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## Correlation Between Height and Width of Orbital Opening Among the Igbo Ethnic Group of Nigeria: A Radiologic Study

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### ABSTRACT

the orbit is roughly pyramidal in shape with the apex located posteriorly forming the optic canal and the base located anteriorly forming the orbital margin. The orbital margin has the form of a quadrilateral with rounded corners. The aim of this study was to investigate the correlation between orbital height and width among the Igbo ethnic group of Nigeria. A total number of 350 radiographic films of subjects aged between less than one year and seventy nine years (<1year – 79years) were collected, comprising of 217 males and 133 females, from the National Orthopaedic Hospital, Enugu, Nigeria. The orbital height was measured from the frontal film as the maximal distance between the superior and inferior orbital margins. The orbital width was also measured from the same frontal film as the maximal distance between the medial and lateral orbital margins. The data gathered were presented in scattergrams and analyzed using Microsoft excel, version 2007. The coefficients of correlation and determination were determined. The significance of correlation was also calculated and was considered statistically significant at 95% confidence level (that is when  $P < 0.05$ ). The result showed that there is a strong positive correlation between orbital height and width with correlation coefficient of 0.7 which was statistically significant ( $P < 0.05$ ). For the first time, it was shown that when one of the parameters of the orbital opening (orbital height or width) is known, a rough estimate could be made of the other parameter with some degree of accuracy. It is recommended that since there are racial discrepancies in orbital dimensions, similar study be carried out in other populations so as to assist surgeons in their practice.

**Keywords:** orbital height, orbital width, correlation, Igbo ethnic group

### INTRODUCTION

The orbit is a confined space bounded by four bony walls. Due to the fact that it is made up of many bones and that it has fissures, foramina and canals, the orbit is said to have a very complex structure. However, the orbit is roughly pyramidal in shape with the apex located posteriorly forming the optic canal and the base located anteriorly forming the orbital margin. The orbits are aligned so that the medial walls are parallel and the lateral walls are perpendicular. The arc from medial to lateral wall in each orbit is  $45^\circ$ . Lines dropped through a central anterior-to-posterior axis of each orbit meet at an angle of  $45^\circ$ . The length of the floor is two-thirds the depth of the orbit.

The orbital margin has the form of a quadrilateral with rounded corners. The orbital margin usually has the form of a spiral; the inferior orbital margin is continuous with the anterior lacrimal crest, while the superior is continued down into the posterior lacrimal

crest. The lacrimal fossa thus lies in the medial orbital margin.

The studies of the orbit, its dimensions and volume have long been done by many researchers in various parts of the world. The use of vernier calipers to study the dimensions of the orbital rims is a common process even to the present day. However, with the advancement in technology, the study of the orbit at present day could be done more accurately with the aid of various radiological techniques.

Many anthropologists had given various values to the dimensions and volumes of the orbit in various populations.<sup>1,2,3</sup> Orbital dimensions had been found to vary among different races.<sup>4,5,6,7</sup> Racial variations were recognized as the result of evolutionary process, that is, mutations that are inheritable are acted upon by natural selection. Racial differences, thus, reflect current environmental pressure, genetic drift, past and present

hybridization between geographically distinct subspecies and the present selective adaptation of human varieties to their environment.<sup>8</sup> Bentley et al.<sup>9</sup> and Haas et al.<sup>6</sup> all agreed that there were no significant differences between the right and the left orbits. Orbital dimensions had also been correlated with sex and age.

Whereas some researchers established gender differences in orbital dimensions,<sup>10,11,12,13</sup> others<sup>7,9,14</sup> all agreed that there was no significant difference between males and females in all parameters studied. However, it was proposed that there could be a correlation between orbital width and height. The aim of this study was to investigate the correlation between orbital height and width among the Igbo ethnic group of Nigeria. Studies such as this are of paramount importance as a thorough understanding of orbital anatomy is essential to fully appreciate the effects of disease on the orbit and therefore useful for performing safe orbital surgery<sup>15</sup>. This study would also be of help to surgeons especially when performing reconstructive surgery in and around the orbit.

