

# Study of prosopic index of Nigerian skulls

## Abstract

**Background and objectives:** The prosopic index exhibits different shapes of face and sexual differences. This information will be an invaluable tool for Plastic surgeons, Forensic Scientists, Anatomists, Criminologists & Physical Anthropologists. The present study aimed at measuring facial length and face width of Nigerian skulls.

**Methodology:** One hundred Nigerian skulls 78 males and 22 females were used for this study. Automatic Vernier caliper was used to measure facial width and facial length. Data was analyzed with Graph Pad Prism 5.03. The mean, coefficient of variation, percentiles, sexual dimorphism ratio were computed and prosopic index was calculated.

**Result:** Nigerian males had a prosopic index of 90.66 and females had higher value of 96.15. In the incidence of male prosopic index, majority of the skulls were Mesoprosopic (29.49%), the least number were Hypereuriprosopic (10.26%) for male while female had Hyperleptoprosopic (45.5%) (highest), least Mesoprosopic (18.18%), Hypereuriprosopic and Euriprosopic were not seen. The Bizygomatic length of male and female were  $139.2 \pm 1.10$  and  $124.8 \pm 1.44$  mm respectively. The mean of nasion-gnathion length (mm) were  $126.2 \pm 1.18$  and  $120.0 \pm 0.87$  mm for male and female respectively. The sexual dimorphism ratio was greater than unity.

**Conclusion:** The findings from this study will be of immense help to surgeons and forensic experts.

**Keywords:** prosopic index, face length and width, anthropometry, skull, nasion – gnathion, bizygomatic, mesoprosopic

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## Introduction

Facial appearance is to a large extent determined by the convexities and concavities of the underlying facial bones projection provided by the zygomatic bone and mental protuberance of the mandible.<sup>1</sup>

These appearances determine the facial attractiveness and beauty of an individual. The facial skeleton consists of the frontal bone superiorly, the bones of the mid face and the mandible inferiorly. The mid face is bounded superiorly by the zygomaticofrontal suture lines, inferiorly by the maxillary teeth, and posteriorly by the sphenothmoid junction and the pterygoid plates. The bones of the mid face include the maxillae, the zygomatic bones, palatine bones, nasal bones, zygomatic processes of the temporal bones, lacrimal bones, ethmoid bones, and turbinates. To create a more youthful, natural-looking form, the surgeon endeavors to reverse some of the changes that occur due to aging. These involves rhytidectomy, platysmaplasty, autologous fat transfer, implants, or endoscopic techniques and a sound knowledge of facial anatomy and anthropometry is vital in order to increase the likelihood of success and reduce the incidence of undesirable results or complications.

Prosopic Index (PI) is very useful anthropometric tool to find out racial and sexual differences and also give a clue to genetic transmission of inherited characteristics from parents to their offspring.<sup>2</sup> Prosopic Index (PI) is defined as the ratio of face length to face width multiplied by hundred: Prosopic index is classified into five groups namely hypereuriprosopic (very broad face), <79.9, euriprosopic (broad face) ranges from 80.0 to 84.9, mesoprosopic (round face) which is between 85.0 and 89.9, leptoprosopic (long face), ranges from 90.0 to 94.9 hyperleptoprosopic (very long face),

which is greater than 95.<sup>3</sup> Comparison of changes in facial index between parents, offspring and siblings can give a clue to genetic transmission of inherited characters. The main objective of this study was to find the prosopic index of Nigerian skulls. This will provide a data base of facial measurements that will help maxillo-facial surgeons with wide range of facial dimensions which would be helpful in facial reconstruction surgery.

## Methodology

A total of one hundred adult dry skulls (78 males, 22 females), free from damage and deformity fully ossified obtained from Departments of Anatomy in Nigerian Universities were used for this study. Automatic Vernier caliper was used to measure the following parameters zgyon-zygion and nasion - gnathion length.

### Bizygomatic length

It measures the straight distance between the two zygia i.e. the most lateral point on the zygomatic arch. The skull was placed with Norma basal facing the observer (Figure 1).

### Nasion- gnathion (Total facial height)

It measures the straight distance between nasion –gnathion. The skull was kept with Norma frontalis facing the observer (Figure 2).

