EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 6
Issue: 6
9-18
Year: 2019

SEX ESTIMATION FROM ODONTOMETRIC PARAMETERS OF ANNANG ETHNIC GROUP OF NIGERIA

***Igbemi, Mathias Akama; Oghenemavwe, Ese Loveday and Ugwa, Okezie Chinedu**

Department of Anatomy, Faculty of Basic Medical Science, College of Health Science, University of Port Harcourt, Nigeria.

***Corresponding Author: Dr. Igbemi, Mathias Akama**
Department of Anatomy, Faculty of Basic Medical Science, College of Health Science, University of Port Harcourt, Nigeria.
Email Id:

Article Received on 24/03/2019 **Article Revised on 14/04/2019** **Article Accepted on 04/05/2019**

ABSTRACT
Establishing identity of an individual is a very important part of forensics and various methods have been used. The aim of this study was to estimate sex using odontometric parameters of the people of Annang ethnic group of Nigeria. 252 respondents (110 males and 142 females) from the ages of 15-30 were used for the study. Volunteers were meant to sit comfortably on a chair; using a good light source, a pair of divider was used to take measurement of the mesiodistal dimensions, crown height, buccolingual dimension of the incisors, canine and both premolars of the mandibular and maxillary teeth of the right side in addition to the maxillary intercanine width. Data was analyzed using Microsoft excel and Statistical Package for Social Sciences (SPSS). Student t test and Discriminant Function Analysis (DFA) was used to determine sexual differences and generate model for sex determination. There was significant difference in male and female values at $p<0.05$ in the maxillary canine, maxillary central incisor and mandibular canine. 83% of samples were correctly classified as males and 83.03% as females using DFA. The canine was found to be the best predictor of sex with the crown height of maxillary canine (CH3) having the highest predictive value followed by the maxillary intercanine width(MAX ICW), the mesiodistal dimension of the mandibular lateral incisor(MD7), buccolingual dimension of mandibular premolar (BL9), buccolingual dimension of maxillary canine (BL3). It is concluded that the odontometric parameter are reliable method for sex estimation in forensic studies.

KEYWORDS: Odontometric parameters, mesiodistal dimension, crown height, buccolingual dimension, maxillary intercanine width, forensics.

INTRODUCTION
Establishing identity of a missing person from their remains is a very important aspect of forensics.[1] This becomes very necessary in situations of natural mass disasters like floods, tsunamis, earth quakes, landslides, etc., and also in disaster situations caused by the influence of man as in cases of tanker fire explosions, terrorist attacks, collapse of buildings etc and in cases involving severely destroyed body parts beyond recognition either from decomposition or crushed deliberately to make identifying of the victim difficult if not impossible.[2] The necessity for identification of these disaster victims is usually for social and medico-legal purposes. In Identification of persons, the big four is ascribing, "how old, gender, how tall and what ethnic group" the victim may be from which forms the bases of tentative identification.[3]

Sex determination is usually done by osteometric assessment for which several bones have been used ranging from skull, long bones of the extremeties and pelvic bones[4] and use of DNA.[5] The only method with 100% accuracy is the use of DNA but in many cases especially in resource and technology-poor areas it is not readily available.[6]

Teeth are one of the strongest structures in the human body, and can withstand high explosion and are not damaged by such incidents. Thus, teeth are likely to be recovered in mass fatality incidents where the other means of identification such as fingerprints, long and pelvic bones and facial features are destroyed.[7] Also, an adult human jaw has 32 and hence, even though some teeth gets missing, others may still be well preserved in the jaw bone.[8] Use of odontometric parameters for identification is still an emerging area of research in Nigeria and as such, there is paucity of information regarding sex prediction and stature estimation using the teeth. Various authors have reported the fact that odontometric features differ in specific populations,[9] and also within the same population in the historical and evolutionary context, hence the need to determine population specific values is necessary to make identification of persons possible on the basis of measuring dimensions from the teeth.[9]

The aim of the study was to determine sexual dimorphism using the mesiodistal dimension, crown height and buccolingual dimension of the maxillary and mandibular incisors, canine and premolars of the right side of the teeth and also the maxillary intercanine width of the people of annang ethnic group of Nigeria. The Annang is a cultural and ethnic group native to "South South" geopolitical zone in Nigeria and are the second largest ethnic group in Akwa Ibom State.[10]

MATERIALS AND METHODS

The population of study was selected from the Annang ethnic group Of Nigeria. The study was carried out between October 2018 and March 2019. It was a cross sectional descriptive study involving 252 volunteers comprising of 110 Males and 142 females. Subjects were selected randomly from government secondary schools and hospitals from randomly selected four(4) out of the eight(8) local governments areas that make up the annang ethnic group in Akwa Ibom State.

