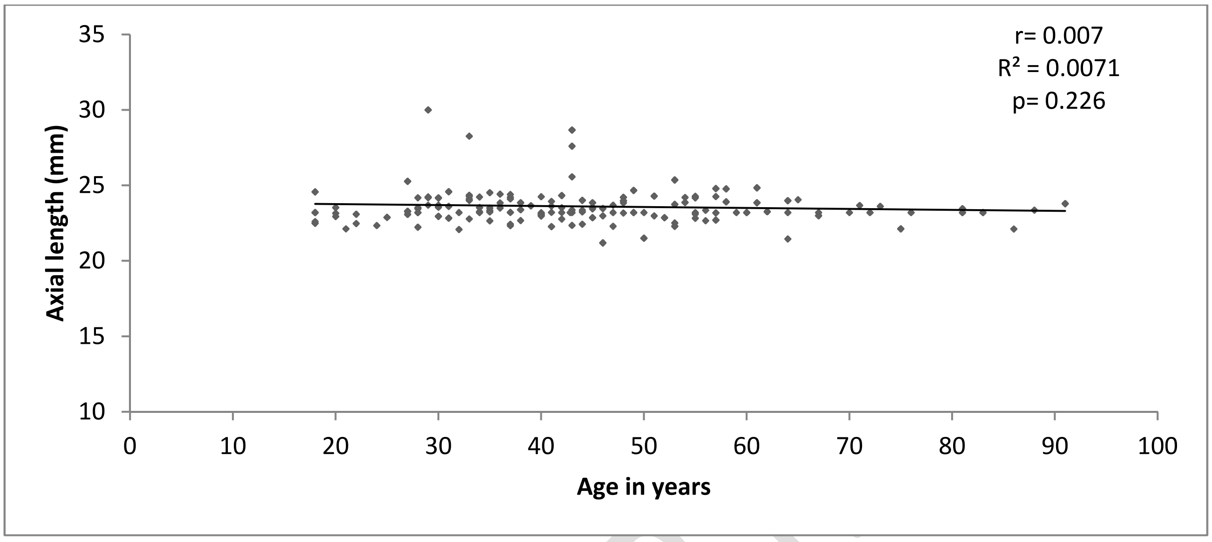
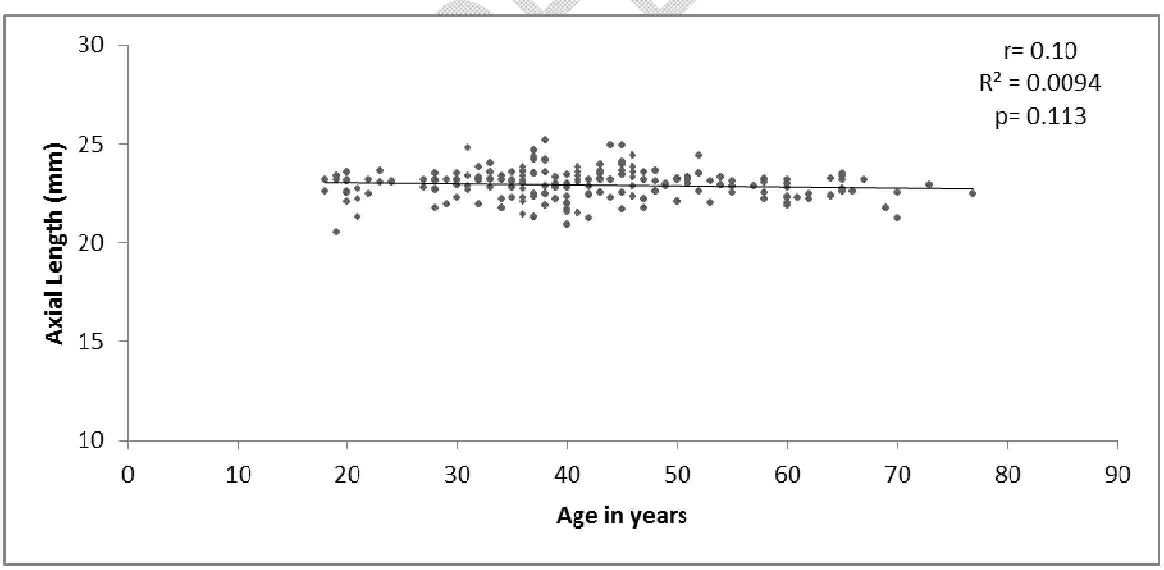


