

# Cephalofacial characteristics of the Akan people in the Assin Districts in Central Region of Ghana: Anthropometric studies

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**Objective** Cephalic and facial indices are very important in the classification and identification of populations. The present study aims at determining the cephalic and facial indices among the Akan ethnic group living the Assin Districts in the Central Region of Ghana.

**Methods** A total of 100 (50 males and 50 females) Akan volunteer adults between the age of 20 and 58 years were recruited for the study. Cephalic length (CL), cephalic width (CW), facial width (FW) and total facial height (TFH) were measured using a Spreading caliper. Cephalic index (CI)  $[(CW/CL) \times 100]$  and facial index (FI) or prosopic index (PI)  $[(TFH/FW) \times 100]$  as well statistical analysis such as z-test and Pearson correlation were performed. The *p*-value of less than 0.05 was considered statistically significant.

**Results** Our results are comparable with other authors with mean (for both male and females) CI and FI of  $78.6 \pm 4.66$  and  $96.51 \pm 12.55$ , respectively. There was a correlation between CW and FW as well as some other cephalofacial parameters. There was no sexual dimorphism of both CI and FI. The predominant head type among the study populations was mesocephalic and brachycephalic while hyperleptoprosopic was the face type.

**Conclusion** This study provides baseline data for the Akan people of the Assin Districts of the Central Region of Ghana, which will be a valuable in cephalometric anthropometry and in forensic science.

**Keywords** Cephalic index; Facial index; Anthropometry; Akan People, Ghana.

## Introduction

Modern humans exhibit great diversity of physical differences because of some factors such as sexual dimorphism, topography, climate, geographical location, and diet.<sup>1,2</sup> These physical differences account for different races, tribes, and ethnicities.<sup>3y</sup> It also has very important influence on the health and identification of an individual; therefore, becomes very necessary to establish baseline for health and physical identification of humans for each population.<sup>4,5</sup>

Physical anthropology relies mainly on external measurements (Anthropometry) and descriptions (Morphology) of the human body. Such measurements are useful in the analysis and classification of fossil remains as well as study of living population. Anthropometry comes from a Greek word “Anthropos” which means human and “metron” which means measure. It is a non-invasive technique to measure the dimensions of the human body and skeleton.<sup>1,6</sup> Anthropometry has become essential tool of biological anthropology that involves a series of standardized measuring techniques that express quantitatively, the dimensions of human body. Cephalic and facial indexes are very important anthropometric index used in describing head and facial dimensions and morphology, respectively.<sup>7-9</sup>

Cephalic index (CI) is very useful in racial, ethnic, and gender identification of individuals. It is defined as the ratio of maximum cephalic width to maximum cephalic length multiplied by hundred percent. Based on the value of CI, there are six different types of heads.<sup>10</sup> Facial index (Prosopic index), on the other hand, is used to describe the facial proportion, prognosis of orthodontic treatments as well as indicating the direction of growth of craniofacial complex. The facial index is

also defined as the ratio of morphological facial height to the ratio of facial width (bizygomatic width) multiplied by hundred percent. There are five different types of face based on facial index.<sup>10,11</sup>

The facial and cephalic indices of an individual are determined by growth and developmental pattern. According to Virchow's law of parallel and perpendicular bone expansion, patency of the metopic and sagittal sutures are responsible for the adequate growth of cranial vault in the anterior–posterior while that of coronal and lambdoid sutures account for the growth in the transverse directions.<sup>12</sup> The fusion of metopic suture occurs between 3 and 9 months while the others fuse between 22 and 39 months.<sup>13</sup> Premature fusion of the sagittal suture may result an increase the entire length of the head in the anterior–posterior direction but in early fusion of metopic suture, only the anterior length is reduced.<sup>13</sup>

Although a high amount of report on cephalic and facial indices exist among various tribes and ethnic groups but there are little or no published data of such kind exist for the Akan people in Ghana. This study therefore aims at establishing for the first time, the baseline of cephalic and facial indices among the Akan people of Ghana.

## Materials and methods

A total of 100 (50 males and 50 females) Akan volunteer adults between the age of 20 and 58 years (mean age of 29.7 years for males and 30.7 years for females) were recruited for the study. These volunteers were randomly selected from teachers and students of ObiriYeboah SHS and College of Distant Education, UCC (ObiriYeboah SHS Center) as well as inhabitants of AssinFosu and the neighboring towns within the

Assin Districts. Subjects with history of craniofacial injury or trauma and obstructive hairstyle were excluded from the study. Verbal informed consent was obtained from each participant.