#### MATERIALS AND METHODS

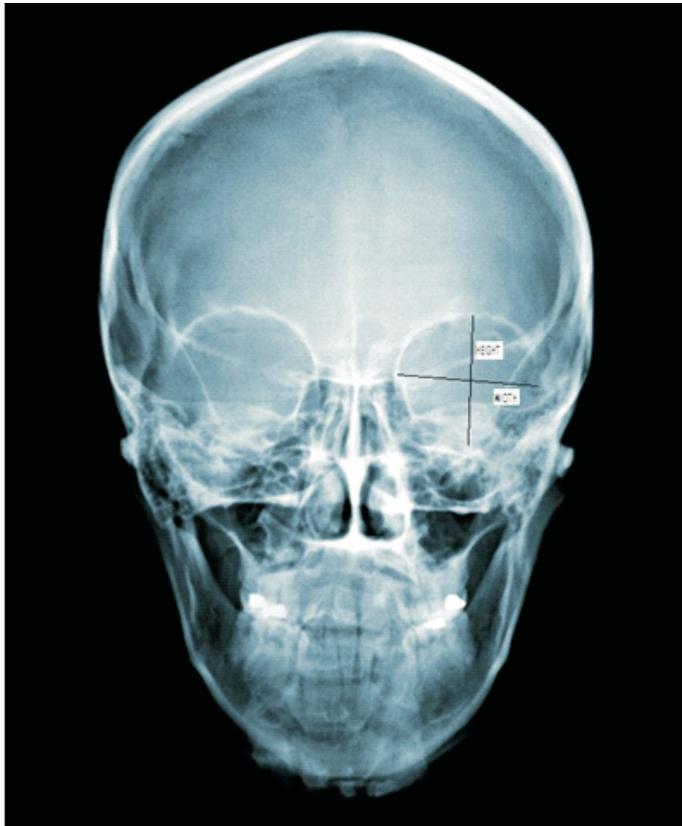
The study was carried out retrospectively in the National Orthopedic Hospital Enugu using Plain X-rays of the Water's (frontal) view of the skull that were taken between 2000 and 2006.

A total number of 350 radiographic films (Water's view) of patients aged between less than one year and seventy nine years (<1year – 79years) were collected, comprising of 217 males and 133 females, from the National Orthopaedic Hospital, Enugu, Nigeria from which a total of 700 orbital margins were measured (350 from each side).

Measurements were only taken on skulls that were evidently healthy or, if pathology was present, from those that did not affect the dimensions of the orbit. Information on the age and gender were also gathered from the hospital cards. All cases of raised intracranial or intraorbital pressures as reported by the radiologists were discarded. The films that were selected for the study were strictly those of the Igbos based on the information given by the subjects and filled in their cards. Non-Igbos were not included in the study.

In addition to the radiographs employed in this research, other materials that were helpful in my measurements include: an X-ray illuminator, a metre rule calibrated in millimetres and a pair of dividers.

