Original Research Article

Craniofacial Photogrammetry: Evaluation of Normative Facial Angles of Ijaws Resident in Port Harcourt

Abstract

Aim: Evaluation of facial angles is essential for defining facial traits in clinical and population studies. The aim of this research was to quantify the normative values of craniofacial angular parameters in Ijaws using a photogrammetric approach**.**

Methodology: The study employed a cross-sectional design involving 300 (150 males and 150 females) persons of Ijaw extraction between the ages of 18 to 40 years. Frontal and lateral view photographs of each subject were taken in the Natural Head Position andanalyzed using Pro-Image Facial Software to evaluate nine angular facial parameters. Data were analyzed using SPSS version 25.

Result and discussion: The mean value Nasofrontal (NFA), Nasolabial (NLA), Nasofacial (NFCA), Nasomemtal (NMA), Mentocervical (MCA) angles, were 158.36±95.86º, 127.49±37.68 º, 34.27±12.72 º, 135.63±33.77 º, 88.38±20.26 º respectively. Males had a mean value of NFA, NLA, NFCA, NMA and MCA 154.02±20.90º, 137.00±32.97º, 39.14±19.00º, 122.59±45.2º, 86.93±29.66º respectively while females are 162. 69±134.03º 117.98±39.76º, 31.28±4.26º, 143.79±20.29 º, 89.41±8.9º respectively. NLA, NFC and NMA were statistically significant P <0.05.

Conclusion: The study showed some facial profile trait differences in Ijaw males compared to females

Key words: Ijaw, sexual dimorphism, normative, facial angles, faciIntroduction

Introduction

Many patterns of growth, development, and treatment changes may be observed with high precision using anthropometry. [1] Craniofacial anthropometry has aided in the diagnosis and follow-up of diseases such as Down syndrome, Cushing syndrome, Celiac disease, Addison

disease, and Horner syndrome. [2] It is employed in industrial design of products like head gear and face masks [3]. The face possesses a major role to provide personal identity for every individual [4]. The face just like other parts of the body shows morphological variation from individual to individual. The shape of the face is determined by underlying bone, thickness and distribution of the underlying fat as well as the facial muscles [5].

Oghenemavwe et al. [6] expressed that angle of face assesses the forehead to jaw relationship and has long been employed to make judgments of inferiority and superiority of certain human populations. Populations vary genetically and geographically in their craniofacial features. Study by Powell and Humphry [7] on the proportions of the aesthetic face of North American population, Fernandez-Riveiro et al. [8] in Spain, Jain et al. [9] in India and Kale-varlk [10] in Turkeyshowed the existence of variation in craniofacial features of the various populations.

Craniofacial study is used to understand the shape and proportion of the head and face [11] which is relevant in maxillofacial surgery and facial reconstruction [12] as it provides a wide range of facial dimensions. It is difficult when evaluating craniometrics of the negroidsas a result of insufficient data. [13] To this end, it became necessary to conduct this study of facial angles of the Ijaws ethnic group of Nigeria using photogrammetry.

Materials and method

Study Design

The study adopted a cross-sectional descriptive design to generate values of angular craniofacial anthropometric features of young male and female adults of Ijaw ethnic group of Nigeria using anthropometric standards. The population of the study included participants drawn from Delta, Bayelsa, Cross River and Rivers States whose parents and grandparents were of Ijaw origin.

The study involved three hundred respondents (150 males and 150 female) residing in Port-Harcourt. University of Port-Harcourt was used as the study area and the respondent were sampled using a multi-stage random sampling technique. Sample size was determined using the Taro-Yamane formula:

$n=N/1+N(e)^2$〗

where n = minimum sample size, N = total population, and e = margin of error = 0.05.

Materials/ photographic setup

A questionnaire was administered to every respondent to gather information on sociodemographic variables. A digital camera (Nikon COOLPIX S2800, 20.1 mega pixel, x5 zoom) was used for facial capturing which was fixed on a tripod stand 120cm away from a graphic board. A mirror was place opposite the graphic board where the tripod was in between, to ensure that the head was in a natural head position. All respondents were captured in a relaxed state with their head in natural head position (NHP) and stored in a hard drive for photo analysis.

