Ophthalmology Research: An International Journal

10(4): 1-8, 2019; Article no.OR.50877
ISSN: 2321-7227

Anthropometric Parameters Affecting Ocular Axial Length in Niger Delta Region of Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Author INA designed the study and performed the statistical analysis. Author CSE wrote the protocol and the first draft of the manuscript. Author AOA managed the analyses of the study. Author BF managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/OR/2019/v10i430112
Editor(s):
(1) Dr. Tatsuya Mimura, Department of Ophthalmology, Tokyo Women's Medical University Medical Center East, Japan.
Reviewers:
(1) Anil Kumar Verma, H. P. University Shimla, India.
(2) Engy M. Mostafa, Sohag University, Egypt.
(3) Umezurike Benedict Chidozie, Government House Clinic, Nigeria.
Complete Peer review History: http://www.sdiarticle3.com/review-history/50877

Original Research Article

Received 04 June 2019
Accepted 13 August 2019
Published 22 August 2019

ABSTRACT

Aim: To determine the anthropometric parameters affecting ocular axial length in Niger Delta region of Nigeria.

Methods: This was a community based descriptive study carried out in Port Harcourt City LGA, Nigeria using a multistage random sampling technique. Inclusion criteria were Visual Acuity > 6/18, age greater than 18 years and no history of past ocular surgeries or trauma. Socio demographic data was obtained through an interviewer based proforma and included age, sex and tribe. Anthropometric parameters 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 ≤ .05.

Results: The study was 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 giving a total of four hundred and sixty six (466) subjects. The age range was 18-92 years and mean age of the subjects studied

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43.0±14.2 years. Findings revealed mean AL, Height and Weight to be (23.2±1.0 mm), (162.5±9 cm) and (70.5±14.8 kg) respectively. The mean AL was greater in males than females. 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 0.025 mm (p=0.001, r=0.2680) in females. There was also a statistically significant (0.009 mm) increase in AL per one kilogram change in weight in females (p=0.0001, r=0.188).

Conclusion: This study noted that there are significant relationships between AL and height and weight respectively. This could add to the data bank for AL in the country and form a basis for identifying deviations from the normal, for further research.

Keywords: Anthropometric parameter; ocular axial length; Niger Delta.

1. INTRODUCTION

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. [1,2,3]. It is an important biometric parameter in the eye whose measurement using the amplitude scan is the "Gold standard" in ophthalmology [4]. This 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. At birth, the axial length is approximately 17-18 mm; following which it increases by about 5 mm (up to 23 mm) from birth to age 3- 6 years until it reaches an average of 24 mm in adulthood [3]. Mean axial length in the Blue mountain eye study [4], was 23.44 mm, values noted for the Tanjong Pagar study [5], in China was 23.23 mm, 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 and how it is affected by height and weight. This can subsequently be used as a yardstick to detect those with abnormal values, and subsequently screen them for the associated pathological conditions.

The axial length is the most important anthropometric variable in the calculation of Intra ocular Lens power as a 0.1mm error in its measurement will result in as much as 0.25D change in post-operative refraction [17].

Several studies have explored the association of axial length with both ocular and systemic parameters; Ojaimi et al. [18] studied the effect of stature and anthropometric parameters on eye size and refraction in a population based study of Australian children with mean age of 6 years measured height, weight and waist circumference using a standardized protocol. After adjustment for age in weeks, height was found to be strongly associated with Axial length although other parameters were not associated with AL. In contrast, Osuobeni et al. [19] who studied the effects of physical size on refractive error and optical component dimensions in sickle cell disease (SCD) patients noted that, the height correlated positively with axial length although this correlation was lost after adjustments for age and gender. This variation in the findings as compared with the previous study might have been brought about by the fact that SCD patients have some form of stunted growth from chronic ill health as well as less body fat than normal for their age and sex.

In the Reykjavik Eye Study [20], height correlated positively with axial length using multivariate analysis (p-value< 0.01) but there were no correlations between axial length and other parameters. The strengths of this study as pointed out by the author include the fact that it was a homogenous large population based cross sectional study.