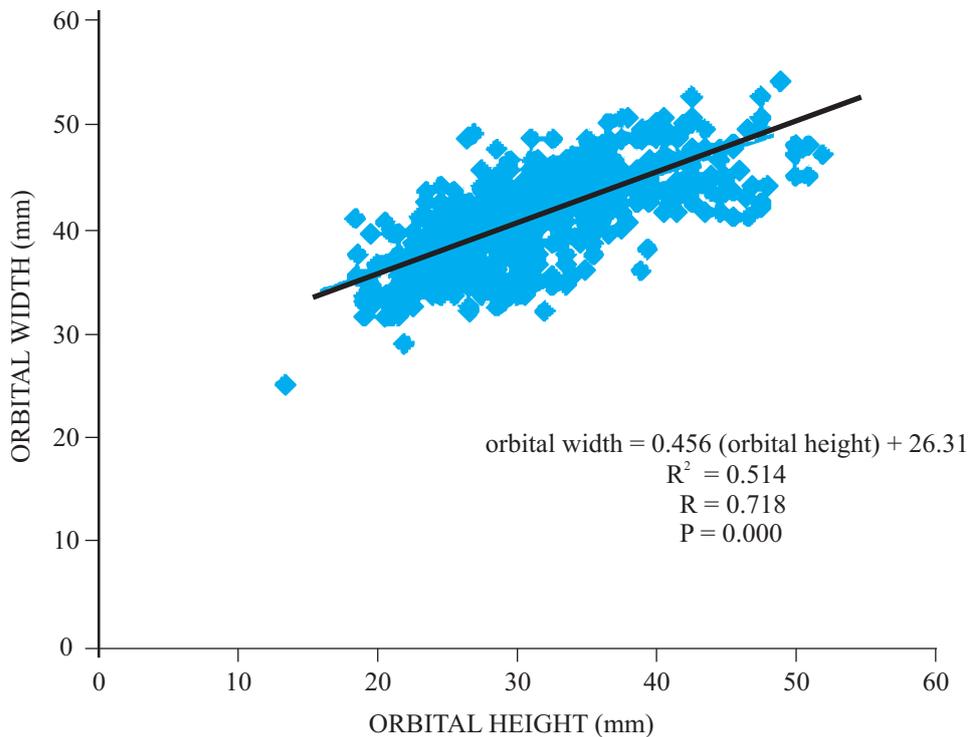
The orbital height was measured from the frontal film as the maximal distance between the superior and inferior orbital margins. The orbital width was also measured from the same frontal film as the maximal distance between the medial and lateral orbital margins.



**Figure 1:** Plain film showing the orbital margin and measurement of orbital width and height.

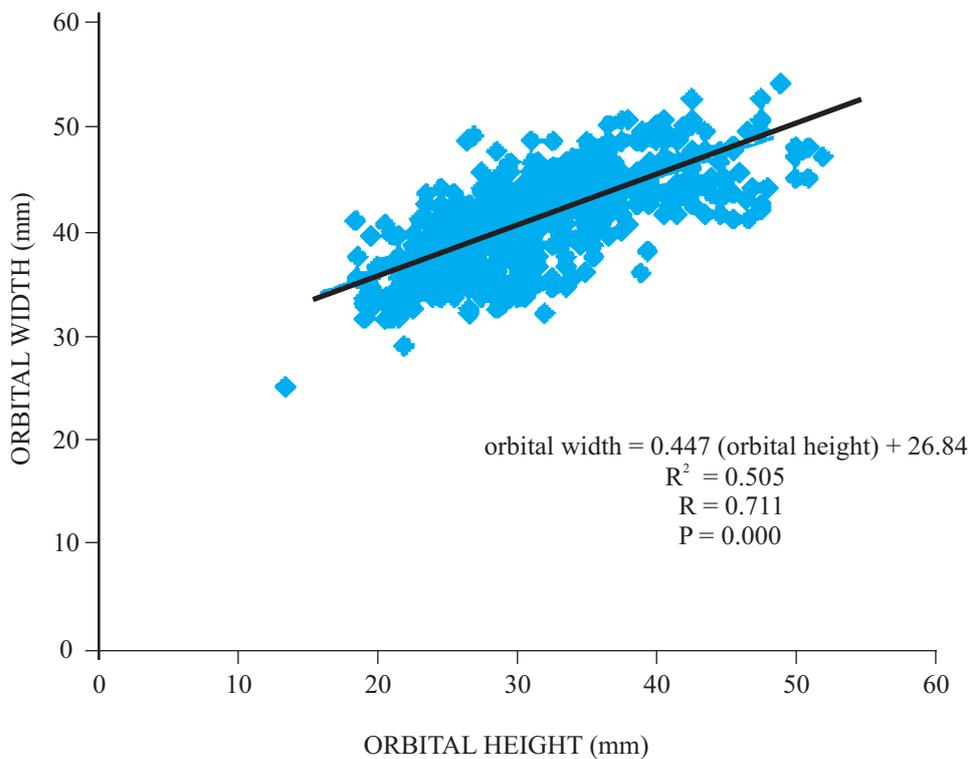
The data gathered were presented in scattergrams and analyzed using Microsoft excel, version 2007. The coefficients of correlation and determination were determined. The significance of correlation was also calculated and was considered statistically significant at 95% confidence level (that is when  $P < 0.05$ ).