Photographic analysis

The study made use of a digitalized photo analyzer, the WinImager developed by Oghenemavwe et al. [6] to measure the cutaneous points and determine value of various angles of the face such as nasofrontal angle (G-N-Prn), nasolabial angle (Cm-Sn-Ls), nasofacial angle (Gpg/ N-Prn), nasomental angle (N-PRn_Pg) and mentocervical angle.

Statistical analysis

The data was subjected to statistical analysis using the International Business Machines Statistical Package for Social Science (IBM SPSS version 26) for statistical analysis. Result were presented as mean ± standard deviation. Independent T test was used to test for significance in the variables between genders, one way ANOVA was used to test for significance in age and the variable. Probability less than 0.05 ($P<0.05$) was considered statistically significant.

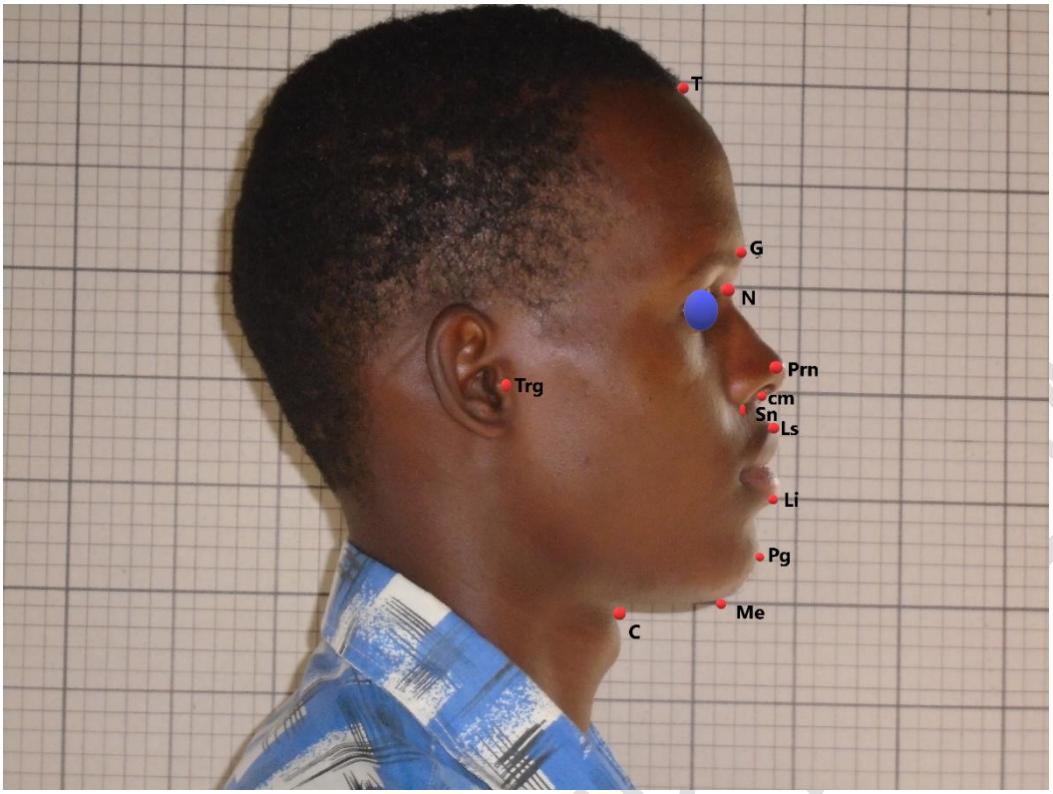

Figure 1. Facial landmarks: trichion (T), glabella (G), nasion (N), nasal dorsum (Nd), tragion (Trg), pronasal (Prn), columella (Cm), subnasal (Sn), labial superior (Ls), labial inferior (Li), pogonion (Pg), menton (Me), cervical point (C)