The Hrdlicka's method was used in assessing the cephalofacial parameters.<sup>14</sup> The cephalic width (CW) was also measured as the maximum transverse diameter between two fixed points of the head (euryon), above the mastoid prominence (Fig. 1A). The cephalic length (CL) was measured with the help of spreading calipers, from glabella to mid-point of external occipital protuberance (Fig. 1B). Then the CI was calculated and the head type determined for each subject. Table 1 illustrates the types of heads and their designated values of cephalic indices. CI was calculated using the following formula (No. 1)<sup>15</sup>:

$$CI = \frac{CW}{CB} \times 100 \quad (1)$$

As well, total facial height (TFH) was measured from the nasion to mental tubercle (Fig 1. C). and facial (bizygomatic) width (FW) was measured as a distance between the right and left zygion (Fig. 1D). Additionally, facial index (FI) was calculated and face type was determined for each case. Table 2 illustrates the types of faces and their designated values of cephalic indices. FI was calculated using the following formula (No. 2)<sup>16</sup>:

$$FI = \frac{FL}{FW} \times 100 \quad (2)$$

All the measurements were taken with the subject sitting in relaxed condition and head in anatomical position. To reduce the technical error of the measurements, each dimension was taken twice and the average recorded. All measurements were taken to the nearest 1.0 cm.

The following give descriptions of the measured parameters:

- **Cephalic length (CL):** Glabella to inion
- **Cephalic width (CW):** Distance between parietal eminences (zygion)
- **Total facial length (TFL):** Nasion to gnathion
- **Facial width (CW):** Distance between zygomatic arches.

The data obtained were statistically analyzed using IBM-SPSS version 22 and Microsoft Excel 2016 for Windows. Basic

Table 1. **Classification of head type based on cephalic index.**

Type of head	Cephalic index
Hyperdolicocephalic	65.5–69.9
Dolichocephalic	70.0–74.9
Mesocephalic	75.0–79.9
Brachycephalic	80.0–84.9
Hyperbrachycephalic	85.0–89.9
Ultrabrachycephalic	≥90

Table 2. **Classification of face type based on Facial index.**

Type of face	Facial index
Hypereuryprosopic	<79.9
Europrosopic	80.0–84.9
Mesoprosopic	85.0–89.9
Leptoprosopic	90.0–94.9
Hyperleptoprosopic	≥95.0

descriptive statistics and independent sample *t*-test were performed at 95% confident interval. The *p*-value of less than 0.05 was considered statistically significant.

## Results

Tables 3–7 show the results of present study. Basic statistics of CL, CW, CI, TFH, FW, and FI are shown in Table 3. The mean CL and CW of males were  $18.26 \pm 0.85$  and  $14.20 \pm 0.76$ , while those in females were  $17.52 \pm 0.91$  and  $13.88 \pm 0.82$ , respectively. As the data show, there were significant differences ( $p < 0.05$ ) in both mean CL and CW between male and female subjects. The means of CI were also  $77.92 \pm 5.37$  and  $79.28 \pm 5.08$  for males and females, respectively, but there were no significant differences between the two genders ( $p = 0.052$ ) (Table 4).

The mean CI of both males and females was  $78.60 \pm 4.66$ , which falls within mesocephalic (a head of medium proportions). This type together with brachycephalic (a moderately

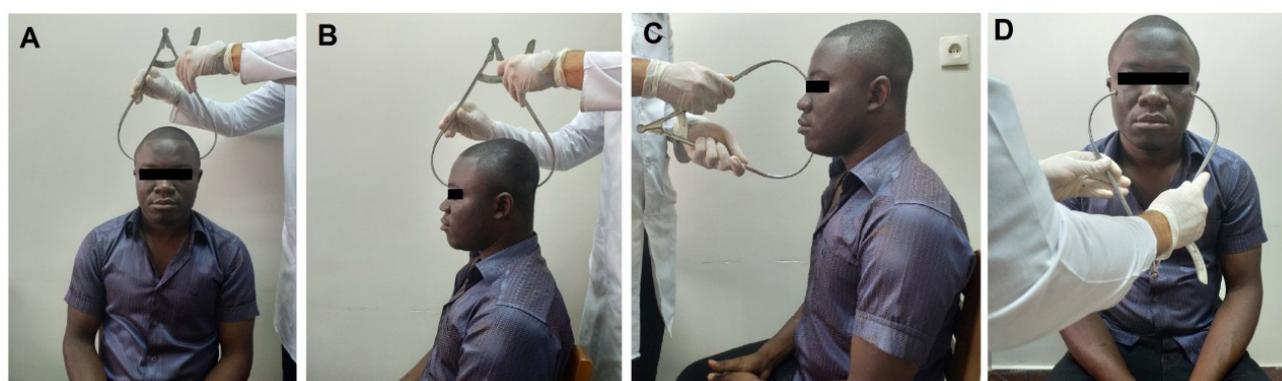


Fig. 1 **A.** The cephalic width (CW) was also measured as the maximum transverse diameter between two fixed points of the head (euryon), above the mastoid prominence. **B.** The Cephalic length (CL) was measured with the help of spreading calipers, from glabella to mid-point of external occipital protuberance. **C.** Total facial height (TFH) was measured from the nasion to mental tubercle. **D.** Facial (bizygomatic) width (FW) was measured as a distance between the right and left zygion.