## RESULTS



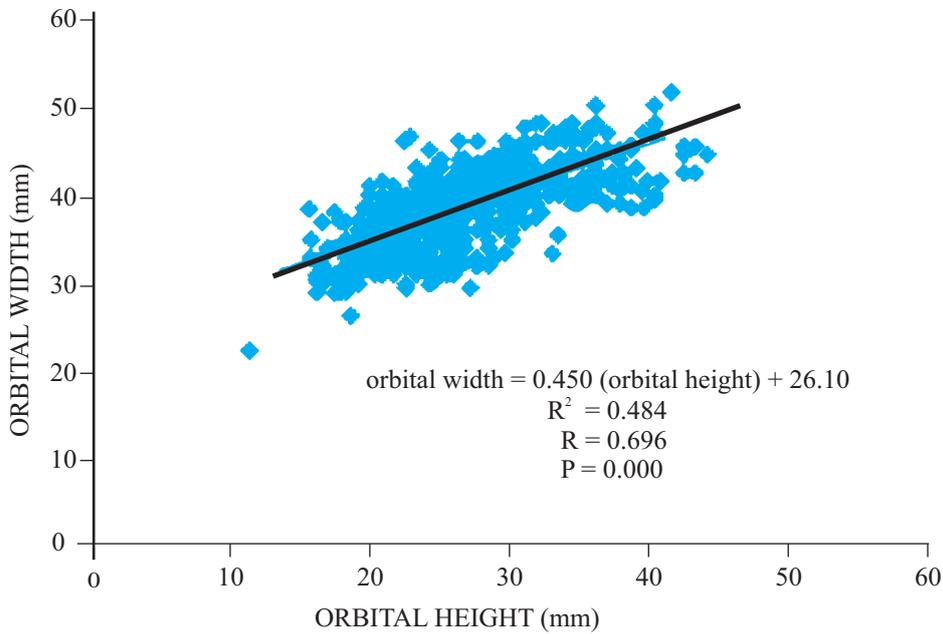
**Figure 2:** Correlation between orbital height and orbital width (irrespective of genders and sides)

From figure 2 above, there was a strong positive correlation of orbital height with orbital width [orbital width = 0.456(orbital height) + 26.31] with the coefficient of correlation (R) equal to 0.718 and the coefficient of determination ( $R^2$ ) equal to 0.514. This relationship is statistically significant ( $P < 0.05$ ).



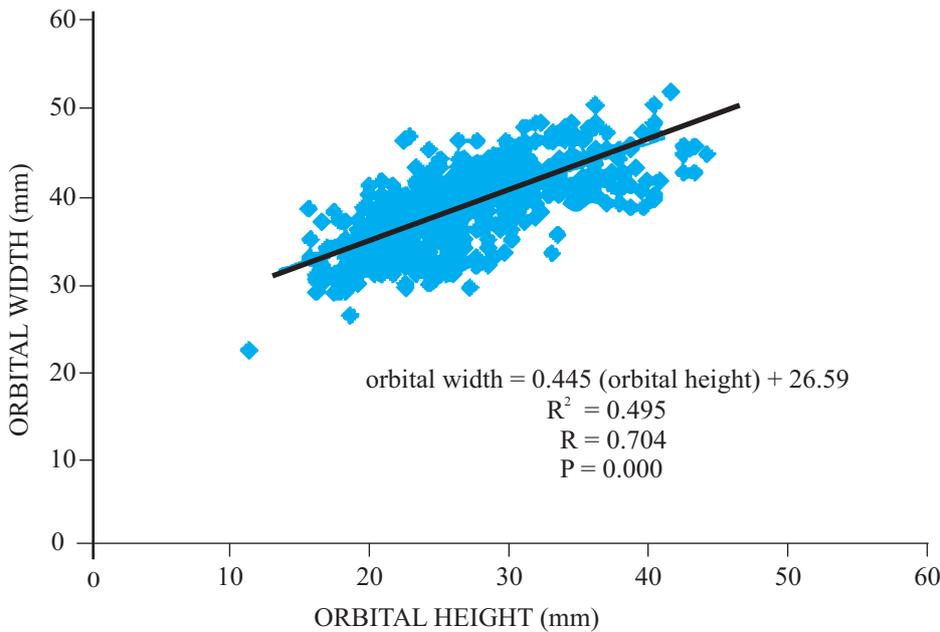
**Figure 3:** Correlation between orbital height and orbital width in males (irrespective of sides)