The minimum sample size for the study was determined and calculated using the Cochran method.[11] An individual was considered for the study if both parents and grandparents were Annang, gave a written informed consent and had periodontally heathy teeth without history of dental procedure or chronic illness.

Each subject was made to sit comfortably on a flat surface. With good light, the lips were parted using disposable sterile spatula. Using a pair of sterile manual divider, the measurements of the misiodistal dimension, the bucolingual dimension and the crown height of the maxillary and mandibulla central and lateral incisors, canine, and first and second premolars of the right side of the teeth was measured, in addition to the maxillary intercanine width. (Figure 1 - 4) the mensured dimension was then measured on a digital Vernier calliper (Figure 5) to the nearest 0.01mm. Each parameter was measured twice, and the average taken by same observer and same Digital Vernier Calliper to minimize intra-observer error. The measurements were done under aseptic conditions and at the end of each day, the pair of dividers were autoclaved. The measured parameters were; buccolingual dimension of maxillary central incisor (BL1), mesiodistal dimension of maxillary central incisor (MD1), crown height of maxillary central incisor (CH1), buccolingual dimension of maxillary lateral incisor (BL2), mesiodistal dimension of maxillary lateral incisor (MD2), crown height of maxillary lateral incisor (CH2), buccolingual dimension of maxillary canine (BL3), mesiodistal dimension of maxillary canine (MD3), crown height of maxillary canine (CH3), buccolingual dimension of maxillary premolar one (BL4), mesiodistal dimension of maxillary premolar one (MD4), crown height of maxillary premolar one (CH4), buccolingual dimension of maxillary premolar two (BL5), mesiodistal dimension of maxillary premolar two (MD5), crown height of maxillary premolar two (CH5), buccolingual dimension of mandibular central incisor (BL6), mesiodistal dimension of mandibular central incisor (MD6), crown height of mandibular central incisor (CH6), buccolingual dimension of mandibular lateral incisor (BL7), mesiodistal dimension of mandibular lateral incisor (MD7), crown height of mandibular lateral incisor (CH7), buccolingual dimension of mandibular canine (BL8), mesiodistal dimension of mandibular canine (MD8), crown height of mandibular canine (CH8), buccolingual dimension of mandibular premolar one (BL9), mesiodistal dimension of mandibular premolar one (MD9), CH9 = crown height of mandibular premolar one (CH9), buccolingual dimension of mandibular premolar two (BL10), mesiodistal dimension of mandibular premolar two (MD10), crown height of mandibular premolar two (CH10), maxillary intercanine width (MAX-ICW).


Figure 1: measurement of mesiodistal dimension. Figure 2: Measurement of buccolingual dimension.


Figure 3: Measurement of crown height. Figure 4: Measurement of maxillary intercanine width.

Figure 5: Transfer of measurement from divider to Vernier calliper.

RESULTS

Descriptive statistical analysis was used to summarize the collated data for males and female subjects and presented in charts and tables. Student t-test was done for difference in mean of male and female samples to test for significance. Wilks' Lamda test for independent samples was done to see if the variables were fit for discriminant function analysis (DFA). Multivariate Stepwise discriminant function analysis was used to generate a predictive model for sex determination and sexual dimorphism of each tooth variable were ranked accordingly.

Figure 6-7 are multiple bar charts showing average for values of some of the measured odontometric parameters in both males and females.