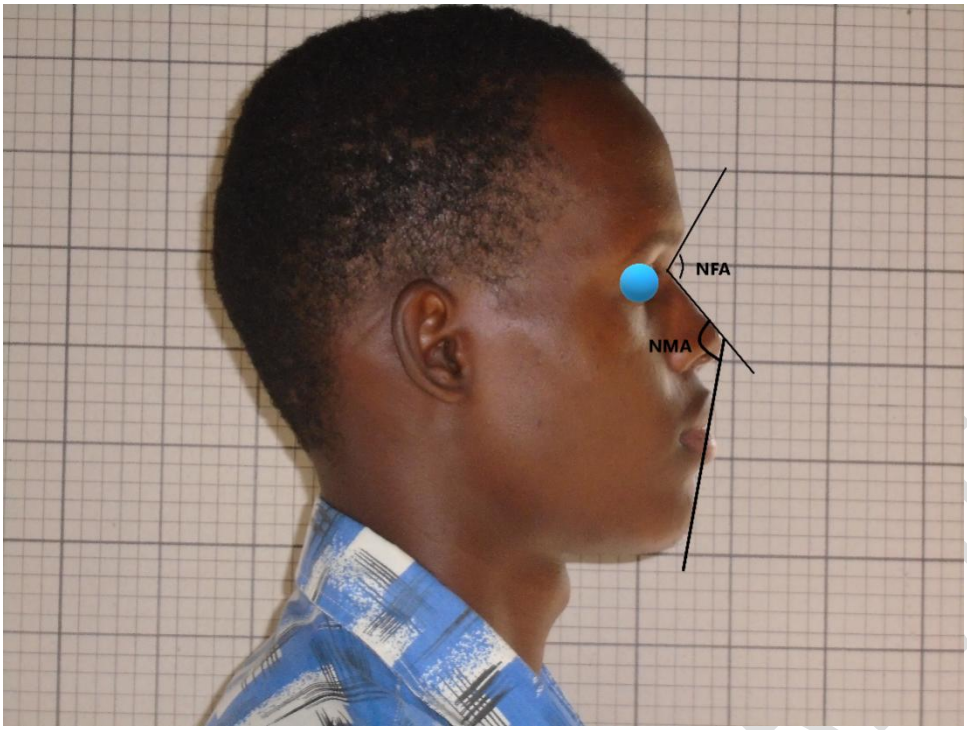

Figure 2. Nasofrontal angle (NFA) and nasomental angle (NMA)