Ojaimi et al. [18], in Australia noted the effect of stature and other anthropometric parameters on eye size and refraction stating that height correlated positively with axial length.

In another study by Pereira et al. [21], on ocular biometry noted that a positive correlation was established between axial length and height. Similarly, the Meiktila Eye Study [22], in central Myanmar, reported that height and weight were significantly correlated with age, gender and all the ocular biometric parameters even after adjusting for age and gender. Taller and heavier persons had eyes with longer axial lengths and deeper anterior chambers.

Multivariate analysis showed consistent results with the findings for associations between height, weight and ocular biometry. These results were consistent with results of the Beijing Eye Study [23], which was also a population based study of 3251 subjects aged above 40 years. This study was carried out to determine whether anthropomorphic measurements were associated with ocular and general parameters and it was discovered on multivariate analysis that there was a significant association between axial length and higher age, higher body height and level of education.

Axial length is an important anthropometric parameter in relation to the eye, if our data is in agreement with that of other studies and relationships do exist with height and weight, it would form a basis for identifying deviations from the normal, for further research, and also add to the data bank for axial length.

2. METHODS

This was a community based descriptive cross-sectional study carried out in Port Harcourt City LGA, Nigeria using a multistage random sampling technique. Inclusion criteria were Visual Acuity > 6/18, age greater than 18 years and no history of past ocular surgeries or trauma. Socio demographic data was obtained through an interviewer based proforma and included age, sex and tribe. Anthropometric parameters were measured using a standard height and weight automated scale (SECA 769,220). Ocular examinations done included visual acuity with Snellen's chart, intra ocular pressure with Perkin's applanation tonometer, and funduscopy with Welch Allen's ophthalmoscope. 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 ≤ .05.

3. 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 Fig. 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= .01).

In the general population studied, a positive relationship was found between axial length and height (r= 0.351, P-value .0001) that for every 1 cm increase in height, AL rises by 0.039 mm (0.030 to 0.048 mm at a constant value of 16.909) given an hypothetical equation for AL estimation from height Fig. 2.

There was a statistically significant positive relationship between height and axial length in both male and female population as shown in Figs. 3 and 4. This showed that axial length increased with every one centimetre increase in height by 0.035 mm (CI 0.018 to 0.052) in males and 0.025 mm (CI 0.014 to 0.036) in females.

There was a statistically significant positive relationship between weight and axial length in female population but no relationship was found in males as shown in Figs. 5 and 6. Among the female population it was found that for every one kilogramme increase in weight the AL increased by 0.009 mm (CI 0.003 to 0.015).

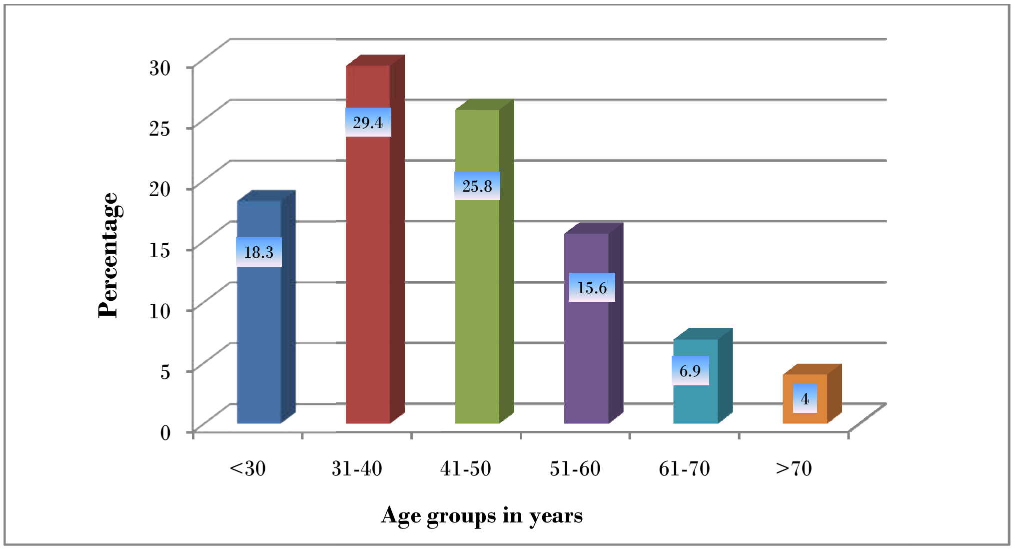

Fig. 1. Age distribution of study population

Table 1. Gender distribution of different age groups

Age groups / Gender	Male N (%)	Female N (%)	Total 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 – 50 years	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 .01

