

Analysis of nasal parameters and nasal index of dry crania in Southern Nigeria

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Abstract

Background: Nasal index shows the ratio of the width to the height of the nasal skeleton. It is useful in forensic science, anthropology and clinical medicine. The aim of this study was to analyse the nasal parameters and nasal index of dry cranium in Southern Nigeria.

Methods: Nasal height (ns-n) and nasal breadth (al-al) were measured with a Vernier caliper in 150 adult male crania in southeast and southsouth geopolitical regions of Nigeria. From these variables, nasal index was calculated as nasal breadth/nasal height x 100.

Results: For the southeast region, the values of nasal aperture height, nasal breadth and nasal index were 52.4 (± 5.1) mm, 27.6 (± 2.7) mm and 53.0 (± 5.4) respectively. For the southsouth region, the values of the nasal height, nasal breadth and nasal index were 49.8 (± 3.1) mm, 26.9 (± 4.2) mm and 54.1 (± 7.4) respectively. Nasal height was significantly higher in southeast region than in southsouth region. There was no significant difference in the nasal breadth and nasal index in the two regions.

Conclusions: The crania in the southern part of Nigeria exhibit platyrrhine type of nasal index

Keywords: Nasal height; Nasal breadth; Nasal index; Cranium; Nigeria

1. Introduction

Anthropometry is the measurement of the human body. It is an early tool of physical anthropology [1]. The piriform aperture is the pear shaped anterior nasal opening, which is bounded by the nasal bones superiorly, palatal process of the maxilla inferiorly and frontal process of maxilla laterally [2, 3]. Nasal anthropometry is therefore the study of size, proportion and shape of the nose or the underlying bone.

The morphometrics of the anterior nasal aperture appears to be a distinguishing characteristics of the hominid [4]. The nose is at the centre of the face. Therefore, it is the beauty defining feature of the face of an individual [1]. The shape and dimensions of the anterior nasal aperture is affected by several factors which include climate/geographical location, race, ethnicity, age and sex [5]. This is why there is great variation in the parameters of the anterior nasal aperture across populations. Consequently, race, ethnicity and sex can be predicted from the morphometrics of the anterior nasal aperture [1]. The nose is widely accepted as one of the best indicators of racial origin [6].

Among the parameters of the anterior nasal aperture, nasal index is the one that is mostly affected by regional or climatic differences [1]. Nasal index is the ratio of the width to the height of the piriform aperture expressed in percentage [7]. The understanding of the morphometrics of the anterior nasal aperture is crucial in the field of anthropometry, population study, forensic science, facial reconstructive surgery, syndromology, genetic counselling [6,8] and rhinology

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[5]. Nasal index is equally useful in the analysis and classification of fossil remains as well as the study of living population [5].

Nasal index is important in forensic science in classification of fossil remains, estimation of ancestry, estimation of sex of individuals and also in understanding evolution [9]. Europeans tend to have a narrower triangular opening while Africans tend to have a much wider and more rectangular opening [4, 10]. This observation shows that these variations may have resulted from adaptation to physiological and functional need of the climate [11]. Narrower nose is favoured in cold weather and dry climate while broader nose is favoured in warmer climate [6,9]. Some studies have associated nasal index with nasal size, oxygen utilization, average temperature and humidity [10].

The skull is more durable than other bones because it resists fire, explosions, mutilations and decomposition. Therefore, it is a preferred bone for the purpose of identification [12]. Nasal index as well as cranial index and orbital index is commonly used in sexing the skull, and this give high accuracy [12].

The clinical importance of dimensions of anterior nasal aperture is evident in its significance in facial reconstructive surgery, neurosurgery and otorhinolaryngology [6,10]. It has been shown that surgical or traumatic alterations of the piriform aperture may alter the respiratory mechanics [2,3]. Assessment of the nasal bone and piriform aperture is done preoperatively to estimate the pattern of the nose, soft tissues as well as skeletal changes essential for an improved surgical outcome [13]. Furthermore, during surgical procedures for treatment of tumours of anterior and medial cranial base, the anterior nasal aperture is widened in subcranial, transnasal, and transsphenoidal approaches [11].