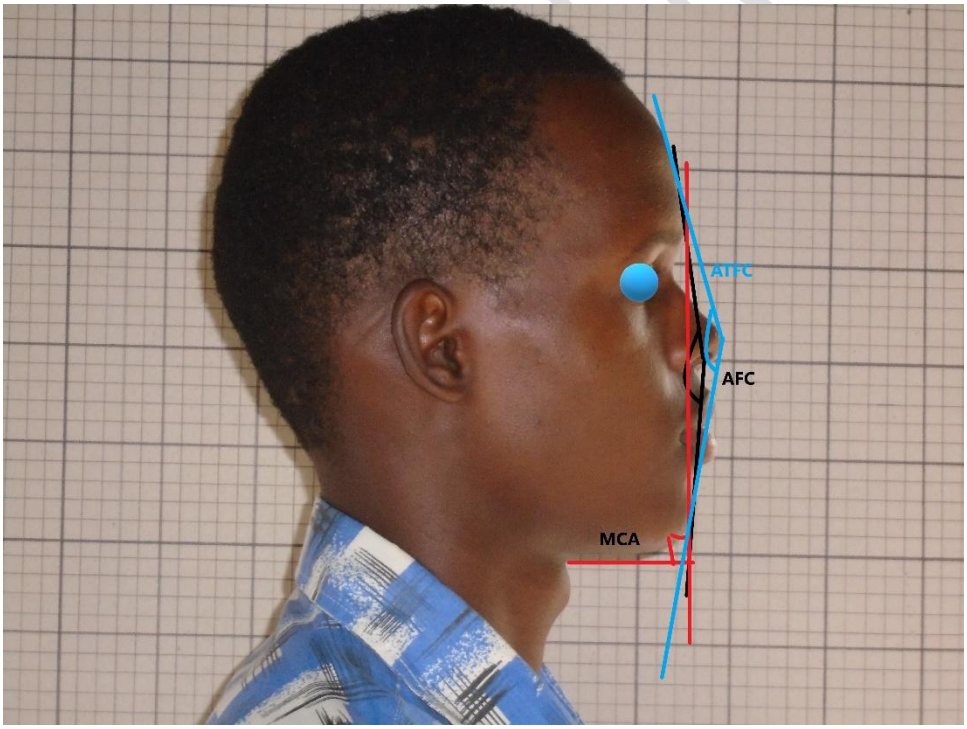

Figure 3. Mentocervical Angle (MCA)

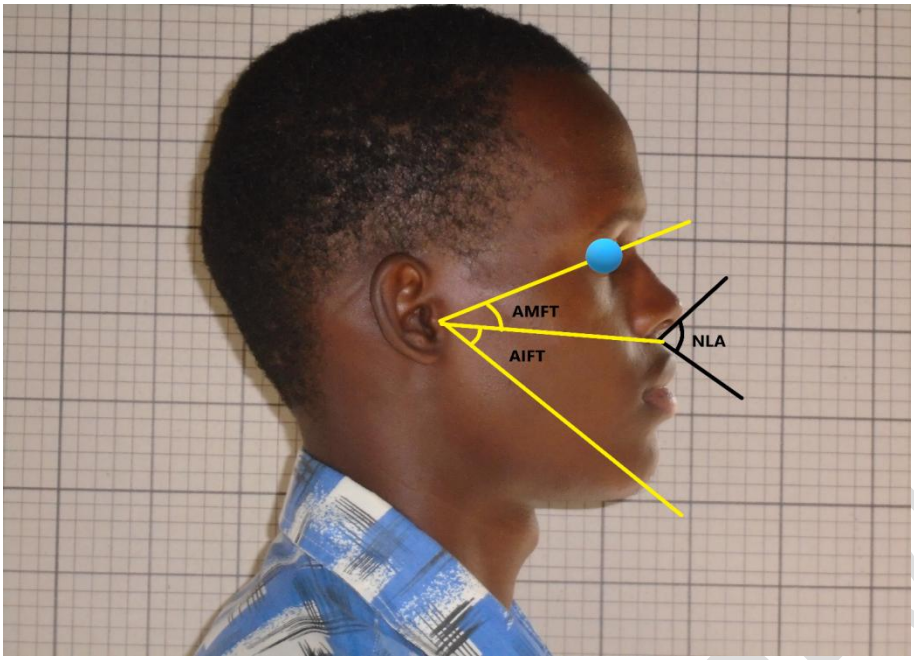

Figure 4. Nasolabial Angle (NLA)

Results

Three hundred (300) subject were involved in this study (150 males and 150 females) within the age interval of 18-40 years. The descriptive statistics of the facial angles; Nasofrontal angle was 158.36±95.85º, Nasolabial angle 127.49±37.68º, nasofacial angle 34.27±12.72 º, nasomental angle 135.63±33.7º, Mentocervical angle 88.38±20.26º as shown in table 1.

Table 2. shows the association of facial angles and gender and revealed that males had a mean value of nasofrontal angle 154.02±20.90º while the female 162.69±134.03º. the nasolabial angle inmales was 137.00±32.97º, in females was 117.98±39.76º, nasofacial angle, nasometal angle and mentocervical angle in males were also observed to be 39.14±19.00º, 122.59±45.21º, 86.93±29.66º respectively while in females it was observed that nasofacial angle, nasometal angle and mentocervical were 31.28±4.26º, 143.79±20.29º, 89.41±8.91º respectively. Nasolabial, nasofacial and nasomental angles were observed to be statistically significant ($P < 0.05$) while nasofacial and mentocervical angle were not significant ($P > 0.05$).