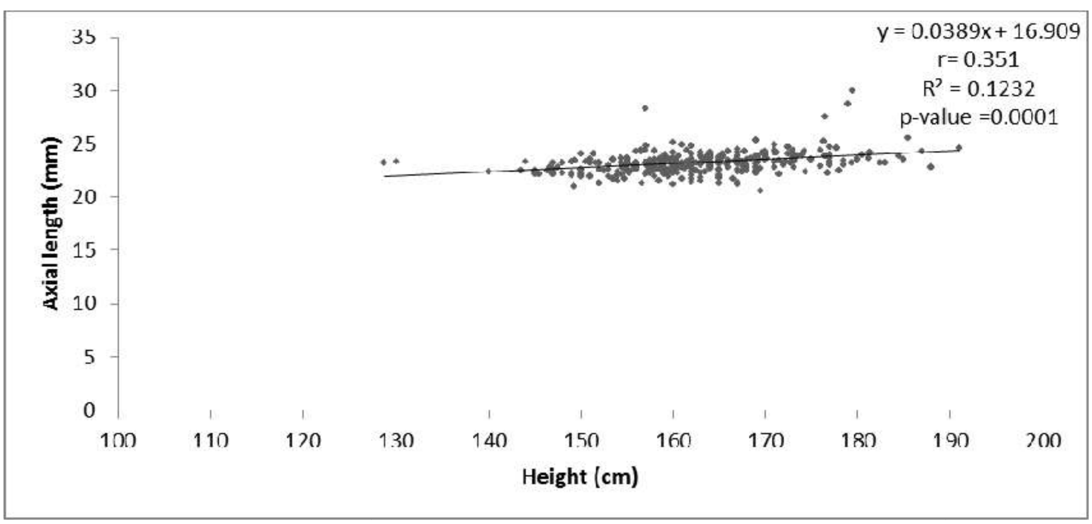

Fig. 2. Relationship between axial length and height in the general population
Bivariate linear regression

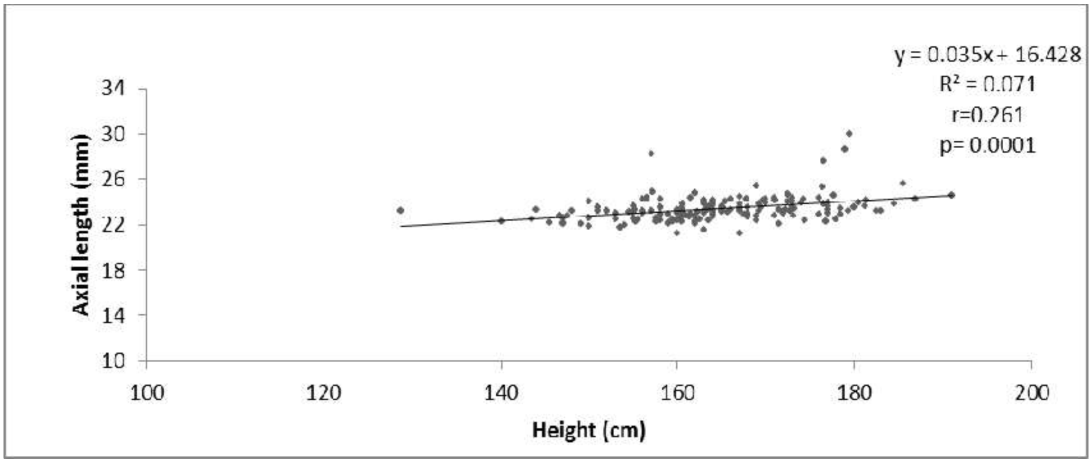

Fig. 3. Relationship between axial length and height in males
Bivariate linear regression

