Morphometric Analysis of Nasofacial Parameters among the Okrika Tribe: Forensic and Clinical Significance

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ABSTRACT

Background: Craniofacial anthropometry measures the head and face, useful in fields like forensic science and plastic surgery. Nasofacial measurements show sexual dimorphism and stability during growth, aiding identification. Facial features differ between males and females due to sex hormones, with males having larger dimensions. Nasofacial parameters correlate with body height, helping with stature estimation in forensic contexts.

Aim: To determine the potential forensic and clinical implications of nasofacial parameters amongst the Okirika tribe.

Materials and Method: This study measured nasofacial parameters in 450 Okirika indigenes (245 males, 205 females) aged 18years and above. Exclusion criteria included nasofacial abnormalities or previous surgeries. Measurements included nasal length, width, facial length, and width using a digital vernier caliper. Height and weight were measured using a stadiometer and weighing scale respectively. Nasal index and body mass index were calculated. This study used the R programming for data analysis, using descriptive statistics and independent t-tests to investigate sex differences. Pearson's correlation coefficients assessed relationships between nasofacial measurements and stature. Level of significance was set at p-value<0.05.

Results: The study included 450 participants (54.5% males, 45.5% females). Males were significantly taller than females (mean height = 1.55 ± 0.12 m vs. 1.52 ± 0.10 m; p = 0.002). Males were found to significantly have greater nasal length (44.8 ± 8.43 mm vs 43.6 ± 8.48 mm, p = 0.0461) and facial width (116.0 ± 70.3 mm vs 108.0 ± 17.1 mm, p = 0.00871) compared to females. Facial length was higher in males but not statistically significant (p = 0.0562). Nasal index was marginally higher in females, indicating broader noses, but without statistical significance. Females had a higher body mass index (BMI) than males (31.1 vs 29.1 kg/m², p = 0.006). Nasal width (NW) and nasal index (NI) showed significant positive correlations with stature(r = 0.146, p = 0.002 and r = 0.106, p = 0.024, respectively). Individuals with wider noses or higher nasal indices tended to be taller. Other parameters like nasal length, facial length, and facial width didn't show significant correlations with height.

Conclusion: This study determined nasofacial anthropometric parameters in the Okrika population, revealing sexual dimorphism and correlations between nasal width and index with stature. These findings provide essential data for forensic identification and clinical applications, highlighting the importance of population-specific standards.

Keywords: Nasofacial parameters, stature, forensics, sexual dimorphism

INTRODUCTION

Anthropometry is the scientific study of the measurements of physical properties of the human body (Rahimi, et.al. 2019), and has been a fundamental component of physical anthropology since its inception in the 19th century. Within the broad field of anthropometry, craniofacial anthropometry has emerged as a specialized discipline focusing on the precise measurement of the head and face (Utkualp& Ercan, 2015). Among the various craniofacial parameters, nasofacial measurements have gained significant attention due to their relative stability during growth and development, resistance to environmental influences, and marked sexual dimorphism (Grabcika*et al.,* 2024). Evidence of previous researches have shown anthropometric variations across different populations, and this may be due to environmental, genetic and nutritional factors (Zobin, et. al., 2015; Mortezaee, et. al., 2013). Anthropometric parameters are useful in forensic medicine and also in clinical practice. In forensic medicine, it is useful in identifying unknown human skeletal remains,(Krishan, 2007); in clinical medicine, craniofacial anthropometry helps in determining craniofacial abnormalities, and also in designing prosthetic materials for plastic surgeries (Oladipo, et. al. 2015).Facial measurements, particularly those involving the nose, have been extensively documented to exhibit sexual dimorphism across various populations (Rahimi, et.al. 2019 amongst Iranians; Erekosima et al. 2022 amongst Ekpeye tribe Nigeria; Mohammed, et. al. 2018 among Hausa; Din, et. al. 2015 amongst Malasians; Omotoso, et. al. 2011 amongst Bini Tribe in Nigeria). Males generally display larger dimensions in most facial parameters compared to females, a phenomenon attributed primarily to the differential effects of sex hormones during puberty (Kleisner*et al.,* 2021). Additionally, nasofacial parameters have demonstrated significant correlations with body height in numerous anthropometric studies. This relationship forms the basis for stature estimation from fragmentary remains in forensic contexts, a critical application in disaster victim identification and criminal investigation (Gu *et al.,* 2024).