Data was analyzed with Graph Pad Prism 5.0. The mean, standard deviation, standard error of mean, maximum, minimum, geometric mean, coefficient of variation, percentiles, sexual dimorphism ratio were computed. Prosopic index was calculated. Student's T-test was used to compare male-female parameters.

$$\text{Prosopic index} = \frac{\text{Facial length}}{\text{Facial width}} \times 100\%$$



Figure 1 Bizygomatic length.



Figure 2 Nasion- gnathion.

Nasion, This is the midpoint of the sutures of the frontal and nasal bones. Gnathion (GN), Most inferior point of the mandible in the midline (mid-sagittal plane).

### Results

Table 1 shows Prosopic indices of male and female (%) were represented in Table 1 with male having prosopic index of 90.66 while female had 96.15. Table 2 shows Sexual dimorphism ratio. The male/female ratios for the mean measurements were greater than unity in all.

Table 3 shows maximum, minimum, geometric mean, coefficient of variation and mean zygion-zygion (bizygomatic) length (mm) and nasion -gnathion length. The Bizygomatic length of male and female were  $139.2 \pm 1.10$  and  $124.8 \pm 1.44$  mm respectively. The Nasion - gnathion length of male and female were  $126.2 \pm 1.18$  and  $120.0 \pm 0.87$  mm respectively. The difference was significant at  $p < 0.05$ . Table 4 shows percentiles of facial width (bizygomatic length), facial height (nasion- gnathion) and prosopic index. There was a progressive increase in length of facial width (bizygomatic length), facial height (nasion- gnathion) and prosopic index from 10<sup>th</sup> percentiles to 90<sup>th</sup> in both male and female. Male values were higher than female. The prosopic index was higher in female than male.

Figure 3 shows the incidence of male and female prosopic index. Majority of the skulls in male were Mesoprosopic (29.49%), while female were Hyperleptoprosopic (45.5%).

Table 1 Prosopic indices of male and female (%)

Sex	Prosopic Index (%)
Male	90.66
Female	96.15

Table 2 Sexual dimorphism ratio

Parameters	Male mean(mm)	Female mean(mm)	Sexual dimorphism ratio
Nasion-gnathion	126.2	120	1.05
Bizygomatic length	139.2	124.8	1.12

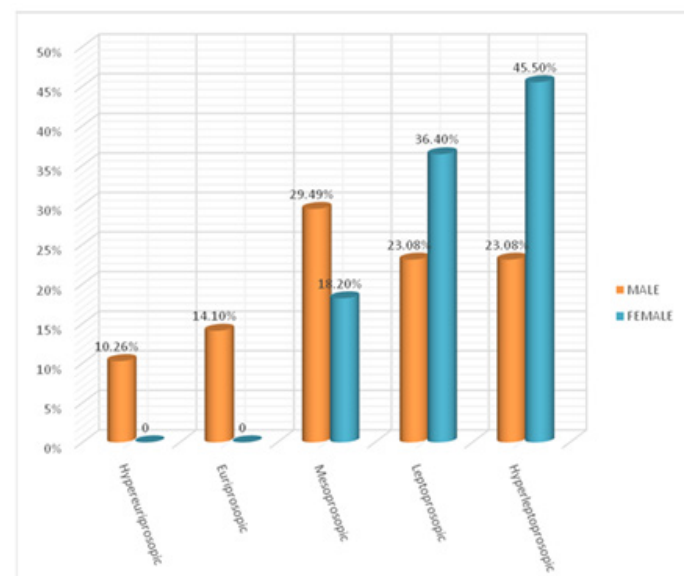


Figure 3 Incidence of male and female prosopic index.