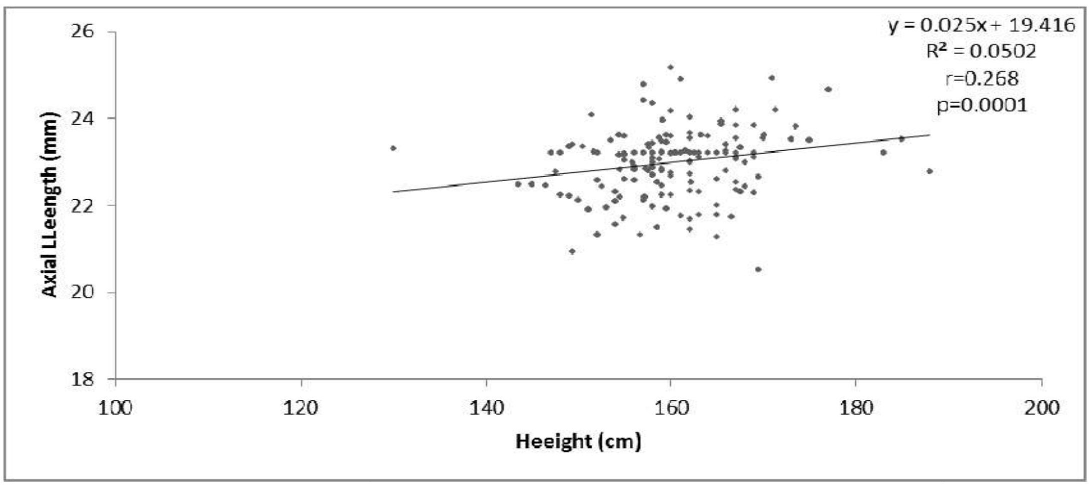

Fig. 4. Relationship between axial length and height in females
Bivariate linear regression

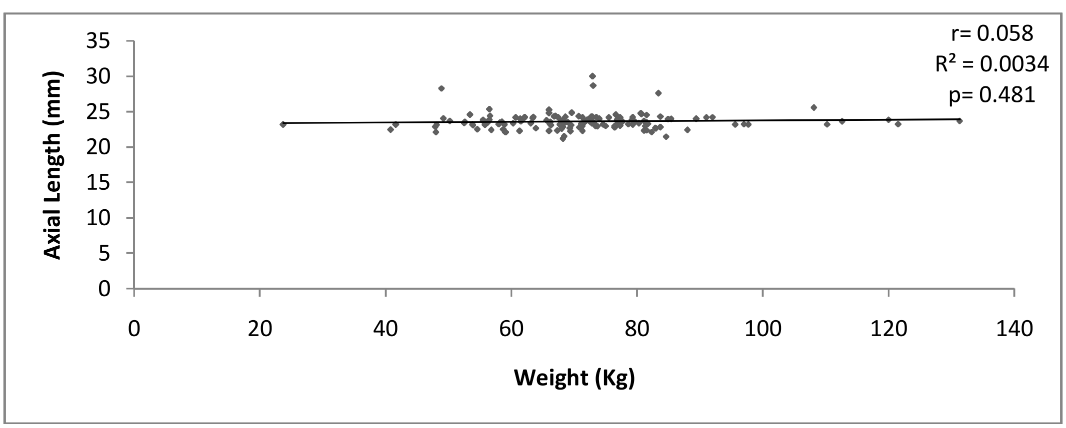

Fig. 5. Relationship between weight and axial length in males
Bivariate linear regression