The aim of this study is therefore to characterize the nasal parameters and nasal index in Southern part of Nigeria for its possible use in forensic anthropology and in medicine; and to add to the body of literature.

2. Materials and Methods

The study was a cross sectional study in which one hundred and fifty (150) dry adult male crania were collected after obtaining ethical approval from the Faculty of Basic Medical Sciences of our Institution. The samples were taken in the Southeast and Southsouth part of Nigeria, consisting of about eleven States in Nigeria. The skeletal materials were lodged in the Anatomy Department of Institutions within the study region. Southeast zone is mainly occupied by Igbos while the Southsouth region is mainly occupied by the Ijaws [14].

Inclusion criteria includes intact crania while exclusion criteria include crania that were poorly preserved, whose important landmarks are destroyed. Measurement was taken with a Vernier caliper (Gilson tools Japan, 0-150mm X 0.05/6" X 1/128, with precision of 0.05mm). Two measurements were taken and the mean was calculated.

The variables that were studied include the nasal height, nasal width and nasal index. The definitions of the variables and landmarks is as follows (figure 1).



Figure 1 Landmark for measurement

- Nasospinale (ns) is the point where a line tangent to the inferiormost points of the two inferior curves of the anterior nasal aperture margin crosses the midline.
- Nasion (n) is the midline point where the two nasal bones and the frontal intersect
- Alare (al) is instrumentally determined as the most lateral point on the margin of the anterior nasal aperture.
- Nasal height (ns-n) is the midline distance from nasospinale to nasion [15].
- Nasal width (al-al) is the distance between alare on both sides.

$$\text{Nasal index} = \text{nasal width} / \text{nasal height} \times 100$$

The sampling technique was purposive type of convenience sampling. Therefore, all available skeletal materials in the Institutions that were visited were studied.

Data analysis was done with the Statistical Package for Social Sciences (SPSS version 25). Descriptive statistical methods (mean and standard deviation) were applied to the data. Test of significance of difference between means was done with student's t test. Nasal index was calculated as the ratio of nasal width to nasal height multiplied by 100. The nasal index of skull is categorized into four based on Martin and Sallar classification [5,10]. This include:

- leptorrhine (nasal index less than 47)
- mesorrhine (47 to 50.9)
- platyrrhine (51 to 57.9)
- Hyperplatyrrhine (58 or more).

3. Results

The mean, minimum, maximum and range of parameters in the southeast region is presented in table 1. The category of nasal index is platyrrhine.

Table 1 Means of nasal parameters in Southeast region

Variables	Mean (±SD)	Minimum	maximum	Range
Nasal aperture height (ns-n) (mm)	52.4 (±5.1)	44.6	93.2	48.6
Nasal aperture breadth (al-al) (mm)	27.6 (±2.7)	22.6	45.2	22.6
Nasal index (%)	53.0 (±5.4)	32.3	82.6	32.3

Similarly the mean, minimum, maximum and range of parameters in the southsouth region is presented in table 2. The category of nasal index here is also platyrrhine.

Table 2 Means of nasal parameters in Southsouth region

Variables	Mean (±SD)	Minimum	maximum	Range
Nasal aperture height (ns-n) (mm)	49.8 (±3.1)	42.1	56.4	14.3
Nasal aperture breadth (al-al) (mm)	26.9 (±4.2)	20.4	49.4	29.0
Nasal index (%)	54.1 (±7.4)	40.4	90.64	50.6

The nasal aperture height is significantly higher in southeast region than in southwest region with a Cohen's d of 0.54 (Table 3).

Table 3 Variables of combined southeast and southwest region

	Southeast	Southwest				Combined
Variables	Mean (±SD)	Mean (±SD)	t	P value	Cohen's d	Mean (±SD)
Nasal aperture height (ns-n) (mm)	52.4 (±5.1)	49.8 (±3.1)	2.980	0.003	0.54	51.7 (±4.8)
Nasal aperture breadth (al-al) (mm)	27.6 (±2.7)	26.9 (±4.2)	1.113	0.268		27.4 (±3.2)
Nasal index (%)	53.0 (±5.4)	54.1 (±7.4)	-1.070	0.286		53.2 (± 6.1)

4. Discussion

The nose is situated at the centre of the face. It therefore defines the beauty of the face [1]. Aside its cosmetic value, the nose gives identity to an individual. The morphometry of the anterior nasal aperture is therefore an important element of forensic anthropology. In addition, it finds application in anthropometry, population study, facial reconstructive surgery, syndromology, genetic counselling [6,8].