**Table 3** Maximum, minimum, geometric mean, coefficient of variation, mean and SEM of Zygion Zygion (Bizygomatic) length(mm)

Parameters	Sex	Mean±Sem	Coefficient of variation	Geometric mean	Maximum	Minimum	Significant level
Nasion-gnathion	M	126.2±1.18	8.27%	125.7	145.2	102.6	p<0.05*
	F	120.0±0.87*	3.40%	120	126.3	112	
Zygomatic	M	139.2±1.10	6.95%	138.8	171.2	110.4	p<0.05*
	F	124.8±1.44*	5.39%	124.6	132.1	108.1	

**Table 4** Percentiles of facial width (bizygomatic length), facial height (nasion- gnathion) and prosopic index

Parameters	Sex	10 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup> (median)	75 <sup>th</sup>	90 <sup>th</sup>	Normality test
Facial width	Male	129.1	133.5	138.5	145	151.5	0.0944
	Female	114.5	119.4	127.6	130	131.7	0.1391
Facial height	Male	110.6	119.2	125.6	134.8	140	0.2018
	Female	113.7	116.7	121	122.6	125.9	0.5907
Prosopic index	Male	79.51	84.43	89.52	94.93	102.8	0.0460*
	Female	89.3	91.79	93.51	103.8	108.7	0.231

## Discussion

The present study shows that male prosopic index as 90.66% (leptoprosopic) while the female was 96.15% (hyperleptoprosopic). Dominant face type in this study in females was hyperleptoprosopic (45.5%), while the rarest types were hyperleptoprosopic (0%) and euriprosopic (0%). Dominant face type in this present study in males was mesoprosopic (29.49%), while the rarest type was hyperleptoprosopic (10.26%). Our findings are different from Shettir et al.,<sup>4</sup> study on prosopic (facial) index of Indian and Malaysian students. Malaysian males had a mean facial index of 85.72 and females had marginally higher value 87.71. Both belonged to mesoprosopic face type. Indian males had a mean facial index of 87.19 where as 86.75 in females with both sexes belonging to the mesoprosopic face type. They reported that dominant type of face shape in Malaysian males was euriprosopic whereas females showed mesoprosopic with 34% each respectively.<sup>4</sup> Least common type was hyperleptoprosopic (4%) in males and females hyperleptoprosopic and hyperleptoprosopic (8%) face shape each. Among Indian males dominant type of face shape was mesoprosopic with 32% and females had dominant type of mesoprosopic and euriprosopic with 32% each respectively.

Hyperleptoprosopic type was least common type in both males and females with 5% and 9% respectively. The present findings also differs from Prasanna et al.,<sup>5</sup> result which recorded total facial index between north Indian males (101.4±1.95) and females (107.7±7.69) and south Indian males (100.28±1.77) and females (85.39±6.33). Prasanna et al.<sup>5</sup> reported that southern Indian males are hyperleptoprosopic whereas females are mesoprosopic while North Indian males and females have hyperleptoprosopic. Pandey<sup>6</sup> in his study on Indians of Andaman and Nicobar Island indicated that almost 60% males and 77% females were hyperleptoprosopic (had very broad faces) This is different from our report of males (mesoprosopic 29.49%) and females (hyperleptoprosopic 45.5%). Raji et al.<sup>7</sup> reported that Nigerians are hyperleptoprosopic in both genders. Similarly the present study has shown Nigerian females have hyperleptoprosopic face type while male are mesoprosopic. Ghosh et al.<sup>8</sup> study which was

done on West Bengal population (India) reported that Indians from this area are euriprosopic to hyperleptoprosopic in both genders differs. This is different from the present findings which recorded that female have hyperleptoprosopic face type while male are mesoprosopic. Jahanshahi's et al.<sup>9</sup> study on Fars and Turkmans of Iran revealed that they had mesoprosopic to euriprosopic round face contradict our findings. Maina et al.<sup>10</sup> on craniofacial forms among three dominant ethnic group of Gombe state, Nigeria reported facial shape of Fulani males and females were hyperleptoprosopic (PI>95); Tangale males and females were both leptoprosopic (PI between 90 and 94.9); Tera males were leptoprosopic (PI 94.1) while their females were hyperleptoprosopic (PI 102.4). However, total mean prosopic indices in all males (PI 93.7) and females (PI 98.1) of the three tribes placed them in the leptoprosopic and hyperleptoprosopic groups respectively. Hyperleptoprosopic face type was found to be the dominant face type among all the tribes (>35%) in both sexes except Tangale males whose dominant face type was leptoprosopic (32.69%).