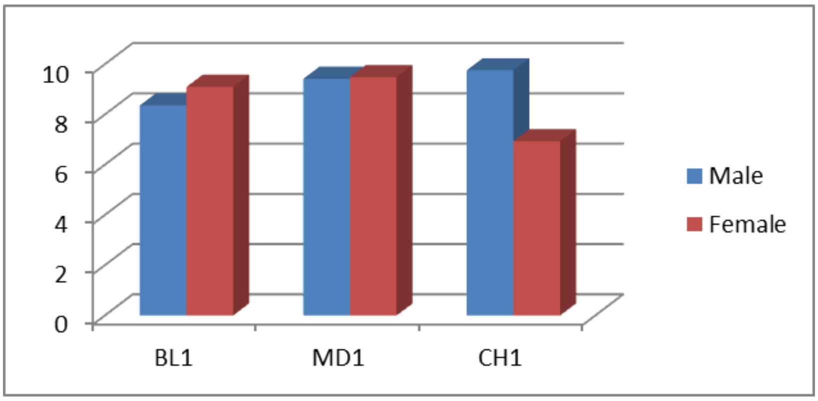

Figure 6: Average for values of buccolingual, mesiodistal and crown height dimensions of maxillary central incisor.

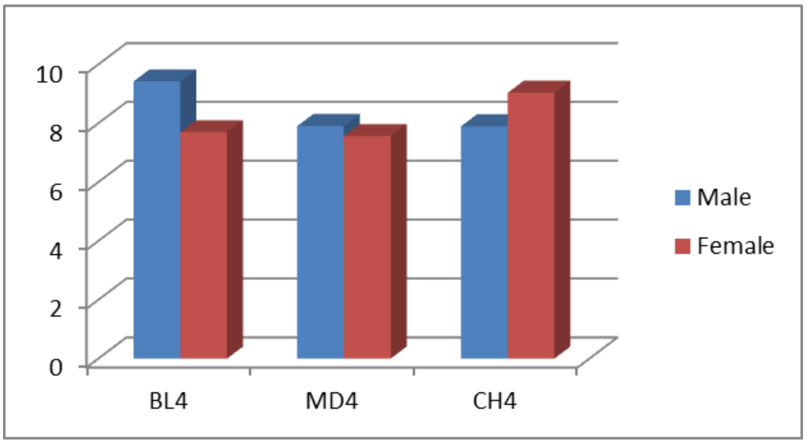

Figure 7: Average for values of buccolingual, mesiodistal and crown height dimensions of maxillary first premolar.

Table 1: Descriptive statistics of teeth parameters for male subjects.

Parameter	Sex	N	mean	SE	SD	Var	MinV	MaxV
BL1(mm)	Male	110	8.36	0.07	0.78	0.60	7.00	11.40
MD1(mm)	Male	110	9.42	0.08	0.79	0.62	8.00	11.44
CH1(mm)	Male	110	9.76	0.10	1.09	1.19	5.49	12.23
BL2(mm)	Male	110	7.38	0.08	0.82	0.68	5.39	8.80
MD2(mm)	Male	110	7.48	0.08	0.86	0.74	5.35	9.44
CH2(mm)	Male	110	8.28	0.11	1.11	1.24	5.20	10.92
BL3(mm)	Male	110	8.58	0.09	0.98	0.97	5.20	10.34
MD3(mm)	Male	110	8.43	0.05	0.56	0.31	6.10	9.60
CH3(mm)	Male	110	9.58	0.11	1.16	1.34	7.32	12.44
BL4(mm)	Male	110	9.42	0.08	0.87	0.76	7.50	11.30
MD4(mm)	Male	110	7.90	0.06	0.61	0.38	6.47	9.60
CH4(mm)	Male	110	7.89	0.07	0.75	0.57	5.56	10.50
BL5(mm)	Male	110	9.25	0.09	0.99	0.98	6.29	11.40
MD5(mm)	Male	110	7.18	0.06	0.60	0.36	5.91	9.21
CH5(mm)	Male	110	6.74	0.07	0.71	0.51	5.19	8.21
BL6(mm)	Male	110	6.43	0.07	0.69	0.48	5.00	9.85
MD6(mm)	Male	110	5.74	0.04	0.40	0.16	4.75	6.76
CH6(mm)	Male	110	8.17	0.06	0.67	0.45	7.00	9.70
BL7(mm)	Male	110	6.88	0.06	0.67	0.45	5.32	7.98
MD7(mm)	Male	110	6.52	0.05	0.57	0.32	5.38	9.24
CH7(mm)	Male	110	8.11	0.08	0.84	0.71	5.97	10.44
BL8(mm)	Male	110	8.03	0.08	0.85	0.73	6.00	9.83
MD8(mm)	Male	110	7.72	0.06	0.65	0.43	6.43	10.50
CH8(mm)	Male	110	9.56	0.11	1.18	1.39	5.76	11.90
BL9(mm)	Male	110	8.33	0.08	0.79	0.63	6.56	10.10
MD9(mm)	Male	110	7.92	0.07	0.72	0.52	6.40	9.90
CH9(mm)	Male	110	8.32	0.07	0.75	0.56	6.35	10.12
BL10(mm)	Male	110	8.54	0.08	0.79	0.63	6.75	9.82
MD10(mm)	Male	110	7.64	0.06	0.62	0.38	5.89	8.78
CH10(mm)	Male	110	7.46	0.07	0.68	0.47	5.97	9.30
MAX- ICW(mm)	Male	110	42.66	0.17	1.74	3.03	37.90	46.30

