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RESEARCH ARTICLE

ANTHROPOMETRIC STUDY OF FACIAL AND NASAL INDICES OF THE AKAN ETHNIC POPULATION OF GHANA

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ABSTRACT

Introduction: Facial anthropometry is required in many medical and dental disciplines, particularly for prosthodontists, orthodontists, plastic surgeons, maxillofacial surgeons, and forensic medicine experts. An individual's facial shape is a reflection of their race, age, and gender. The present study aimed at determining the facial and nasal indices among the Akan ethnic group in Kumasi, Ghana.

Methodology: A total of 307 (182 males and 125 females) Akan adult volunteers between the age of 18 - 30 years were recruited for the study. Standard procedures were used to obtain the necessary facial and nasal measurements for generating the appropriate indices. A p-value of 0.05 or less was judged statistically significant.

Results: In males, the facial index ranged from 75.28 to 117.90, while in females it ranged from 76.58 to 97.87. The nasal index ranged from 52.0 to 115.3 in males and 52.0 to 105.7 in females. There were significant differences between males and females in all facial parameters utilized to calculate facial and nasal indices. The facial index, but not the nasal index, differed significantly between Akan males and females. Mesoprosopic was the most prevalent face type in both male and female Akan populations, whereas mesorrhine was the most common nose type.

Conclusion: The findings of this study can be used as a reference to improve the outcome of cosmetic and reconstructive facial surgery and rhinoplasty, as well as for medico-legal purposes in the Akan people of Ghana.

Keywords: *Akan; Anthropometry; Facial index; Ghana; Nasal index*

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INTRODUCTION

Understanding and analyzing facial parameters is essential in a variety of medical and dental specialities, particularly for prosthodontists, orthodontists, plastic surgeons, and maxillofacial surgeons[1,2]. Facial anthropometric data is also useful in the development of personal protective equipment and forensic medicine[3]. The dimensions of the face differ greatly between races due to genetic, environmental, dietary, and climatic influences[1-6]. The majority of people desire to maintain their core ethnic characteristics while undergoing cosmetic enhancement. Because of this, applying Caucasian standards to other ethnic groups could lead to dissonant face proportions. Therefore,

facial anthropometry data must be established for each population[1,4,6].

We conducted this study utilizing facial anthropometric data to document and provide baseline data of facial and nasal indices since according to our knowledge no such study has been conducted among Akans in Kumasi, Ghana. The finding will benefit craniofacial surgeons given Ghana's booming cosmetic surgery market.

METHODOLOGY

This study was a cross-sectional study involving 307 persons with Akan ancestry up to the second generation Akans (182 males and 125 females). To reduce the possible effect of ageing on facial measurements, participants between 18 to 30 years of age were recruited. This study excluded pregnant women, those with craniofacial injuries, facial scars, visible tumours or oedema, and those who have had facial fractures or surgery.

All standard anthropometric measurements of the face were taken in the Frankfurt plane with participants sitting comfortably on a chair. A spreading calliper (GPM 107, North America) was used to measure the face, and a digital Shahe Vernier calliper (IP54 Shanghai, China) was used to measure the nose. It was ensured that the participants were neither smiling nor laughing when taking the measurements. After each subject, the callipers were cleaned with cotton wool and methylated spirit. The measurements were taken to the nearest 0.01 mm using the following landmarks[7]:

- **Nasion (n)**: A depression at the root of the nose that overlies the junction of nasofrontal and internasal sutures.
- **Gnathion (gn)**: The lowest point on the lower border of the mandible in the midline
- **Zygion (zy)**: The most prominent point on the zygomatic arch
- **Subnasale (sn)**: The midpoint of the angle at the columella base where the lower border of the nasal septum and the surface of the upper lip meet
- **Alare (al)**: The most lateral point on each alar contour

The facial height (n-gn) was measured as the linear distance between the nasion to gnathion whereas the facial width (zy-zy) was measured as the linear distance between the right and left zygion. The facial index (FI) was calculated by dividing facial height and facial width and multiplying by 100. Table 1 shows the types of faces and their designated values of facial indices using Banister's classification. The nasal height (n-sn) was measured from the nasion to the subnasale whereas the nasal width (al-al) was measured as the maximum distance between the right and left alare. The nasal index (NI) was calculated by dividing nasal width and nasal height and multiplying by 100. The type of nose and their corresponding nasal indices according to the Martin and Saller classification are shown in Table 1.