While the rarest face type was hyperleptoprosopic in all the tribes (<8%) except in Fulani males where euriprosopic face type was the rarest (2%). This is in line with the present findings which also reported prosopic indices in males (PI 90.66) and females (PI 96.15), the incidence doesn't differ to any noteworthy degree from Maina et al.<sup>10</sup> findings. Farahani et al.<sup>11</sup> on estimation of facial indices in males 19-20years old reported that the dominant type of face shape of males aged 19-20years was mesoprosopic agrees with our findings. Similarly Farahani et al.<sup>12</sup> in their work titled 'Anthropometric indices in females 16years in Kerman reported the dominant type of face shape of females (16years of age) was mesoprosopic, differs from the present results. Jahanshahi et al.<sup>9</sup> in their work titled the effect of ethnicity on facial anthropometry in Northern Iran Singapore among Fars and Turkman ethnic groups found that the dominant type of face shape in both native Fars and Turkman females was euriprosopic (37.7% and 51.7%, respectively). In contrast with our findings reported dominant face type in females to be hyperleptoprosopic (45.5%). The dominant type of face shape in both native Fars and



Turkman males was mesoprosopic (44% and 38.4%, respectively) which is in line with our finding with a report of mesoprosopic (29.49%) too. The mean facial index in Turkman males and females were 87.25% and 81.48% respectively. The mean facial index in Fars males and females were 88.22% and 84.48% respectively. The rare type of face shape was hyperleptoprosopic (5.8%) in the native Fars females and leptoprosopic (3%) in Turkman females. The rare type of face shape in the native Fars males was hyperleptoprosopic and hypereuryprosopic (4% each) and in Turkman males, it was hypereuryprosopic (8.6%) differs with present findings with facial index of 90.66% and 96.15% for male and female respectively and the rare type of face in female was hypereuryprosopic (0%), euriprosopic (0%) and hypereuryprosopic (10.38%) in male.

In a study by Bhasin<sup>13</sup> Indians showed dominant type face shape of mesoprosopic well correlated with our findings which also showed that dominant type of face in male was mesoprosopic. The mean value of facial index among Indians as 86.34 which varied from 75 among Naga Sundan of Nagaland to 122.80 in Bhil Khandesh of Maharashtra region is in contrast with our findings which showed facial index of 90.66% and 96.15% for male and female respectively. In a study of craniofacial measurements by Nagle et al.,<sup>14</sup> among Latvian and non-Latvian residents reported that Latvian residents had longer face comparable with the present study which reported female to have longer face.

Heidari et al.<sup>15</sup> on 'Morphological evaluation of head and face in 18-25years old women in southeast of Iran reported that PI was significantly different in Sistani (Fars) and Baluchi women, and the dominant face type in Sistani (Fars) and Baluchi women were euryprosopic, with a statistically significant difference between them. The rare types were hypereuryprosopic and hyperleptoprosopic in the Sistani and hyperleptoprosopic in the Baluchi groups which is in contrast with the present study which reported hyperleptoprosopic as dominant and hypereuryprosopic and euriprosopic as rare types. Ghosh et al.<sup>8</sup> study on the Indian population reported that the hypereuryprosopic and euryprosopic types of facial forms are present in the highest and equivalent percentages in Santhals. However, females were generally hypereuryprosopic, while males were euryprosopic in their total facial index. The hyperleptoprosopic face was the rarest type of facial form in both genders. The gender difference was statistically significant in their total facial index. Differs from the present study which reported female hyperleptoprosopic in their total facial index while male were leptoprosopic in their total facial index, dominant face type were hyperleptoprosopic and mesoprosopic for female and male respectively. The rarest type of facial form was mesoprosopic and hypereuryprosopic for female and male respectively.

Prasanna et al.<sup>5</sup> in their study titled facial indices of North and South Indian Adults: Reliability in Stature Estimation and Sexual Dimorphism found facial height between north Indian males (123.6±4.0) and females (117.0±7.4) and south Indian males (119.7±5.9) and females (101.0±6.2) and a significant difference was obtained between males and females (p<0.001). The findings differed from our own research which reported higher values. Shettir et al.<sup>4</sup> studied prosopic (facial) index of Indian and Malaysian students and reported facial height between India males (11.08±0.62cm and females (10.48±0.5cm) and Malaysian males (11.14±0.54cm) and females (10.48±0.5cm) and a significant difference was obtained between males and females (p<0.001). That observation is different from the present study. The face length ranged from