BL-Buccolingual dimension, MD-Mesiodistal dimension, CH-Crown, 1-10(Maxillary central incisor, Maxillary lateral incisor, Maxillary Canine, Maxillary first premolar, Maxillary second premolar, Mandibular central incisor, Mandibular lateral incisor, Mandibular canine, Mandibular first premolar, Mandibular second premolar respectively), MAX-ICW- maxillary intercanine width, SE- Standard error, SD-Standard deviation, VAR-Variance, MinV- Minimum variance, MaxV-Maximum variance.

Table 2: Descriptive statistics of teeth parameters for female subjects.

Parameter	Sex	N	mean	SE	SD	Var	MinV	MaxV
BL1(mm)	Female	142	7.87	0.08	0.94	0.89	5.28	10.41
MD1(mm)	Female	142	9.10	0.07	0.85	0.72	5.29	11.90
CH1(mm)	Female	142	9.49	0.08	0.96	0.92	7.30	12.13
BL2(mm)	Female	142	6.94	0.08	0.92	0.85	4.60	9.70
MD2(mm)	Female	142	7.43	0.06	0.73	0.54	5.49	9.21
CH2(mm)	Female	142	8.24	0.08	0.92	0.84	6.30	10.34
BL3(mm)	Female	142	7.96	0.08	1.00	1.00	5.28	11.05
MD3(mm)	Female	142	8.03	0.05	0.66	0.43	6.00	9.46
CH3(mm)	Female	142	8.67	0.07	0.88	0.77	6.39	10.80
BL4(mm)	Female	142	8.90	0.08	0.92	0.84	5.20	10.50
MD4(mm)	Female	142	7.69	0.05	0.63	0.39	6.30	9.33
CH4(mm)	Female	142	7.56	0.06	0.76	0.58	5.35	10.29
BL5(mm)	Female	142	9.03	0.08	0.93	0.86	6.27	12.44
MD5(mm)	Female	142	7.10	0.06	0.70	0.48	5.57	9.41
CH5(mm)	Female	142	6.51	0.08	0.89	0.80	4.40	9.13
BL6(mm)	Female	142	6.04	0.07	0.87	0.75	3.60	8.23
MD6(mm)	Female	142	6.17	0.35	0.87	0.75	3.60	8.23
CH6(mm)	Female	142	8.24	0.07	0.82	0.67	6.20	10.49
BL7(mm)	Female	142	6.52	0.07	0.82	0.68	4.50	8.76
MD7(mm)	Female	142	6.58	0.05	0.54	0.29	5.46	8.30
CH7(mm)	Female	142	8.18	0.09	1.04	1.08	5.75	11.32
BL8(mm)	Female	142	7.49	0.07	0.84	0.70	5.01	9.01
MD8(mm)	Female	142	7.37	0.04	0.53	0.28	5.66	8.55
CH8(mm)	Female	142	8.89	0.08	0.92	0.85	5.03	11.10
BL9(mm)	Female	142	7.65	0.07	0.85	0.72	4.85	9.51
MD9(mm)	Female	142	7.59	0.05	0.57	0.32	6.00	8.73
CH9(mm)	Female	142	7.90	0.07	0.89	0.79	5.00	10.30
BL10(mm)	Female	142	8.12	0.07	0.87	0.76	5.55	9.70
MD10(mm)	Female	142	7.39	0.04	0.49	0.24	6.03	8.50
CH10(mm)	Female	142	7.00	0.08	0.94	0.88	4.28	9.30
MAX- ICW(mm)	Female	142	40.95	0.22	2.66	7.05	36.40	52.63

BL-Buccolingual dimension, MD-Mesiodistal dimension, CH-Crown, 1-10(Maxillary central incisor, Maxillary lateral incisor, Maxillary Canine, Maxillary first premolar, Maxillary second premolar, Mandibular central incisor, Mandibular lateral incisor, Mandibular canine, Mandibular first premolar, Mandibular second premolar respectively), MAX-ICW- maxillary intercanine width, SE- Standard error, SD-Standard deviation, VAR-Variance, MinV- Minimum variance, MaxV-Maximum variance.