Figure 2: Mean Axial length between genders at different age groups



Bivariate linear regression

Figure 3: Relationship between Age and Axial length in males



Bivariate linear regression

Figure 4: Relationship between Age and Axial Length in females

Table 2: BMI distribution in different genders

BMI group	Male	Female	Total	X^2	p-value
	n (%)	n (%)	n (%)		
<18.5	12 (52.2)	11 (47.8)	23(4.9)	0.043	0.924
18.5 – 24.5	81 (54.7)	67(45.3)	148 (31.8)	1.321	0.249
25 – 29.5	92 (53.8)	79 (46.2)	171 (36.7)	0.99	0.320
≥30	27 (21.8)	97 (78.2)	124 (26.6)	39.52	0.0001
Total	**212 (45.5)**	**254 (54.4)**	**466 (100.0)**		

Chi-square test. df= 1

Table 3: Mean distribution of Axial length with BMI group in different genders

		AXIAL LENGTH			
BMI group		**Mean ±S.D**		**t- value**	**p-value**
	n	**Male**	**Female**		
<18.5	23	23.4±0.7	22.9±0.7	1.660	0.112
18.5 – 24.5	148	23.8±1.6	22.8±0.7	4.65	0.000

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25 – 29.5	171	23.4±0.8	22.9± 0.7	4.603	0.000
≥30	124	23.5 ±0.9	23.0 ±0.7	2.599	0.010
Total	**466**	**23.6 ±1.2**	**22.9 ±0.7**		

Independent t-test.

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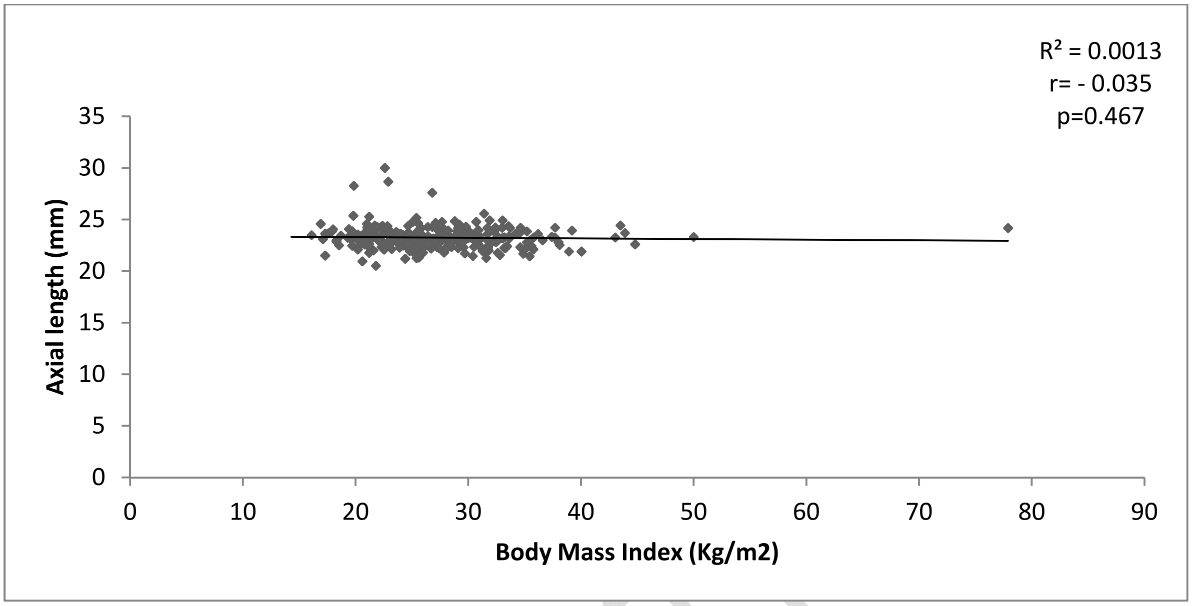