Table 3 illustrates the association of facial angles based on the age there was an increase in these angles, however, only nasolabial angle was significant ($P < 0.05$).

Table 1. Descriptive Statistics of Ijaws facial angles

Angular parameter	Min.	Max.	Mean	SD
nasofrontal angle	65.49	1775.80	158.3628	95.85946
nasolabia angle	44.97	185.34	127.4931	37.68874
nasofacial angle	21.98	98.99	34.2773	12.72425
nasomental angle	8.21	179.85	135.6342	33.77405
mentocervical angle	21.39	167.80	88.3892	20.26142

Min. = minimum, max. = maximum, SD = standard deviation

Table 2, Association of facial angles based on Gender

	Gender	Mean	Std. Deviation	Std. Error Mean	T score	p-value	Inference
nasofrontal angle	male	154.0264	20.90178	1.70662	-0.783	0.434	NS
	female	162.6991	134.03357	10.94380			
nasolabia angle	male	137.0026	32.97247	2.69219	4.509	0.000	S
	female	117.9836	39.76376	3.24670			
nasofacial angle	male	39.1471	19.00016	2.53900	3.804	0.003	S
	female	31.2804	4.26573	.44717			
nasomental angle	male	122.5987	45.21785	4.99348	-4.670	0.000	S
	female	143.7939	20.29639	1.77330			
mentocervical angle	male	86.9359	29.66875	3.09318	-0.899	0.37	NS
	female	89.4178	8.93249	.78343			

Table 3, Association of facial angles based on age

AGE	NFA	NLA	NFCA	NMA	MCA
18-21	158.79±18.68	140.89±34.25	37.34±21.34	144.74±38.73	86.07±21.33
22-25	160.47±12.04	124.11±37.76	34.16±11.12	132.29±32.82	88.73±21.28
26-29	144.31±25.03	113.62±37.35	31.95±6.08	135.55±27.54	90.66±11.37
30-33	174.21±21.06	165.54±35.03		174.22±26.45	89.24±14.34
34-37	138.56±2.19	91.31±12.08	27.98±4.07	133.49±3.22	90.89±9.27
F score	0.205	4.941	0.832	1.536	0.254
P value	0.936	0.001	0.478	0.193	0.907
Inference	NS	S	NS	NS	NS

Nasofrontal angle (NFA), nasolabial angle (NLA), nasofacial angle (NFCA), nasomental angle (NMA), mentocervical angle (MCA), Insignificant (NS), significant (S).

Discussion

The mean nasofrontal angle in this study was 158.36±95.85º. Compared to the findings ofUkoha et al. [14] among Igalas of Nigeria, Malkoc et al. [15] in Turkey, Wamalwa et al. [16] in Kenya, Osunwoke and Onyeriodo, [17] in Khana in Rivers State, Nigeria, nasofrontal angle in our study was higher.Similarly, Leong and White, [18] reported lower nasofrontal angle among Caucasians.Our study also investigated other facial angles such as nasolabial, nasomental and nasofacial angles with meanvalues 127.49±37.68 º, 135.63±33.77 º, 34.27±12.72 º respectively. In their submission, Pasinato et al. [19] reported lower nasolabial andnasomentalangles but highernasofacial anglein Caucasians, whereas the mean values of these facial angles in our study were lower compared to the findings of Ukoha et al. [14], and Osunwoke and Onyeriodo, [17] and fell within similar range with the findings ofMussammat et al. [20] in Bangladeshi and Reddy et al., [21] in North India. Existence of variances in these parameters could be attributed to ethnic and racial variations, geographical and environmental factors.

Considering sexual dimorphism, though the mean female nasofrontal angle in our study was higher than that of the males, the difference was not statistically significant ($p<0.05$). This is consistent with the findings of Anicy-Milosevicy et al.[22] who reported that nasofrontal angle had no difference in gender whereas Ukoha et al., [14]Osunwoke and Onyeriodo, [17] Oghenemavwe et al., [6] Anibor and Okumagba, [23]and Reddy et al. [21] reported that females had a higher nasofrontal angle compared to the males.