Table 1: Classification of the human nose and face based on nasal and facial indices

Type of Nose	Nasal Index	Type of Face	Facial Index
Hyperleptorrhine	40.0 – 54.9	Hypereuryprosopic	≤ 79.9
Leptorrhine	55.0 – 69.9	Euryprosopic	80.0 – 84.9
Mesorrhine	70.0 – 84.9	Mesoprosopic	85.0 – 89.9
Platyrrhine	85.0 – 99.9	Leptoprosopic	90.0 – 94.9
Hyperplatyrrhine	≥ 100.0	Hyperleptoprosopic	≥ 95.0

The Committee for Human Research, Publication, and Ethics at the School of Medicine and Dentistry, Kwame Nkrumah University of Science and Technology, approved the study with the approval number CHRPE/AP/397/21, following the Helsinki Declaration. Informed consent was obtained from all participants involved in the study.

Statistical analysis was done using IBM Statistical Package for Social Sciences software (SPSS 24.00 version, Inc. Chicago, IL, U.S.A). The data were presented as means and standard deviations. Data normality was checked using the one-sample Kolmogorov–Smirnov test and Shapiro–Wilk test. An independent samples t-test was used to compare the mean differences between the sexes. The level of statistical significance was determined at a p-value of less than 0.05.

RESULTS

The Kolmogorov-Smirnov test revealed that the data acquired in both groups were distributed normally. We observed excellent intraobserver repeatability with intraclass correlation coefficients (ICCs) ranging from 0.90 to 0.96 in all the measurements. Table 2 shows the descriptive statistics of the measurements of the nose and nasal indices. The nasal width of males was statistically significantly wider than females [t(305) = 3.837, 95%CI (0.83-2.57), p < 0.001]. The nasal height of males was similarly greater than females and this was statistically significant [t(305) = 4.250, 95%CI (0.86 - 2.35), p < 0.001].

The mean nasal index of males and females were 82.61 ± 11.80 and 81.53 ± 9.85 respectively. The difference was not statistically significant (p = 0.400). The mean difference between the facial width of males and females, 6.65, 95% CI [5.07 – 8.22] was statistically significant, t(305) = 8.306, p < 0.001. Also, there was a significant difference in facial height between males and females, t(305) = 3.272, p < 0.001. There was a significant difference in the mean facial index of males (89.89 ± 7.07) and females (86.99 ± 4.92), t(305) = 3.972, p < 0.001 (Table 2).

Table 2: Descriptive statistics of facial and nasal indices among the Akan Population

	Male			Female				
	Min.	**Max**	**Mean ± SD**	**Min.**	**Max**	**Mean ± SD**	**T**	**p**
n-gn	91.89	139.68	117.07 ± 7.03	91.32	124.60	110.42 ± 6.69	8.306	< 0.001
zy-zy	99.16	156.34	130.81 ± 10.31	102.69	151.02	127.18 ± 8.33	3.272	< 0.001
FI	75.28	117.90	89.89 ± 7.07	76.58	97.87	86.99 ± 4.92	3.972	< 0.001
al-al	24.31	45.76	36.29 ± 4.05	23.85	42.69	34.59 ± 3.45	3.837	< 0.001
n-sn	32.47	53.21	44.24 ± 3.38	33.27	50.67	42.64 ± 3.05	4.250	< 0.001
NI	52.0	115.3	82.61 ± 11.80	52.0	105.7	81.53 ± 9.85	0.843	0.400

al-al: nasal width; n-sn: nasal height; NI: nasal index; n – gn: facial height; zy-zy: facial width; FI: Facial index

Table 3: Distribution of Facial and Nasal Types among Akans in Ghana

Facial Types	**Female**		**Male**		**Pooled**	
	N	**%**	**N**	**%**	**N**	**%**
Hypereuryprosopic	11	8.8	17	9.3	28	9.1
Euryprosopic	31	24.8	27	14.8	58	18.9
Mesoprosopic	51	40.8	51	28.0	102	33.2
Leptoprosopic	26	20.8	44	24.2	70	22.8
Hyperleptoprosopic	6	4.8	43	23.6	49	16.0
Nasal type						
Hyperleptorrhine	1	8.0	1	0.5	2	7
Leptorrhine	15	12.0	26	14.3	41	13.4
Mesorrhine	60	48.0	76	41.8	136	44.3
Platyrrhine	46	36.8	69	37.9	115	37.5
Hyperplatyrrhine	3	2.4	10	5.5	13	4.2