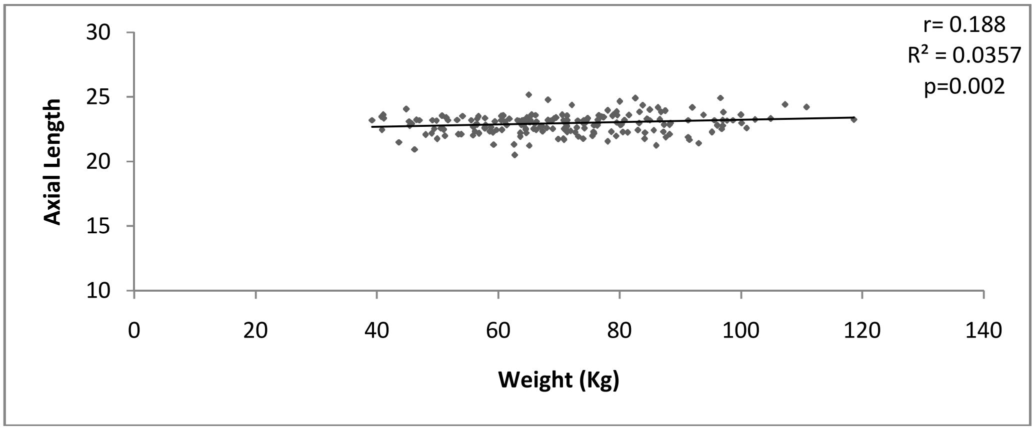

Fig. 6. Relationship between weight and axial length in females
Bivariate linear regression

4. DISCUSSION

This study describes anthropometric parameters affecting ocular axial length in Niger Delta region of Nigeria. This could add to the data bank for AL in the country and form a basis for identifying deviations from the normal, for further research.

Most of the subjects studied were of Rivers ethnicity (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.

The mean axial length of the population in this study was 23.2±1.0 mm which was similar to the values noted by Connell et al. [24] (23.03±1.61 mm), Hashemi et al. [7] (23.14 mm) and other eye studies, [25,26] (23.25±1.14). It was however slightly lower than that obtained by Adio et al. (23.57±1.19 mm), and Iyamu et al. [13] (23.5±0.70 mm). 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.

The mean height in this study was 162.5±9 cm, and males were noted to be significantly taller than females (P=.0001). This was similar to the values noted in the Brazilian study by Pereira et al. [21] (160.26±8 cm) but was notably lower than the mean values of height noted in the Reykjavik eye study (176 cm) although in the latter study, males were also found to be significantly taller than females. The difference in the height may not be unrelated to the fact that the Reykjavik eye study was carried out among Scandinavians who are taller than the Nigerians in this study population. Conversely the mean height in this study was lower than that noted in the Central India eye study, [1] (156±9 cm) and may have been due to the difference in body stature between the two study populations [24].

The mean weight in this study was 70.5±14.8 kg with no significant difference in both genders. (p=0.898), this was also lower than the mean weight in the Reykjavik eye study (77.5 kg). Although in the latter, males were also noted to be heavier than females.

The statistically significant relationship between axial length and height noted in this study as shown in Figs. 2, 3 and 4 was similar to that noted on regression analysis in the Epic Norfolk study, [9] which stated that for every increase in height of 8 cm, there is an attendant increase in axial length of 0.21 mm. This was also the case in the study by Pereira et al. [21] where every 10 cm increase in height was associated with a 0.32 mm increase in axial length and the study on Mongolians by Uranchimeg et al. [27] where every 10 centimeter increase in height was associated with a 0.27 mm increase in axial length. Following the same trend, the Central India eye study, [1] also noted a 0.23 mm increase in axial length for every 10 cm rise in height. Similarly, in the Reykjavik study, [20] height was noted to correlate positively with axial length. This trend was however not noted in the study by Osuobeni et al. [19] where the relationship between axial length and height was lost after corrections for age. This difference in the relationship between axial length and height in this study may likely have been due to the fact that this latter study was carried out among sicklers with average height attained reduced due to the chronic nature of the illness and thus not comparable.

A statistically significant relationship was noted between axial length and weight in only the female gender. This relationship was however not noted in the male gender (Figs. 5, 6). This is similar to results noted in the Reykjavik study, [20] where weight was said to be unrelated to all ocular parameters. The Epic-Norfolk study noted a relationship between axial length and weight, but majority of the studies did not show a relationship between axial length and weight.

5. CONCLUSION

This study noted that there are significant relationships between AL and height as well as weight respectively. This could add to the data bank for AL in the country and form a basis for identifying deviations from the normal, for further research.

CONSENT

As per international standard, patient's informed written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
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