This study shows that in males, the nasolabial angle was higher compared to the females.This disagrees with the submission ofOsunwoke and Onyeriodo, [17] who in their study reported that the nasolabial angle in female was higher than in males, though Ukoha et al. [14] and Mussammat et al. [20] reported that the nasolabial angle had no gender difference which does not agree with the findings of our study. The present study is in agreement with Reddy et al. [21] and Femandez-Riveiro et al. [8] who reported that nasolabial angle was higher in males compared to the females.

Nasofacial angle in the present study was observed to behigher in males than in females. This is consistent with the submission ofUkoha et al. [14]. Nasomental angle of the females was higher than the males. Mentocervical angle of males was higher compared to the female. This is in agreement with the submission of Eliakim et al. [24] who reported that mentocervical angle was higher in males compared to females.

In the present study, nasolabial, nasofacial and nasomental were statistically significant ($p<0.05$) when compared between sexes. This finding agrees with that of Ukoha et al. [14] though mentocervical angle was not significant when compared between sexes.

This study also categorized age in association with angular craniofacial parameters. Okoh and Amadi [25] reported age relted changes in angular craniofacial parameters. In the present study, it was observed that nasofrontal, nasolabial, nasofacial, mentocervical and nasolabial angles increased across age groups with increase in age. Conversely,nasomental and nasofacial angles decreased across age groups with increase in age. However, only the nasolabial angle was statistically significant ($p<0.05$).

The study demonstrated some similarities and differences in angular craniofacial parameters of Ijaws residing in Port Harcourt when compared to other related studies. Variations observed

could be attributed to nationality, ethnicity and race. There was sexual dimorphism in nasolabial, nasofacial and nasomental angles. Age-related difference was observed in nasolabial angle while nasofrontal, nasomental and nasofacial have no age differences.

Conclusion

The present study shows that the normative facial angles of Ijaws currently residing in Port Harcourt has a higher angle compared to Caucasians, and neighboring ethnicities There was sexual dimorphism in nasolabial, nasofacial, nasomental, only nasolabial showed significant difference with age. The findings of this study will be useful in industrial designs, ergonomics, maxillofacial surgery and facial reconstruction.

References

1. Medialdea, L., Bogin, B., Thiam, M., Vargas, A., Marrodán, M. D., & Dossou, N. I. Severe acute malnutrition morphological patterns in children under five. *Scientific Reports*, 2021;*11*(1), 4237.
2. Isikay, S., Bahsi, I., Orhan, M., Kul, S., Kizilkan, N., Kocamaz, H., & San, M. Craniofacial morphometric measurements of children with celiac disease. *Iranian Journal of Pediatrics 2020*.
3. Liu, W., Beltagui, A., & Ye, S. Accelerated innovation through repurposing: exaptation of design and manufacturing in response to COVID- 19. *R&D Management*, 2021;*51*(4), 410-426.
4. Pradana, D. A., Mahfud, M., Hermawan, C., & Susanti, H. D. Nasionalism: Character Education Orientation in Learning Development. *Budapest International Research and Critics Institute-Journal (BIRCI-Journal) 2020; Volume*, *3*, 4026-4034.
5. Tay, W., Quek, R., Kaur, B., Lim, J., & Henry, C. J. Use of Facial Morphology to Determine Nutritional Status in Older Adults: Opportunities and Challenges. *JMIR Public Health and Surveillance*, 2022;*8*(7), e33478
6. Oghenemavwe, E. L., Osunwoke, A. E., Ordu, S. K., &Omovigho, O. Photometric analysis of soft tissue facial profile of adult Urhobos. *Asian J Med Sci*, 2010;*2*(6), 248-252.