Figure 5: Relationship between AL and BMI in the general population

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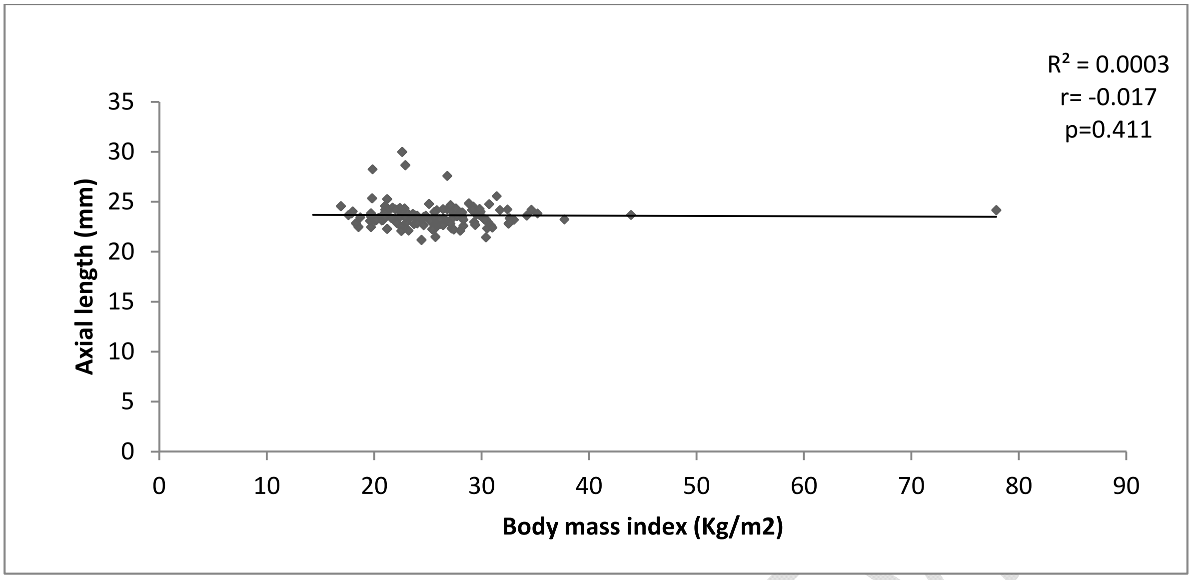

Figure 6: Relationship between AL and BMI in males

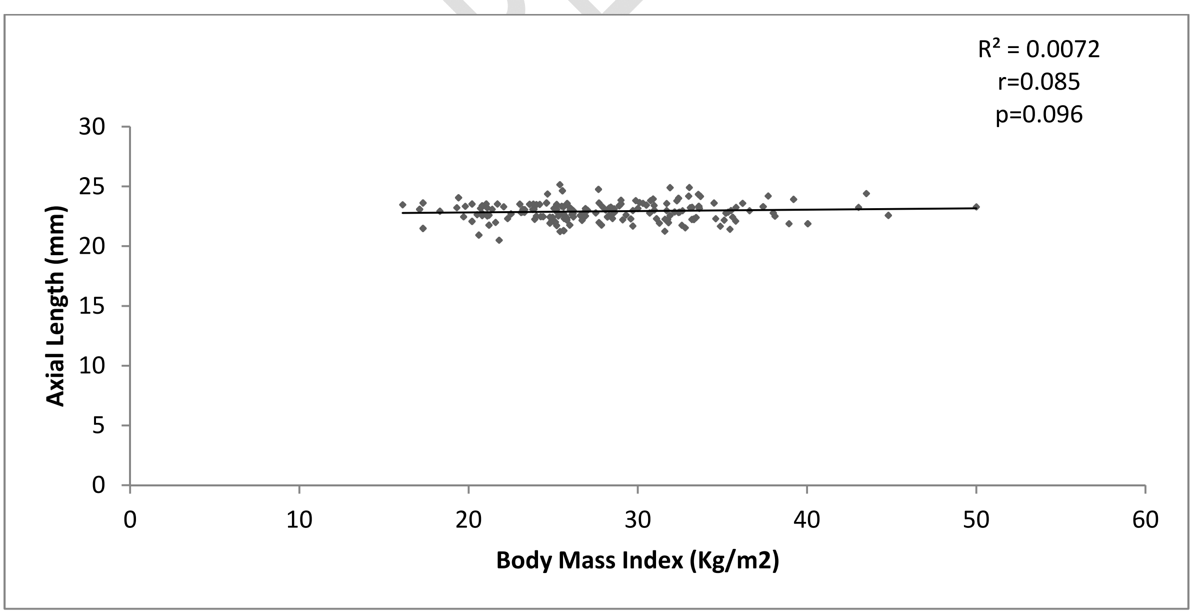

Figure 7: Relationship between AL and BMI in females.