10cm to 12.5cm in males and females showed minimum of 9.6cm to maximum of 12 cm while the present study ranged from 145.2-102.6mm for males and 126.3-112.0 mm for female. Nagle et al.<sup>14</sup> reported Latvian males mean face length of 12.48±0.5cm and Latvian females face length of 11.88±0.65cm. This is in accordance with the present study which reported Nasion -gnathion length of male and female to be 126.2±1.18mm and 120.0±0.87 mm respectively. The difference was statistically significant at p<0.05. Roopakun et al.<sup>16</sup> in craniometric studies using 104 skulls (63 males and 41 females) reported Bizygomatic breadth to be 133.7±5.1 and 127.7±5.2 for male and female respectively. The same is true of data compiled by Kajanjola<sup>17</sup> in his study in sex determination of Finnish crania by discriminant function analysis using reported bizygomatic breadth to be 13.33±0.56cm and 12.5±0.59cm for male and female respectively. This is in line with the present study that showed male length to be higher than female. The difference is statistically different at p<0.05. Deshmukh et al.<sup>18</sup> using total no of 74 adult human crania of known sex (40 males & 34 females) available in department of Anatomy reported bizygomatic breadth 126±4.82 and 121±6.47 for male and female respectively and all were found to be significant by univariate analysis with p<0.05. This differs from the present study but is true of data compiled by other workers<sup>19,20</sup> on sexual dimorphism in the crania and mandibles of South African whites using 43 male and 46 female reported bizygomatic breadth 128.9±4.41 and 121.9±3.49 all were statistically significant at p<0.05.<sup>19</sup> Vidya et al.<sup>20</sup> in their work titled anthropometric Predictors for Sexual Dimorphism of Skulls of South Indian found bizygomatic breadth to be 12.7±1.56 and 12.0±1.45cm for male and female respectively.

The data from the present study are slightly higher than values reported by others.<sup>4,5,21,22</sup> Kranioti et al.<sup>21</sup> in their work titled 'Craniometric analysis of the modern Cretan population' found that Bizygomatic breadths were 130.54±5.13 and 122.07±4.57mm for male and female respectively all statistically significant at p<0.001. Franklin et al.<sup>22</sup> studied sexual dimorphism and discriminant function sexing in indigenous South African crania in three indigenous South African subgroups (Natal Nguni, Cape Nguni and Sotho). They found in the South African series that the Bizygomatic breadths to be 122.6±5.35 and 115.7±4.49mm for male and female respectively. In Sotho bizygomatic breadth were 121.7±5.73 and 115.1±4.52mm for male and female respectively. In Cape Nguni they reported bizygomatic breadth as 122.6±5.84 and 116.6±4.98 for male and female respectively whereas in Nata Nguni the bizygomatic breadth were 126.6±4.56 and 116.0±4.29 for male and female respectively. Prasanna et al.<sup>5</sup> reported the bizygomatic breadth between north Indian males (122.2±3.1) and females (108.8±2.11) and south Indian males (119.3±4.7) and females (118.5±4.9) and a significant difference was obtained between males and females (p<0.001). Shettir et al.<sup>4</sup> reported bizygomatic breadth between Indian males (12.73±0.60cm) and females (12.12±0.72cm) and Malaysian males (13.02±0.63cm) and females (11.97±0.68cm) and a significant difference was obtained between males and females (p<0.001). The face width ranged from 12cm to 14.7cm in males and 10.4cm to 14.3cm in females.

Ahmed et al.<sup>23</sup> reported that sexual dimorphism ratio (male/female ratios) for the mean measurements were greater than unity, indicating that the male crania were larger in all linear dimensions than female crania. This correlates well with the present study which reported that sexual dimorphism ratio for the mean measurements were greater than unity too, indicating that the male crania were larger in all linear dimensions than female crania.

## Conclusion

The mean prosopic index of Nigerian population has been identified. There is a significant difference present in prosopic index between the males and females. The predominant face type for Nigerian population is Mesoprosopic (29.49%) for males and Hyperleptoprosopic (45.5%) for females. This study will serve as a vital tool to forensic expert with respect to race classification and cosmetic surgeons.

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## Conflict of interest

Author declares that there is no conflict of interest.

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