Table 3. **Basic descriptive statistic of cephalofacial anthropometric characteristics among the Akan population in Assin Districts.**

Parameters	N	Mean ± SD(cm)	SEM	Range	95% CI	CV %
CL	100	17.89 ± 0.95	0.095	16.00–20.00	17.70–18.08	5.31
CW	100	14.04 ± 0.80	0.080	12.00–16.00	13.88–14.20	5.70
CI	100	78.60 ± 4.66	0.466	66.67–88.88	77.68–79.53	5.93
TFH	100	11.55 ± 0.96	0.096	10–14	11.36–11.74	8.31
FW	100	12.08 ± 1.17	0.117	10.00–15.00	11.85–12.31	9.67
FI	100	96.51 ± 12.55	1.255	71.43–130	94.03–99	13.00

Cephalic length (CL)/ Cephalic width (CW)/ Cephalic index (CI)/ Total Facial Height (TFH)/ Facial (bizygomatic) Width (FW)/ Facial index (FI).

Table 4. **Comparing the cephalofacial characteristics between males and females among the Akan population in Assin Districts.**

Parameters	Gender	Mean ± SD (cm)	SEM	Range	95% CI	CV %	z /p-value
CL	Male	18.26 ± 0.85	0.121	16–20	18.26–18.50	4.65	z = 4.199 p < 0.001
	Female	17.52 ± 0.91	0.129	16–20	17.26–17.78	5.19	
CW	Male	14.20 ± 0.76	0.107	13–16	13.99–14.41	5.35	z = 2.023 p = 0.021
	Female	13.88 ± 0.82	0.119	12–16	13.65–14.11	5.91	
CI	Male	77.92 ± 5.37	0.759	68.42–88.89	76.39–79.45	6.89	z = -1.628 p = 0.052
	Female	79.28 ± 5.08	0.532	66.67–83.33	78.21–80.35	6.41	
TFH	Male	11.58 ± 0.97	0.137	10.00–14.00	11.30–11.86	8.38	z = 0.331 p = 0.370
	Female	11.52 ± 0.95	0.135	10.00–14.00	11.25–11.79	8.25	
FW	Male	12.02 ± 1.12	0.158	10.00–14.00	11.70–12.34	9.31	z = -0.511 p = 0.304
	Female	12.14 ± 1.23	0.174	10.00–15.00	11.79–12.49	10.13	
FI	Male	97.21 ± 12.70	1.796	76.92–127.2	93.6–100.82	13.06	z = 0.552 p = 0.290
	Female	95.82 ± 12.49	1.766	71.43–130	92.27–99.37	13.03	

Table 5. **Frequency (percentage) of head types among the Akan population in Assin Districts.**

Nose type	Male n (%)	Female n (%)	All n (%)
Hyperdolicocephalic	3 (6)	1 (2)	4 (4)
Dolichocephalic	14 (28)	5 (10)	19 (19)
Mesocephalic	18 (36)	18 (36)	36 (36)
Brachycephalic	10 (20)	26 (52)	36 (36)
Hyperbrachycephalic	5 (10)	–	5 (5)
Ultrabrachycephalic	–	–	–

Table 6. **Frequency (percentage) of face types among the Akan population in Assin Districts.**

Nose type	Male n (%)	Female n (%)	All n (%)
Hyperuryprosopic	3 (6)	3 (6)	6 (6)
Europrosopic	9 (18)	9 (18)	18 (18)
Mesoprosopic	1 (2)	2 (4)	3 (3)
Leptoprosopic	14 (28)	16 (32)	30 (30)
Hyperleptoprosopic	23 (46)	20 (40)	43 (43)

Table 7. **Simple Pearson correlation of the Cephalofacial variables (r-value /p-value).**

Variables	CL	CW	TFL	FW
CL		0.415/0.0001	0.244/0.007	0.099/0.164
CW			0.142/0.080	0.179/0.037
TFL				0.023/0.408
FW				

Cephalic length (CL)/ Cephalic width (CW)/ Total Facial Height (TFH)/ Facial (bizygomatic) Width (FW).

broad and short head) were the predominant types of head (Tables 1, 3 and 5).