Table 3: Result of T test for differences in the mean for males and females subjects.

Parameter	calculated t score	Critical t score	p value	Inference
BL1	4.57	1.96	0.00	Significant
MD1	3.04	1.96	0.00	Significant
CH1	2.09	1.96	0.04	Significant
BL2	4.02	1.96	0.00	Significant
MD2	0.46	1.96	0.65	Not significant
CH2	0.37	1.96	0.71	Not significant
BL3	4.95	1.96	0.00	Significant
MD3	5.23	1.96	0.00	Significant
CH3	6.86	1.96	0.00	Significant
BL4	4.65	1.96	0.00	Significant
MD4	2.75	1.96	0.00	Significant
CH4	3.43	1.96	0.00	Significant
BL5	1.82	1.96	0.07	Not significant
MD5	1.09	1.96	0.28	Not significant
CH5	2.27	1.96	0.02	Significant
BL6	4.03	1.96	0.00	Significant

MD6	1.21	1.96	0.22	Not significant
CH6	0.67	1.96	0.50	Not significant
BL7	3.85	1.96	0.00	Significant
MD7	0.87	1.96	0.38	Not significant
CH7	0.55	1.96	0.59	Not significant
BL8	5.00	1.96	0.00	Significant
MD8	4.50	1.96	0.00	Significant
CH8	4.85	1.96	0.00	Significant
BL9	6.50	1.96	0.00	Significant
MD9	3.99	1.96	0.00	Significant
CH9	4.05	1.96	0.00	Significant
BL10	3.96	1.96	0.00	Significant
MD10	3.58	1.96	0.00	Significant
CH10	4.45	1.96	0.00	Significant
MAX- ICW	6.15	1.96	0.00	Significant

BL-Buccolingual dimension, MD-Mesiodistal dimension, CH-Crown, 1-10(Maxillary central incisor, Maxillary lateral incisor, Maxillary Canine, Maxillary first premolar, Maxillary second premolar, Mandibular central incisor, Mandibular lateral incisor, Mandibular canine, Mandibular first premolar, Mandibular second premolar respectively), MAX-ICW- maxillary intercanine width, SE- Standard error, SD-Standard deviation, VAR-Variance, MinV- Minimum variance, MaxV-Maximum variance.

2 DISCRIMINAT FUNCTION ANALYSIS

A Table 4: Wilks' Lambda.

Test of Function(s)	Wilks' Lambda	Chi-square	Df	Sig.
1	0.446	189.301	31	0.000

**Test is significant and it shows the data can be used for a Discriminant Function Analysis.

B Table 5: Function at Group Centroid.

SEX	Function
	1
Male	1.26
Female	-0.98

**** ShowS DFA score that predict male or females. DFA score at or close to 1.26 indicate males. DFA score at or close to -0.98 indicate females**

C Table 6: Classification Result.

SEX			Predicted Group Membership		Total
			Males	**Females**	
Original	Count	Males	92	18	110
		Females	17	125	142
	%	Males	83.64	16.36	100
		Females	11.97	88.03	100
Cross-validated	Count	Males	86	24	110
		Females	24	118	142
	%	Males	78.19	21.81	100
		Females	16.90	83.10	100

****83% of samples were correctly classified as males while 83.03% of original samples correctly classified as females.**

****In cross validation of samples 78.19% were classified as males while 83.10% were classified as females**

D Table 7: Standardized Canonical Discriminant Function Coefficients.