7. Powell, N., & Humphreys, B. *Proportions of the aesthetic face*. Thieme medical pub 1984.
8. Fernández- Riveiro, P., Smyth- Chamosa, E., Suárez- Quintanilla, D., & Suárez- Cunqueiro, M. Angular photogrammetric analysis of the soft tissue facial profile. *The European Journal of Orthodontics*, 2003;*25*(4), 393-399.
9. Jain, S. K., Anand, C., & Ghosh, S. K. Photometric facial analysis-a baseline study. *J Anat Soc India*, 2004;*53*(2), 11-13.
10. Kale-Varlk, S. Angular photogrammetric analysis of the soft tissue facial profile of Anatolian Turkish adults. *Journal of craniofacial surgery*, 2008;*19*(6), 1481-1486.
11. Shui, W., Zhou, M., Maddock, S., Ji, Y., Deng, Q., Li, K., ... & Wu, X. A computerized craniofacial reconstruction method for an unidentified skull based on statistical shape models. *Multimedia Tools and Applications*, 2020;*79*, 25589-25611.
12. Esmonde, N., Najafian, A., Penkin, A., &Berli, J. U. The role of facial gender confirmation surgery in the treatment of gender dysphoria. *Journal of Craniofacial Surgery*, *30*(5), 2019;1387-1392.
13. Afra, K., Hamilton, M. D., & Algee-Hewitt, B. F. Self-reported ancestry and craniofacial SNPs: Assessing correspondence with implications for forensic case analysis and reporting. *Forensic Anthropology*, 2021;*4*(4), 181.
14. Ukoha, U., Ekezie, J., Okeke, C., & Osmond, A. I. Angular craniofacial photometric analysis of the facial profile of Igalas in Nigeria. *Anthropol Open J*. 2017
15. Malkoç, S., Demir, A., Uysal, T., &Canbuldu, N. Angular photogrammetric analysis of the soft tissue facial profile of Turkish adults. *The European Journal of Orthodontics*, 2009;*31*(2), 174-179.
16. Wamalwa, P., Amisi, S. K., Wang, Y., & Chen, S. Angular photogrammetric comparison of the soft-tissue facial profile of Kenyans and Chinese. *Journal of Craniofacial Surgery*, 2011;*22*(3), 1064-1072.
17. Osunwoke, E. A., &Onyeriodo, G. Angular photometric analysis of Khana people in Rivers State, Nigeria. *Trans Clin Bio*, 2014;*2*(1).
18. Leong, S. C. L., & White, P. S. A comparison of aesthetic proportions between the Oriental and Caucasian nose. *Clinical Otolaryngology & Allied Sciences*, 2004;*29*(6), 672-676

19. Pasinato R., Mocellin, M., Arantes, M. C., Coelho, M. S., Dalligna, D. P., &Soccol, A. Pre and post operative facial angles in patients submitted to rhinoplasty. *Int Arch Otorhinolaryngol*, 2008;*12*(03), 393-396.
20. Mussammat, A. F., Abdullah, A., Laila, A. B., & Sudip, P. Angular photogrammetric analysis of the facial profile of the adult Bangladeshi Garo. Advances in Anthropology. *Journal of Scientific Research*, 2013;*3*(4), 188-192.
21. Reddy M, Ahuja NK, Raghav P, Kundu V, Mishra V. A computer- assisted angular photogrammetric analysis of the soft tissue facial profile of North Indian adults. *Journal of Indian OrthodonticsSociety*.; 2011;45: 119-123
22. Anicy-Milosevicy S, Lapter-Varga M, Slaj M. Analysis of tissue facial profile by means of angular measurement. *Eur J Orthod*, 2008;30(2): 135-140. doi: 10.1093/ejo/cjm116
23. Anibor E, Okumagba M. Photometric facial analysis of the ibo ethnic group in Nigeria. Archive of Applied Science Research. 2010;2(6): 219-222.
24. Eliakim-Ikechukwu, C., Ekpo, A., Etika, M., Ihentuge, C., &Mesembe, O. Facial aesthetic angles of the Ibo and Yoruba ethnic groups of Nigeria. *IOSR J Pharm Biol Sci*, 2013;*5*(5), 14-17.
25. Okoh, P. D.,& Amadi M. A.Angular Photogrammetric Comparison of the Craniofacial Soft-tissue Profile of Three Ethnic Groups in Southern Nigeria. Journal of Advances in Medicine and Medical Research 2020, 32(4): 34-45.