From figure 3 above, there was a strong positive correlation of orbital height with orbital width [orbital width =  $0.447(\text{orbital height}) + 26.84$ ] in males with the coefficient of correlation (R) equal to 0.711 and the coefficient of determination ( $R^2$ ) equal to 0.505. This relationship is statistically significant ( $P < 0.05$ ).



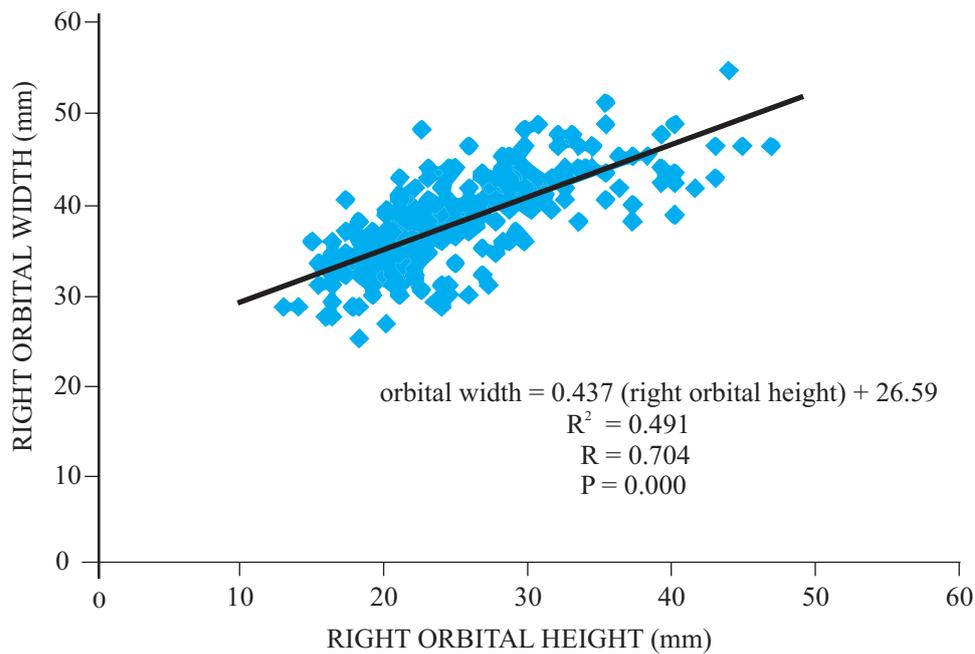
**Figure 4:** Correlation between orbital height and orbital width in females (irrespective of sides)

From figure 4 above, there was a strong positive correlation of orbital height with orbital width [orbital width =  $0.450(\text{orbital height}) + 26.10$ ] in females with the coefficient of correlation (R) equal to 0.696 and the coefficient of determination ( $R^2$ ) equal to 0.484. This relationship is statistically significant ( $P < 0.05$ ).