In forensic science, the ability to determine biological parameters such as sex, age, ancestry, and stature from skeletal or fragmented remains is paramount(Krishan, 2007). Traditional methods of skeletal sex determination have primarily relied on pelvic and cranial morphology, which, while highly accurate when complete, are often unavailable in fragmented remains; similarly, conventional stature estimation typically requires long bones, particularly those of the lower limbs, which may be missing or damaged in many forensic cases (Austin & King. 2016). There has been growing interest in developing alternative methods, including nasofacial parameters. Nasofacial measurements, being both sexually dimorphic and correlated with stature, present a promising alternative approach to biological profile estimation, especially in situations where traditional skeletal elements are unavailable (Solazzo *et al.,* 2025).This study was aimed at determining the potential forensic and clinical implications of nasaofacial parameters amongst the Okirika tribe.

MATERIALS AND METHODS

This study was a descriptive cross sectional study carried out in Okirika, Rivers State, Nigeria. Convenient sampling method was used to recruit 450(245 males, 205 females) adult indigenes of Okirika(18 years and above).The subjects were asked about their tribe to ensure that only those from Okirika by birth were used in the study. Non-indigens of Okirika tribe, indigens with previous nasal or facial surgeries, cleft palate or other nasal or facial anomalies were excluded from the study. The procedure was well explained to the subjects, verbal consent was given and measurements were done using the digital venier caliper, with the subjects sitting upright. The nasal length was measured as the distance between the nasion and the nasopinale; nasal width was measured as the distance between ala to ala (Erekosima, et. al. 2023). The morphological facial length was measured as the distance from the nasion to gnathion and morphological facial width was measured as the distance between right and left zygomatic arches. (Erekosima, et. al. 2023). Nasal index and body mass index were calculated.Nasal index was calculated as nasal width/nasal height ×100 (Pawar, et. al. 2021).Data obtained were analyzed using statistical R programming environment (version 4.3.2). Descriptive statistics (means, standard deviations, interquartile ranges) were computed. Continuous variables were presented as mean±SD, while categorical variables were presented in frequency and percentage. Prior to inferential analysis, the distribution of each continuous variable was assessed for normality using the Shapiro–Wilk test, supplemented by visual inspection of histograms and Q–Q plots, variables followed a normal distribution and were analyzed using parametric tests. Sex differences were determined using independent sample T-test. The association between nasofacial measurements (NL, NW, NI, FL, FW) and stature (height) was assessed using Pearson's correlation coefficient. The strength and direction of correlations were interpreted based on the correlation coefficient (r) and corresponding p-values. Confidence interval was set at 95% and *P* < 0.05 was considered statistically significant.

Sexual dimorphism index was calculated using the formula;

$$\frac{X_M - X_F}{X_F} \text{ multiplied by } 100$$

Where X_M = mean male parameter,
X_F = mean female parameter

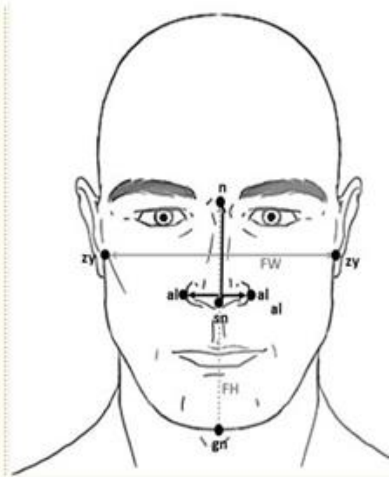

Fig. 1. Measurement of nasofacial parameters
Anthropometric measurements of nasofacial parameters. n Nasion, gn Gnathion, Zy Zygions, sn subnasale, al ala of nose, NL nasal length, NH nasal height, NW nasal width, FH facial height, FW facial width (Rahimi, et. al. 2019)