	Function
	1
BL1	0.02
MD1	0.50
CH1	-0.23
BL2	0.29
MD2	-0.65
CH2	-0.17
BL3	0.37
MD3	0.22
CH3	0.48
BL4	0.06
MD4	0.09
CH4	0.00
BL5	-0.62
MD5	-0.21
CH5	-0.15
BL6	0.05
MD6	-0.09
CH6	0.07
BL7	-0.09
MD7	-0.43
CH7	-0.42
BL8	0.09
MD8	0.33
CH8	0.15
BL9	0.40
MD9	0.11
CH9	0.09
BL10	-0.01
MD10	-0.05
CH10	0.29
MAX-ICW	0.49

BL-Buccolingual dimension, MD-Mesiodistal dimension, CH-Crown, 1-10(Maxillary central incisor, Maxillary lateral incisor, Maxillary Canine, Maxillary first premolar, Maxillary second premolar, Mandibular central incisor, Mandibular lateral incisor, Mandibular canine, Mandibular first premolar, Mandibular second premolar respectively), MAX-ICW- maxillary intercanine width.

E DISCRIMINANT FUNCTION SCORE EQUATION (MODEL)

Discriminant score = (0.02 X BL1) + (0.50 X MD1) – (0.23 X CH1) + (0.29 X BL2) – (0.65 X MD2) – (0.17 X CH2) + (0.37 X BL3) + (0.22 X MD3) + (0.48 X CH3) + (0.06 X BL4) + (0.09 X MD4) + (0.00 X CH4) – (0.62 X BL5) – (0.21 X MD5) – (0.15 X CH5) + (0.05 X BL6) – (0.09 X MD6) + (0.07 X CH6) – (0.09 X BL7) – (0.43 X MD7) – (0.42 X CH7) + (0.09 X BL8) + (0.33 X MD8) + (0.15 X CH8) + (0.40 X BL9) + (0.11 X MD9) + (0.09 X CH9) – (0.01 X BL10) – (0.05 X MD10) + (0.29 X CH10) + (0.49 X Max ICW).

F Table 8: Step Wise Discriminant Function.

Variables Entered/Removed[a,b,c,d]									
Step	**Entered**	**Wilks' Lambda**							
		Statistic	**df1**	**df2**	**df3**	**Exact F**			
						Statistic	**df1**	**df2**	**Sig.**
1	CH3	0.83	1	1	250	50.35	1	250	0.000
2	MAX-ICW	0.77	2	1	250	37.79	2	249	0.000
3	MD7	0.72	3	1	250	31.40	3	248	0.000
4	BL9	0.66	4	1	250	31.51	4	247	0.000
5	BL3	0.64	5	1	250	28.04	5	246	0.000
6	BL5	0.60	6	1	250	26.66	6	245	0.000
7	MD8	0.59	7	1	250	24.67	7	244	0.000
8	MD2	0.56	8	1	250	24.00	8	243	0.000
9	CH7	0.54	9	1	250	22.52	9	242	0.000
10	MD1	0.52	10	1	250	22.17	10	241	0.000
11	BL2	0.50	11	1	250	21.76	11	240	0.000
12	CH10	0.49	12	1	250	20.78	12	239	0.000

** show variables that can be used to best predict sex

CH3-Crown heigh of maxillary canine, MAX-ICW-Maxillary intercanine width, MD7-Mesiodistal dimension of maxillary lateral incisor, BL9-Buccolingual dimension of mandibular second premolar, BL3-Buccolingual dimension of maxillary canine, BL5-Buccolingual dimension of maxillay second premolar, MD8-Mesiodistal dimension of mandibular canine, MD2-Mesiodistal dimension of maxillary laterial incisor, CH7-Crown height of mandibular lateral incisor, MD1-Mesiodistal dimension of maxillary central incisor, BL2-Buccolingual dimension of mandibular lateral incisor, CH10-Crown height of mandibular second premolar.

The mean values of the measured odontometric parameters for males and females samples are shown in Table 1 and Table 2 respectively.

Table 1 showed that among the single tooth parameters measured for males, CH1 had the highest mean value (9.76±1.09 mm), followed by CH3 (9.58±1.16 mm) and then CH8 (9.56±1.18 mm), before MD1 (9.42±0.79 mm) etc. For the females, Table 2 showed the largest parameter to also be the CH1 (9.49±0.96 mm) followed by MD1 (9.10±0.85 mm) before the BL5 (9.03±0.93 mm) and BL4 (8.90±0.92 mm) respectively etc.