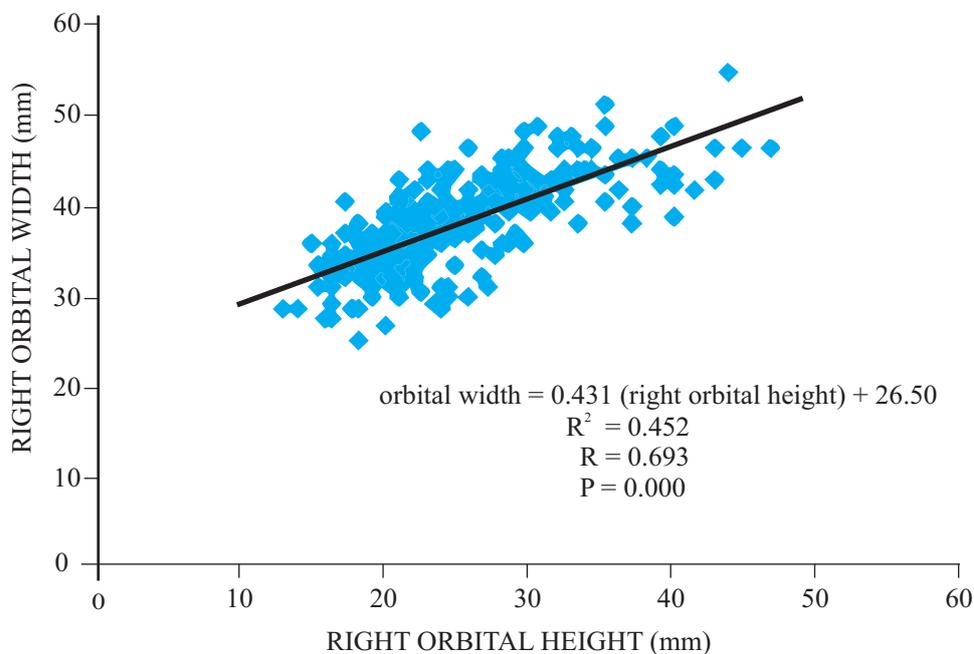
**Figure 5:** Correlation between right orbital height and right orbital width (irrespective of gender)

From figure 5 above, there was a strong positive correlation of right orbital height with right orbital width [right orbital width =  $0.445(\text{right orbital height}) + 26.59$ ] with the coefficient of correlation (R) equal to 0.704 and the coefficient of determination ( $R^2$ ) equal to 0.495. This relationship is statistically significant ( $P < 0.05$ ).



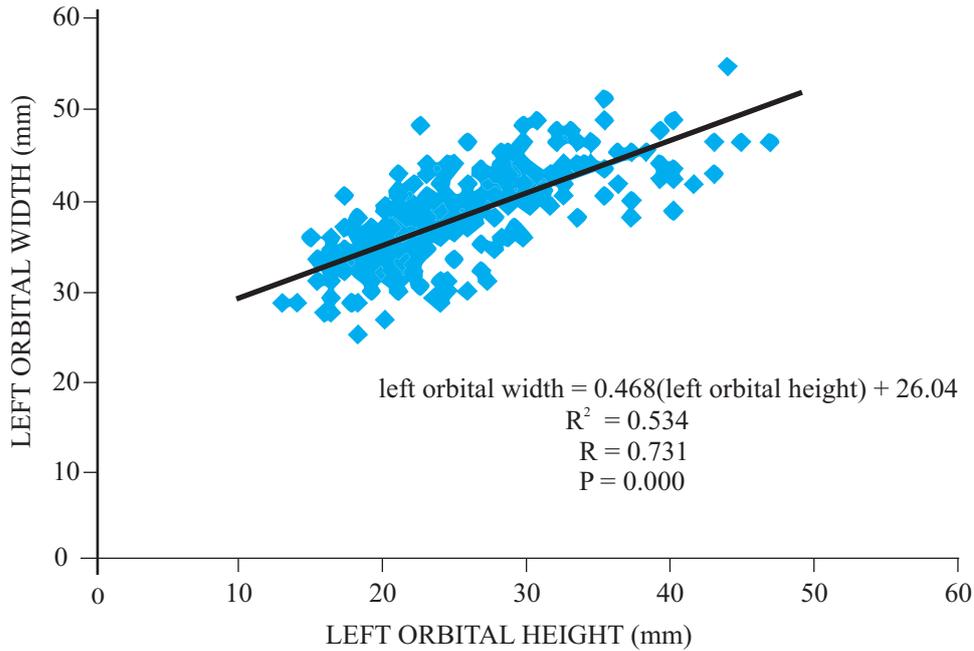
**Figure 6:** Scattergram showing correlation between right orbital height and right orbital width in males