The Basic statistics of TFH and FW are shown in Table 3. The mean of TFH and FW were  $11.58 \pm 0.97$  and  $12.02 \pm 1.12$ , while those in females were  $11.52 \pm 0.95$  and  $12.14 \pm 1.23$ , respectively. There was no significant difference in both mean TFH and FW between male and female subjects ( $p > 0.05$ , Table 4).

Table 4 shows the mean facial index  $97.21 \pm 12.70$  and  $95.82 \pm 12.49$  for males and females respectively, and the difference was not statistically significant ( $p = 0.291$ ). The mean FI of the studied population was  $96.51 \pm 12.55$  (Table 3), which

falls within hyperleptoprosopic (a very long narrow face) type of face (Table 2).

According to our data, hyperleptoprosopic is also the predominant type of face as depicted in Table 6. Furthermore, the correlation between the head width and facial width has been shown in Table 7.

## Discussion

In the present study, cephalofacial anthropometric characteristics of the Akan people in the Assin Districts (Central Region of Ghana) were investigated. This study has revealed that the CI of the Akan people in the Assin Districts was  $78.60 \pm 4.66$ . This value is in agreement with the results obtained by many authors such as Basu<sup>17</sup> and Bhargava and Kher.<sup>29</sup> However, in a study conducted by Madadi et al<sup>18</sup> among Iranian medical students, the CI of 83.51 was recorded.<sup>18</sup> Anupama et al. (2009) also obtained a CI of 85.53 among Punjabi students.<sup>19</sup> These results do not correlate with the result of the current study, however it confirms the fact that there are differences in the CI among different populations.

According to the results, no significant difference was observed between males and females CI. Our findings corroborated with the results of Oladipo and Paul<sup>19</sup> as well as Shema et al.<sup>20</sup> In contrast, the results of Babatunde<sup>21</sup> and Anupama et al<sup>22</sup> were not in accordance with our findings.

The reasons for the absence of difference in CI between male and female are not clear but may be due to the fact that the effect and interplay amongst growth, thyroid, and sex hormones seem to have the similar effect in both sexes. The dominant types of head in our study are mesocephalic and brachycephalic. The existence of more than one dominant head type with an equal percentage of distribution within the same study population is uncommon in the published literatures. However, both head types observed in the present study are among the most common head type in the African population.<sup>19,23</sup>

The facial index of the studied population was  $96.51 \pm 12.55$ . By comparing with the results in other populations, our value showed a degree of variations. Among Fars and Turkmen of Iran, males and females showed a prosopic index of 74.3 and 81.6, respectively.<sup>24</sup> Bini tribe of Nigeria recorded a prosopic index of 86.93,<sup>25</sup> while in Malaysia, males and females respectively had a prosopic index of 85.72 and 87.91.<sup>26</sup> However, our results were comparable with Ukwuani indigenes in Nigeria who had a prosopic index of  $99.15 \pm 6.11$  and  $94.54 \pm 9.89$  among males and females, respectively.<sup>27</sup> As well, Jaber et al recorded  $92 \pm 6$  for an Iranian population.<sup>7</sup>

Indigenes of Maiduguri also had prosopic indexes of 99.59 and 97.54 for males and females, respectively.<sup>28</sup> Among the Qazvin people of Iran, Azizi et al recorded a prosopic index of 102.88 in males and 96.69 in females, respectively.<sup>11</sup> In this study, similar to the CI, there was no significant sexual dimorphism between males and females in the prosopic index as well. The reasons for this observation are not clear but can be the same with CI reasons. The dominant type of face in the study population was hyperleptoprosopic in both males and females. This is in the direct agreement of the face type amongst Bini People of Nigeria.

Finally, our results indicate that there are a significant positive correlation between cephalic length and cephalic width, cephalic length and total facial length as well as cephalic

width and facial width. These findings agree with that of Umar et al<sup>30</sup> among Hausa and Yoruba ethnic groups of Nigeria. Obaje et al<sup>30</sup> also came to the same conclusion in their study of cephalic indices among Benue ethnic groups of Nigeria.

## Conclusion

This study has revealed that the CI and facial index among the Akan people of the Assin Districts in the Central Region of Ghana are, respectively, 78.60 and 96.51. This population has both Mesocephalic and Brachycephalic as dominant types of head. The dominant face type among them is hyperleptoprosopic. There was a positive correlation between head width and facial width among them. Data obtained from this study will serve as a baseline for forensic scientist and anthropologists, and for comparisons between the Akan people of Assin Districts and other ethnic groups within or outside Ghana.

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## Conflict of Interest

There was no conflict of interest.

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