Discussion

This study describes the relationship between axial length and body mass index in normal adults with a view to deriving possible usable working formulae for estimating intraocular lens power for cataract surgeries in resource-challenged settings

Most of the subjects studied were of Rivers state ethnicity of Nigeria (n=184; 39.5%) which could be explained by the fact that the study was carried out in the communities that make up Port Harcourt city LGA. This was similar to the study carried out by Adio,[6] on 400 subjects in UPTH eye clinic where 56% of the subjects were from Rivers state. Most of the subjects were businessmen and women which may probably be due to the fact that Port Harcourt is largely a commercial city.

The mean axial length of the population in this study was 23.2±1.0mm which was similar to the values noted by Connell et al,[23] (23.03±1.61mm) and Hashemi et al,[7](23.14mm). It was however slightly lower than that obtained by Adio et al (23.57±1.19 mm), and Iyamu et al,[13](23.5±0.70mm). This difference may have been attributed to the fact that the former was a hospital-based study and may not have been representative of the population. While the latter had a smaller sample size(n=95), and had an age range of 20-69 years as opposed to this study which had an age range of 18-91years. The younger age range may have attributed to the higher mean axial length since it has been noted in several studies that there is a decline in axial length with older age. The study by Iyamu et al also had a male to female ratio of 1.4:1 as opposed to this study (1:1.2). The higher proportion of males in the study by Iyamu may have further attributed to the higher mean axial length since axial length has been noted to be higher in males than females. The mean axial length in this study was also noted to be lower than that in the Central India eye study (22.66mm).this may be related to the lower height and BMI values in the Indian population (1.56±0.09m,19.37±kg/m^2).

In this study, males were found to have significantly longer axial lengths than females with a mean difference of 0.7±0.1mm (p=0.0001) (Figs 2, 3). This was similar to studies carried out by Adio et al,[6] in Nigeria, Hashemi et al,[7] in Iran, Lee et al,[8] in Britain and the Tanjong Pagar eye study,[5] and the Central India eye study,[1]where males were found to have higher axial lengths than females but dissimilar to the Beijing eye study where there was no statistically significant difference between the axial length in males and females and the study on Nigerians by Iyamu et al,[13]where the mean axial length in females was higher than that in males. This difference in pattern may have been due to the fact that the sample size in the study by Iyamu was small (n=95) with a smaller proportion of female. The age range of the sampled females is also not known as this may have affected the relative mean axial length if the females in the population were younger.

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The longest axial length in males in this study was seen within age group 51 to 60 years which was similar to that found by Lee et al,[8] who stated that adults younger than 65 years had larger eyes than those aged 75 years and above while in females the longest mean axial lengths were noticed amongst the age group 41 to 50 years similar to that obtained by the Tanjong Pagar eye study.

There was no statistically significant relationship between axial length and age in both gender on bivariate linear analysis in this study (Figs 3 and 4), this was similar to the results got by Iyamu et al,[13] where regression analysis performed on axial length and age showed no statistical significance (p=0.46), and Connell et al,[23] in Eritrean eyes who stated that there was no correlation between age and biometric readings of his subjects.

The mean BMI in this study was noted to be 26.9±6.2kg/m^2. BMI was found to be significantly higher in the females than in males (p=0.0001) which is in agreement with the study by Chiu et al,[24] in Taiwan which noted that males had a lower mean BMI than females.

Although there was no relationship between axial length and BMI (figs 14, 15 and 16), a statistically significant difference was seen between the different BMI classes. This is similar to the study carried out by Osuobeni et al, [25] where it was noted that physical size or stature does not affect the sizes of the optical components. This was however not the case in the Central India eye study,[1] where after controlling for age, gender and level of education, subjects with higher BMI were noted to have shorter globes.it was in fact stated that there was a 0.02mm decrease in axial length for each unit increase in BMI.

CONCLUSION

Although axial length showed no relationship with BMI, there was a significant difference between the BMI classes. Axial Length also positively correlated with height in both gender. Weight was found to correlate with axial length in the female gender but no correlation was noted for the general population.

BMI from this study did not show a relationship with AL and so may not be considered in AL estimation.

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