From figure 6 above, there was a strong positive correlation of right orbital height with right orbital width [right orbital width = 0.437(right orbital height) + 27.10] in males with the coefficient of correlation (R) equal to 0.704 and the coefficient of determination ( $R^2$ ) equal to 0.491. This relationship is statistically significant ( $P < 0.05$ ).



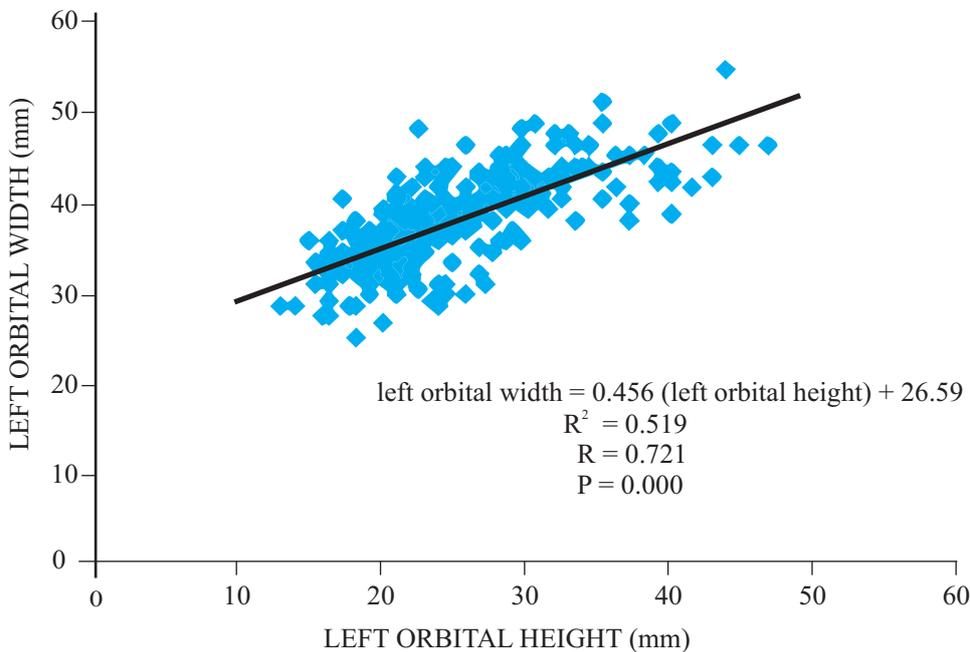
**Figure 7:** Correlation between right orbital height and right orbital width in females

From figure 7 above, there was a strong positive correlation of right orbital height with right orbital width [right orbital width = 0.431(right orbital height) + 26.50] in females with the coefficient of correlation (R) equal to 0.693 and the coefficient of determination ( $R^2$ ) equal to 0.452.