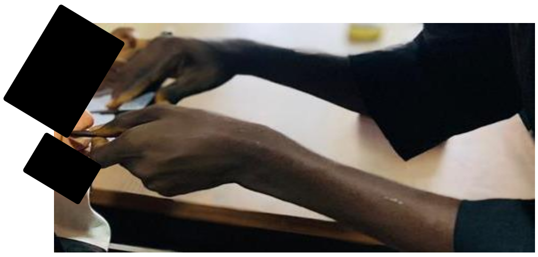

Fig. 2. Measurement of nasal parameters

RESULTS

Participants characteristics

A total of 450 participants were enrolled, comprising 245 males (54.5%) and 205 females (45.5%). Table 4.1 presents the result of the participants characteristics comparising of age, anthropometric parameters, and indices between male and female participants. The mean age of male participants was 38.5 ± 13.5 years, with an interquartile range (IQR) of 21 years, while that of females was 38.7 ± 15.6 years (IQR = 24 years). There was no statistically significant difference in age distribution between the sexes (p = 0.757). In addition, males' participants were significantly taller than females (mean height = 1.55 ± 0.12 m vs. 1.52 ± 0.10 m; p = 0.002). Although males weighed slightly less on average (69.1 ± 15.3 kg) compared to females (71.1 ± 15.5 kg), this difference was not statistically significant (p = 0.219).

The body mass index (BMI) was significantly higher in females (31.1 ± 7.44 kg/m²) compared with males (29.1 ± 6.9 kg/m²), indicating that females were more likely to be overweight or obese (p = 0.006).

Table 1: Participants characteristics

Parameters	Male (n=245, 54.4%)			Female (205, 45.6%)			P-value
	Mean	SD	IQR	Mean	SD	IQR	
Age (years)	38.5	13.5	21	38.7	15.6	24	0.757
Height(m)	1.55	0.12	0.10	1.52	0.10	0.20	*0.002
Weight(kg)	69.10	15.30	23.00	71.10	15.50	24.00	0.219
BMI(kg/m²)	29.10	6.90	9.3.0	31.10	7.44	10.80	*0.006

SD = standard deviation. IQR=interquartile range

Nasofacial Parameters

Table 2 presents the desc[illegible] nasofacial parameters measured among male and female participants in the Okrika population. The mean NL was 44.8 ± 8.43 mm in males and 43.6 ± 8.48 mm in females, with the difference reaching statistical significance (p = 0.046). Similarly, FW was significantly greater in males (116.0 ± 70.3 mm) compared to females (108.0 ± 17.1 mm),(p = 0.009). Although FL was slightly higher in males (133.0 ± 99.7 mm) than in females (120.0 ± 20.1 mm), this difference was not statistically significant (p = 0.0562). No significant sex differences were observed in NW or NI (p > 0.05). The nasal index was slightly higher in females (94.1 ± 27.9) than males (92.2 ± 20.4), suggesting relatively broader noses in females, though the difference was not statistically meaningful.

Table 2. Nasofacial parameters in male and female individuals of the Okrika tribe.

Parameters	Male			Female			P-value
	Mean	SD	IQR	Mean	SD	IQR	
NL	44.8	8.43	6.3	43.6	8.48	5.7	*0.046
NW	40.5	7.33	7.30	39.6	6.76	7.2	0.144
NI	92.2	20.4	19.3	94.1	27.9	23.1	0.861
FL	133.0	99.7	13.8	120.0	20.1	14.7	0.056
FW	116.0	70.3	19.5	108.0	17.1	18.9	*0.009

SD = standard deviation. IQR=interquartile range

Sexual Dimorphism in Nasofacial Parameters

Table 4.3 summarizes the assessment of sexual dimorphism in nasofacial parameters among the Okrika population. Sexual dimorphism index (SDI) was calculated as the percentage difference in nasofacial parameters between male and females to quantify the relative differences between males and females. Males had a higher nasal length (NL) (44.8 ± 8.43 mm) compared to females (43.6 ± 8.48 mm), resulting in an SDI of 2.82% and reaching statistical significance (p = 0.046). Similarly, facial width (FW) was significantly greater in males (116.0 ± 70.3 mm) than in females (108.0 ± 17.1 mm), with an SDI of 7.40% (p = 0.009).