A limitation of our study was scarcity of skeletal samples in our Institutions. Furthermore, a major limitation is unavailability of female crania in the study area. This made it difficult to do gender based analysis which is more useful for forensic study.

In our study, the mean nasal aperture height of the southeast region is significantly higher than that of the southsouth group. However, there was no significant difference in the mean values of nasal aperture width and nasal index. The difference may be due to variation in population genetics. Nasal morphometry does not only exhibit variation in races. It also exhibit inter-tribal and cultural variation [10].

Human variation is of great value as it yields itself a valuable tool for population study. Variation in population is affected by such factors as mutation and adaption of species [5]. Morphometric studies help in understanding the relationship between these factors and the distribution of various morphometric features in humans. It is reported that people who live in cold weather and dry climate tend to have narrower nose while people who live in warmer climate tend to have broader nose [6,9]. Therefore Europeans tend to have a narrower triangular nasal opening while Africans tend to have a much wider and more rectangular opening [4,10]. This assertion is logical because it is known that the moistening and heating of the inspired air are better with a narrow piriform aperture [3]. This observation suggests that these variations may have resulted from adaptation to physiological and functional need of the climate [11].

In the present study, the mean nasal index for the population is 53.2%; this is described as platyrrhine. This is comparable to the findings of Orish et al [16] in Nigeria. It is higher than the findings recorded in previous studies in Brazil, India and Thailand (Table 4).

Table 4 Comparison of nasal index from several studies

Study	Population	Nasal index (%)
Present study	Southern Nigeria	53.2
Fernandes et al [9]	Brazil	50.6
Khan et al [8]	Nepal	47.74
Dhanwate et al [12]	India	50.76
Orish et al [16]	Nigeria	53.67
Mahakkanukrauh et al [17]	Thailand	50.50

It is important to note that several authors use the word nasal index to refer to different things. Some authors studied nasal index in living individuals. As such, the landmarks for measurement is different and the values cannot be compared with measurements obtained from skeletal samples. For works conducted on the skull, several authors used different landmarks for measuring nasal height. Landmark for measuring nasal breadth was however constant. Some authors [2] measured nasal height as the distance from the highest point of piriform aperture to the nasospinale, whereas some

other authors (including the present study) measured nasal height as the distance from nasion to nasospinale. The values that will be obtained from the former will be lower (therefore giving higher nasal index) than the values that will be obtained from the later. Therefore, before interpreting the value of a nasal index, one must determine the landmarks that was used for measurement. Because of this, we were careful to compare the findings of our study with only the works that used the same landmarks for measurement of nasal height.

Even though the proportions of the nose vary between ethnic groups, the size and shape of the nose do not actually confer specificity of race such as Caucassian, Asian or African [4]. But nasal index exhibit sexual dimorphism [4] and therefore it is a useful tool in forensic science.

Rhinoplasty is the most popular type of plastic surgery [18]. It aims to reshape the nose in order to enhance the beauty of the face and to restore the function of the nose in cases of physical defect. The protruding part of the face, the nose, confer sense of beauty because it is located at the centre of the face [19,20]. Nasal morphometrics, especially the nasal index is especially important in rhinoplasty, because patient's perception of beauty after surgery is key to satisfaction. Chinski et al [21] reported that there was significant improvement in beauty indices following series of rhinoplasty. Several studies have shown that rhinoplasty may improve self-esteem, body image, social interactions and hence quality of life [22,23].

5. Conclusion

The dimensions of nasal index in southeast and southsouth Nigeria were similar. Whereas the nasal height in the southeast region was higher than that of the southsouth region, the nasal index of both are mainly platyrrhine and is higher than nasal index reported in parts of America and Asia.

Compliance with ethical standards

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Disclosure of conflict of interest

There was no conflict of interest.

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