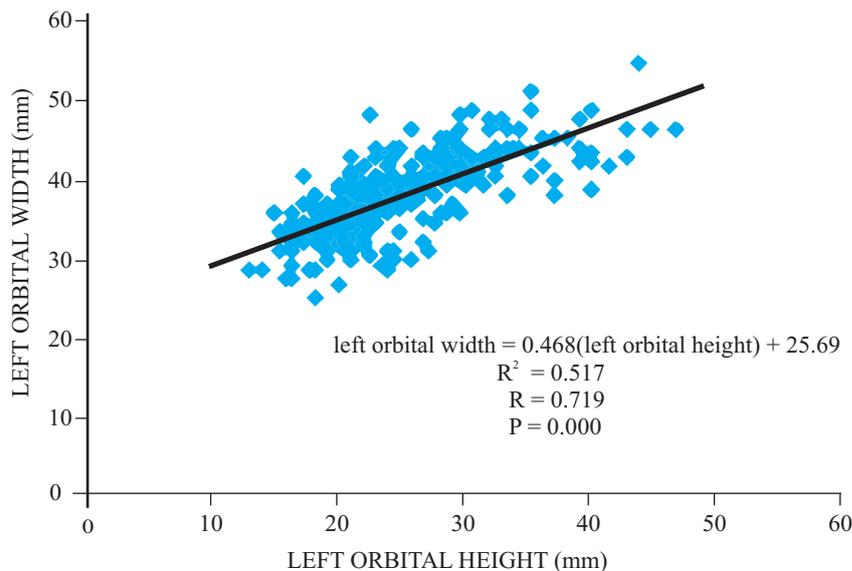
**Figure 8:** Scattergram showing correlation between left orbital height and left orbital width (irrespective of gender)

From figure 8 above, there was a strong positive correlation of left orbital height with left orbital width [left orbital width = 0.468(left orbital height) + 26.04] with the coefficient of correlation (R) equal to 0.731 and the coefficient of determination ( $R^2$ ) equal to 0.534. This relationship is statistically significant ( $P < 0.05$ ).



**Figure 9:** Scattergram showing correlation between left orbital height and left orbital width in males

From figure 9 above, there was a strong positive correlation of left orbital height with left orbital width [left orbital width = 0.456(left orbital height) + 26.59] in males with the coefficient of correlation (R) equal to 0.721 and the coefficient of determination ( $R^2$ ) equal to 0.519. This relationship is statistically significant ( $P < 0.05$ ).



**Figure 10:** Correlation between left orbital height and left orbital width in females

From figure 10 above, there was a strong positive correlation of left orbital height with left orbital width [left orbital width = 0.468(left orbital height) + 26.69] in females with the coefficient of correlation (R) equal to 0.719 and the coefficient of determination ( $R^2$ ) equal to 0.517. This relationship is statistically significant ( $P < 0.05$ ).

## DISCUSSION

The present study presented the correlation between orbital height and width among the Igbos of Nigeria. Whereas previous works had established the values of orbital dimensions in various populations,<sup>1,2,3,16,17,18</sup> none had been able to establish the relationship between the two parameters. Ezeuko et al.<sup>19</sup> had shown the orbital height of Igbos to be 26.62±0.27mm and orbital width to be 39.39±0.17mm.

For the first time, it was shown that when one of the parameters of the orbital opening (orbital height or width) is known, a rough estimate could be made of the other parameter with some degree of accuracy. Previous studies<sup>6,9,16,17,18,19</sup> had also shown that the dimension of the orbital opening is symmetrical. Thus, from the present study, when the dimensions of the orbital opening of one side are known, it could be possible to make an estimate of the contralateral side. However, studies had shown that this dimensions, are gender specific.<sup>10,11,12,13</sup> Thus it is imperative to put the gender into consideration while making estimation of the orbital dimensions.

The study showed that in males, right orbital width = 0.437(right orbital height) + 27.10 while the left orbital width = 0.456(left orbital height) + 26.59. In females, right orbital width = 0.431(right orbital height) + 26.50 while the left orbital width = 0.468(left orbital height) + 25.69. In all, the coefficient of correlation was found to be 0.7 indicating a strong positive correlation between orbital height and width. This relationship was also found to be statistically significant ( $P < 0.05$ ) on both sides in both sexes.

In conclusion, this study has established a correlation between orbital height and width among the Igbos of Nigeria. It is recommended that since there are racial discrepancies in orbital dimensions, similar study be carried out in other populations so as to assist surgeons in their practice.

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