Although facial length (FL) was higher in males (133.0 ± 99.7 mm) compared to females (120.0 ± 20.1 mm), this difference showed only a borderline significance (p = 0.056), suggesting a trend toward dimorphism. In contrast, nasal width (NW) and nasal index (NI) did not show significant sex differences (p > 0.05), with females exhibiting slightly higher NI values (−2.04% SDI), implying relatively broader noses proportionate to nasal length.

Table 3. Sexual dimorphism in nasofacial parameters within the Okrika population

Parameters	Male		Female		SDI	P-
	Mean	SD	Mean	SD	(%)	value
NL (Nasal Length)	44.8	8.43	43.6	8.48	**2.82**	**0.046**
NW (Nasal Width)	40.5	7.33	39.6	6.76	**2.25**	0.144
NI (Nasal Index)	92.2	20.4	94.1	27.9	**−2.04**	0.861
FL (Facial Length)	133.0	99.7	120.0	20.1	**10.6**	0.056
FW (Facial Width)	116.0	70.3	108.0	17.1	**7.40**	**0.009**

Correlation between Nasofacial Measurements and Stature

Table 4 presents the correlation between nasofacial measurements and stature (height) among the Okrika population. Although mean nasofacial measurements were reported separately for males and females, correlation analysis was performed on the combined dataset to determine the overall relationship between nasofacial parameters and stature in the Okrika population. Among the parameters assessed, nasal width (NW) demonstrated a statistically significant positive correlation with staturein the Okirika Population (r = 0.146, p = 0.002). Similarly, nasal index (NI) showed a weaker but still significant positive correlation with stature in the Okirika Population (r = 0.106, p = 0.024).

On the other hand, NL, FL and FW exhibited very weak positive correlations with height (r < 0.05) that were not statistically significant (p > 0.05).

Table 4. Correlation between nasofacial measurements and stature among Okrika population in Rivers State.

Parameters	Male		Female		Correlation	P-value
	Mean	SD	Mean	SD		
NL (Nasal Length)	44.8	8.43	43.6	8.48	0.006	0.898
NW (Nasal Width)	40.5	7.33	39.6	6.76	0.146	*0.002
NI (Nasal Index)	92.2	20.4	94.1	27.9	0.106	*0.024
FL (Facial Length)	133.0	99.7	120.0	20.1	0.047	0.318
FW (Facial Width)	116.0	70.3	108.0	17.1	0.043	0.359

DISCUSSION

This present study showed a clear pattern of sex differences in several nasofacial parameters and a notable sex difference in body mass index. The findings of this study revealed that although males were significantly taller than females, females

exhibited a higher mean Body Mass Index (BMI). This suggests that the observed sex difference in BMI within the Okrika population may be attributed to body composition and fat distribution rather than age or total body mass. Similar findings have been reported in several Nigerian and international studies. For instance, Segun *et al.* (2024) in Ibadan observed that females had significantly higher BMI compared to males, attributing this to lifestyle factors, reproductive hormonal influences, and differences in fat metabolism. Likewise, Adeloye *et al.* (2021) in Delta State found higher BMI among women, suggesting that sedentary lifestyle patterns and dietary preferences play a role. Internationally, Pan *et al.* (2021) reported comparable trends in Chinese adults, noting that estrogen and postmenopausal hormonal changes favor adipose accumulation in females. Similarly, Islam *et al.* (2024) identified a global pattern of higher obesity rates among women, especially in low- and middle-income countries, due to sociocultural and metabolic factors. Conversely, some studies have contradicted this pattern. In northern Nigeria, Bahir, (2025) reported higher BMI among males, attributing it to occupational physical inactivity and higher caloric intake. Similarly, Al-lahou *et al.* (2025) in Kuwait found higher male BMI, potentially reflecting regional dietary habits and lifestyle differences. Such inconsistencies may result from variations in socioeconomic status, physical activity levels, and cultural perceptions of body image that influence weight gain patterns differently across populations. The observed higher BMI in females within the Okrika population may therefore be influenced by a combination of biological and sociocultural factors. Estrogen promotes fat deposition, especially in subcutaneous and central regions, while sociocultural norms may encourage reduced physical activity and acceptance of larger body sizes among women. Additionally, differences in occupational activities—where men are often more engaged in labor-intensive work—could further explain the lower male BMI values.