N = number of observations; % = percentages

Table 4: Comparison of facial indices with other published studies

Study	Sex	Facial index	Facial type
Present study	M = 182	89.89 ± 7.07	Mesoprosopic
	F = 125	86.99 ± 4.92	Mesoprosopic
Sisaalas (Ghana)[8]	M = 88	102.11	Hyperleptoprosopic
	F = 97	104.25	Hyperleptoprosopic
Dagaabas (Ghana)[8]	M = 91	99.70	Hyperleptoprosopic
	F = 111	98.29	Hyperleptoprosopic
Akan people (Ghana)[9]	M = 50	97.21 ± 12.70	Hyperleptoprosopic
	F = 50	95.82 ± 12.49	Hyperleptoprosopic
Andhra Pradesh population (South Indian)[10]	M = 65 F = 65	91.5 ± 0.5 88.1 ± 0.3	Leptoprosopic Leptoprosopic
Tehran (Iran)[11]	M = 100	101.26 ± 6.05	Hyperleptoprosopic
	F = 100	90.24 ± 7.60	Leptoprosopic
Malay (Malaysia)[12]	M = 40	90.85 ± 8.38	Leptoprosopic
	F = 41	85.86 ± 5.69	Mesoprosopic
Haryana (Northern India)[13]	M = 150	87.17 ± 5.63	Mesoprosopic
	F = 150	85.90 ± 5.53	Mesoprosopic
Turkish[14]	M = 470	84.31 ± 5.6	Mesoprosopic
	F = 533	85.25 ± 5.48	Mesoprosopic

Table 5: Comparison of Nasal indices with other published studies

Study	Sex	Nasal index	Nasal type
Present study	M = 182	82.61 ± 11.80	Mesorrhine
	F = 125	81.53 ± 9.85	Mesorrhine
Ekowe indigenes (Nigeria)[15]	M = 179	110.64 ± 12.52	Hyperplatyrrhine
	F = 121	112.89 ± 14.43	Hyperplatyrrhine
Tharu and Mongoloid (Nepal)[16]	M = 250	74.60 ± 3.10	Mesorrhine
	F = 250	75.90 ± 5.10	Mesorrhine
Northern Tehran (Iran)[17]	M = 100	69 ± 8	Leptorrhine
	F = 100	66 ± 8	Leptorrhine
South Indian population[18]	M = 100	67.05 ± 9.53	Leptorrhine
	F = 103	64.84 ± 9.52	Leptorrhine
Igbo (Southern Nigeria)[19]	M = 490	95.9 ± 9.8	Platyrrhine
	F = 260	90.8 ± 9.9	Platyrrhine
Yoruba (Southern Nigeria)[19]	M = 443	90.0 ± 8.1	Platyrrhine
	F = 307	88.1 ± 8.3	Platyrrhine
Ijaw (Southern Nigeria)[19]	M = 100	98.6 ± 9.7	Platyrrhine
	F = 100	94.2 ± 9.6	Platyrrhine
Caucasians[1]	M	65.50	Leptorrhine
	F	64.20	Leptorrhine
Bini (Nigeria)[20]	M	99.13 ± 9.26	Platyrrhine
	F	99.27 ± 11.67	Platyrrhine

DISCUSSION

The present study used anthropometry of the face and nose to determine the prosopic or facial and nasal indices of the Akan people. Akans make up over 47.5% of Ghana's population, making them the largest ethnic group[21]. Twelve groups make up this tribe: Akuapim, Akyem, Akwamu, Ahanta, Safwi, Nzema, Asante, Fante, Agona, Wasssa, Bono, and Kwahu. There is a shared cultural background and language among the residents of these subdivisions (Twi). Almost the entire forest and coastal areas of Ghana's south and west banks of the Black Volta River are occupied by the Akan people. The Akans are believed to have migrated from the Sahel to Africa's western coast.

Human facial anthropometry has always been an intriguing subject for anatomists, anthropologists, and plastic surgeons. An individual's facial shape is a reflection of their race, age, and gender[1,2]. Facial morphology has applications in a variety of fields, including facial aesthetics, forensic identification, and reconstructive surgery[12]. According to this study, the facial height for Akan females ranged between 91.32-124.60 mm and for Akan males 91.89-139.68 mm. The female and male facial breadth ranged between 102.69-151.02 mm and 99.16-156.34 mm, respectively. In general, all-female values were lower than those of males ($p < 0.001$). Hence, males (89.89 ± 7.07) had higher facial indices than females (86.99 ± 4.92) and this was statistically significant ($p < 0.001$). Evidence of sexual dimorphism in facial indices has been reported by several researchers in the literature. This may be due to the high testosterone-to-estrogen ratio in males which results in the difference in facial shape between the two sexes[8-14].