In Table 3, for the difference in mean of the male and female subjects using t-test shows significant difference in CH3 (t-score = 6.86; p = 0.00), BL9 (t-score = 6.50; p = 0.00), Max ICW (t-score = 6.15; p = 0.00) etc. while there was no significant difference in CH7 (t-score = 0.55; p = 0.59) and BL5 (t-score=1.82; p=0.07).

Discriminant function analysis (DFA) was presented in Table 4 to 7. Wilks' Lambda test was significant (X^2 = 189.301; *p*-value = 0.00) implying that the data was suitable for discriminant function analysis.

Group centroids was presented in Table 4.5. Using discriminant function equation, a DFA score was obtained. DFA score close or equal to 1.26 indicates that the unknown teeth possibly belong to a male, or a female if it is close or equal to -0.98.

Classification of the subjects into group membership was presented in Table 6. About 83.00% of the subjects were originally classified as males, while 83.03% were originally classified as females.

Table 7, standardized canonical discriminant function coefficient was presented, from which the DFA equation/model (as presented below) was derived.

Hence by substitution of the corresponding values in the equation, a value is obtained being the discriminant score. If the value is close or equal to 1.26 (a male) or -0.98 (a female).

Table 8 showed the variables entered into the discriminant function equation. In other words, variables that can estimate sex better if other variables are excluded from the equation. The variables include: CH3, MAX-ICW, MD7, BL9, BL3, BL5, MD8, MD2, CH7, MD1, BL2 and CH10. These variables showed significant difference at $p < 0.05$ using multivariate stepwise discriminant function analysis.

DISCUSSION

The study has estimated sex from odontometric parameters of the Annang ethnic people. From the study, males were found to have the largest single odontometric parameters measured were in the order of CH1, CH3, CH8 and MD1 etc. while in the females were CH1, MD1, and BL5 etc. This finding disagreed with the report of Rao who reported in his work that the maxillary central and lateral incisors usually have their MD greater than CH.[12]

The incisor and canine were also found to be the largest in males whereas in females, was the incisor and the maxillary first premolar. This may have been as a result of adaptation to the roles men play in the families such as being responsible for tearing the harder material, cracking the stronger nuts and eating the stronger bones and may also contribute to its sexual dysmorphic features.

It also showed that mean value of CH1, BL2, MD2, CH2, BL3, MD3, CH3 where larger in the males than in the females. This agreed with other studies.[13,14,15] The exception to these findings were the MD1, CH4 where the average values were found to be significantly larger in females (reverse dimorphism). Reversed dimorphism has been reported by various studies in the past,[16,17,18] most of which were Asian studies and has been attributed to genetic and environmental factors. The reason for reverse dimorphism in this present study cannot clearly be explained and may just be a reflection of variations between populations.

Discriminant function analysis correctly classified 83% of the original samples as males while 83.03% were correctly classified as females. Various studies have shown varying degrees of correct sex classification in different populations using DFA; ranging from 58% to 91%.[13,14] DFA is a predictive model where a given set of known variables could be used to predict an unknown variable. The classification result showed that the DFA model generated in this study have high accuracy value and could estimate the sexes 8 out of 10 Annang indigenes if the teeth dimensions are available.

The canine was identified as the best predictor of sex with the crown height of maxillary canine (CH3) having the highest predictive value followed by the maxillary intercanine width (Max-ICW), the mesiodistal dimension of the mandibular lateral incisor (MD7), buccolingual dimension of mandibular premolar (BL9), buccolingual dimension of maxillary canine (BL3). The canine being the best predictor in index study was similar to the reports of other studies in other populations[13,14,19,20,21] but in slight contrast to the report of Khanis in Malaysia and that of Rastogi in India,[22,23] which both reported the mandibular canine as most sexually dimorphic. But differed from other reports which reported the first molar as the most sexually dimorphic in a study involving university students in Brazil.[24] It was also in agreement with the report of Oghenemavwe and Ezugwu in Nigeria that the crown length is more sexually dimorphic than the mesiodistal width.[21]

Various authors have tried to explain the reasons behind the sexual dimorphism of the teeth (Canine) and have led to various assertions being made. Staka and Bimbashi attributed it to a longer period of amelogenesis in males,[25] while Nayak reported it's as a result of males having slower period of maturation reported influenced by the chromosome Y.[26] Y chromosome has also been reported to selectively influence the formation, growth and thickness of dentin hence larger tooth size in males while X chromosome influences amelogenesis.[27] Fincham showed that human males also have specific amelogenin proteins not present in females.[28]