This present study also showed significant sexual dimorphism in certain nasofacial parameters among the Okrika population, with males exhibiting greater nasal length and frontal width compared to females. These findings align with earlier studies in Nigeria and other regions indicating that males generally possess larger nasofacial dimensions due to greater craniofacial bone growth and hormonal influences during puberty. Eboh (2021) reported higher nasal length and facial breadth among Nigerian males, attributing these differences to androgenic effects on bone structure. Similarly, Oladipo et al. (2020) found significantly higher nasal dimensions in Ijaw and Yoruba males, suggesting that sexual dimorphism in facial morphology may be genetically and hormonally determined. Similar findings were documented by Udoaka et al. (2023) among the Ibibio population, where males had greater nasal and facial dimensions. A study by Adebayo et al. (2022) in northern Nigeria observed no significant gender difference in nasal width or index, suggesting that environmental and ethnic variations might influence craniofacial measurements. Internationally, Prasanna et al. (2021) in India also found similar nasal indices across sexes, indicating population-specific variation in dimorphism expression. The larger facial and nasal dimensions in Okrika males may be attributed to genetic and environmental factors, which collectively contribute to the structural robustness and broader craniofacial architecture observed in men.The significant sexual dimorphism in nasofacial parameters found in this study amongst the Okirika population may be helpful in forensic identification of unknown human remains, and also clinically may be useful in reconstructive procedures by maxillofacial, orthodonticsand plastic surgeons which will enhance better aesthetic outcomes.

This present study revealed a modest but significant positive correlation between nasal width and stature, indicating that taller individuals tended to have wider nose within the Okrika population. This agrees with findings by Eboh (2021) and Udoaka et al. (2023) in Nigeria, who observed similar

associations, suggesting that nasal dimensions may scale proportionally with overall body growth. Koirala et al. (2020) in Nepal and Prasanna et al. (2021) in India also reported positive correlations between nasal parameters and height, emphasizing the role of craniofacial growth patterns in predicting stature. However, contrasting findings by Adebayo et al. (2022) showed no significant relationship between nasal width and stature among northern Nigerians, possibly due to ethnic or environmental variations. The correlation in this study may result from shared genetic determinants of skeletal development and the adaptive influence of climate on nasal morphology and body size.

Overall, the findings reveal notable sexual dimorphism among the Okrika population, with males exhibiting greater height, nasal length, and facial width, while females showed higher BMI and nasal index. Additionally, nasal width and index correlated positively with stature, suggesting interconnected growth patterns between facial morphology, body composition, and overall physique.

CONCLUSION

This study established baseline nasofacial anthropometric parameters for the Okrika tribe, highlighting key differences between males and females. While males were generally taller with greater nasal length and facial width, females exhibited higher BMI and slightly broader nasal indices. Nasal width and nasal index showed significant correlations with stature, underscoring their relevance in forensic height estimation. These findings not only demonstrate sexual dimorphism within the population but also provide valuable reference data for clinical applications such as reconstructive surgery and forensic identification. Ultimately, the study underscores the importance of population-specific anthropometric standards in ensuring accuracy and cultural relevance in both medical and forensic practices.

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