In the study population, both males and females had mesoprosopic faces as the predominant face type. Hyperleptoprosopic (4.8%) and hypereuryprosopic (9.3%) facial types had the lowest distribution in females and males, respectively. In contrast, the hyperleptoprosopic face type was predominant in the Sisaala and Dagaaba tribes of Ghana's Upper West Region[8]. Surprisingly, hyperleptoprosopic face type was predominant in both sexes among the Akan people of the Assin District in the Central Region[9]. The least frequent facial type in their study was mesoprosopic, which accounted for 2% of males and 4% of females[9]. We believe the observed disparities may be attributed to the small sample size (50 males and 50 females) and greater age range of 20 to 58 years. Again, they did not indicate how the participants' tribe was ascertained. Males and females with leptoprosopic face types were found in various populations such as Andhra Pradesh[10] and Malay[12]. Among 100 male and 100 female medical students at Tehran University of Medical Sciences, the dominant face type for males was hyperleptoprosopic, whereas for females it was leptoprosopic[11]. Our study was however indirectly in agreement with the Haryana[13] and Turkish[14] populations.

The human nose is a conspicuous facial feature. It is also one of the most obvious variations when analyzing ethnic and racial distinctions[1,8]. This study appears to be the first nose-type study in Ghana. Akan males and females had a nasal height range of 32.47-53.21 mm and 33.27-50.67 mm, respectively. The ranges for male and female nasal width were 24.31-45.76 mm and 23.85-42.69 mm, respectively. The values for the females were significantly lower than the males ($p<0.001$). However, there was no statistically significant difference ($p = 0.400$) between the nasal indices of males and females (82.61 ± 11.80 vs. 81.53 ± 9.85). This agrees with a study by Eboh[20] among Bini Adolescents in Edo State, Nigeria. But it is contradictory to the findings of several other studies in the literature that had reported sexual dimorphism in the nasal index.

The size and shape of the nose are influenced by climatic factors, with cold and dry climates favouring narrowing and moist and warm climates favouring expanding or broad noses[1]. The platyrrhine nose types are often seen in African populations and associated with hot moist climates, whereas leptorrhine nose types are typically seen in European populations and associated with cold dry climates. Because Asia has an intermediate climate, mesorrhine noses are more common[20, 22]. Although studies by Oladipo et al.[19] among the Igbo, Yoruba, and Ijaw in Southern Nigeria and Eboh[20] among Bini Adolescents in Edo State, Nigeria support this assertion, it appears that this is not the case in the Akan population since the mesorrhine or medium nose was the most prevalent nose type among Akan males (41.8%) and females (48.0%). According to the literature, not all Africans are platyrrhine[23]. The commonest nose type among the 200 participants of the Hausa ethnic group of northwestern Nigeria was mesorrhine (60%) followed by leptorrhine (37.5%), and platyrrhine (2.5%)[23]. Oladipo et al.[24] reported nasal indices of 86.38 (platyrrhine) and 81.86 (mesorrhine) among the Andonis and Okrikas of Rivers State, Nigeria. The predominant nose type noted in this study is similar to the findings in the Tharu and Mongoloid populations in Nepal[16].

The hyperleptorrhine or long narrow nose was observed as the predominant type for the Ekowe indigenes, Nigeria[15]. Leptorrhine or moderately narrow nose was prevalent for the Northern Tehran, Iran[17], and South Indian populations[18]. Most Caucasians are leptorrhine having nasal indices ranging from 55.0 to 69.9[1]. The variations in facial and nasal indices between and within populations may be attributed to environmental, dietary, geographical, and racial factors[1,8-23]. The findings, therefore, affirm population variance in facial anthropometry. A potential limitation is that the normal values of facial and nasal indices obtained in the Akan population may not be generalizable to all Ghanaians.

CONCLUSION

The present study has provided normative data on facial and nasal indices of the Akan ethnic group which has not been investigated previously. The Akan ethnic group can be classified under mesorrhine nose and mesoprosopic face types. This finding suggests that genetics and ethnicity can greatly influence nasal and facial characteristics between and within populations. The findings of this study can be used as a reference to improve the outcome of cosmetic and reconstructive facial surgery and rhinoplasty, as well as person identification in forensic medicine.

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CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this paper.

ETHICAL ISSUES

The Committee for Human Research, Publication, and Ethics at the School of Medicine and Dentistry, Kwame Nkrumah University of Science and Technology, approved the study with the approval number CHRPE/AP/397/21, following the Helsinki Declaration. Informed consent was obtained from all participants involved in the study.

SOURCES OF SUPPORT

None

AUTHOR CONTRIBUTIONS

NDK: Conceptualization, data acquisition, writing the manuscript, editing and reviewing the manuscript, approval of the final manuscript; **AK:** Conceptualization, data analysis, writing the manuscript, approval of the final manuscript; **JT:** Conceptualization, writing the manuscript, approval of the final manuscript; **TKD:** Conceptualization, data analysis, editing and reviewing of manuscript, approval of the final manuscript; **CSA:** Conceptualization, editing and reviewing of manuscript, approval of the final manuscript.

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