The canine in humans has been regarded to be the evolutionary remnant of aggressive function and threat in male primate.[14,29] Male primates had larger teeth size than their female counterparts which are thought to be an adaptation to enable them hunt for food, secure territories and mates and fend of threats. This use of the teeth has become less important to the modern man as such functions have been transferred to the fingers, arms and weapons. It is however believed to have persisted to some extent in man in the form of larger canines[14] thus giving it, its sexual dimorphic features.

Other authors have stated that the process through which the teeth acquires sexual dimorphism is complex and cannot solely be explained by the sex chromosomal or evolutionary hypothesis but instead could be an interplay of environmental factors, variations in feeding habits of different human population as well as cultural practices.[29] Probably explaining why sexual dimorphism varies from one population to the other.

CONCLUSION

This research work has demonstrated that the teeth can be used to estimate sex with the crown height of the maxillary canine being the best predictor of sexual dimorphism followed by the maxillary intercanine width and then the mesiodistal dimension of mandibular canine in Annang population. Therefore, in the context of forensic, the odontometry is a reliable way to identify persons whose death makes it difficult to identify by other processes (visual recognition, fingerprints, documents and clothing) and Odontometric baseline reference data for Annang ethnic group have been generated.

REFERENCES

1. Rothwell BR. Principles of dental identification. Dent Clin North Am, 2001; 45: 253–70.
2. Modi JP. A Textbook of Medical Jurisprudence and Toxicology, 24th Ed, Lexis Nexis Butterworths; Nodia, 2011.
3. Vij K. Text book of forensic medicine and toxicology-principles and practice, 4th Ed, New Delhi; Reed Elsevier India Private Limited-A Division of Elsevier, 2008.
4. Hasegawa I, Uenishi K, Fukunaga T, Kimura R, Osawa M. Stature estimation formulae from radiographically determined limb bone length in a modern Japanese population. Leg. Med. (Tokyo), 2009; 11: 260–66.
5. Sharma M, Gorea RK. Importance of mandibular and maxillary canines in sex determination. J Punjab Acad Forensic Med Toxicol, 2010; 10: 27–30.
6. Iwamura E, Vieira J, Munoz D. Human identification and analysis of DNA in bones. Hosp

Clin Fac Med Sao Paulo, Revista do Hospital das Clinicas, 2004; 59(6): 383–88.
7. Pretty IA, Sweet D. A look at forensic dentistry--Part 1: The role of teeth in the determination of human identity. Br. Dent. J, 2001; 190(7): 359–366.
8. Kapila R, Nagesh KS, Iyengar A, Mehkri S.Sexual dimorphism in human mandibular canines: a radiomorphometric study in South Indian population. J Dent Res Dent Clin Dent Prospects, 2011; 5(2): 51-4.
9. Iscan MY, Kedici PS. Sexual variation in buccolingual dimensions in Turkish dentition. Forensic Sci. Int, 2003; 137: 160-164.
10. Udo EU. The history of the Annang People. Calabar, Nigeria. Apcon Press Ltd., 1983; 8.
11. Cochran WG. Sampling techniques, 3rd Ed., New York; John Wiley and Sons, Inc., 1966.
12. Rao A. Principles and practice of pedodontics; Jaypee Brothers Medical Publisher, New Delhi, India, 2006; (2): 11-14.
13. Khangura RK, Sircar K, Singh S, Rastogi V. Sex determination using mesiodistal dimension of Permanent Maxillary Incisors and Canines. J Forensic Dent Sci, 2011; 3(2): 81-85.
14. Angadi P, Hemani S, Prabhu S, Achraya A. Analyses of Odontometric sexual dimorphism and sex assessment accuracy on a large sample. J. Forensic Leg. Med, 2013; 20: 673-77.
15. Shireen A, Ara SA. Odontometric analysis of permanent maxillary first molar in gender determination. J Forensic Dent Sci, 2016; 8: 145-149.
16. Tome W, Ohyama Y, Yagi M, and Takada, K. Demonstration of sex difference in predictability of widths of unerupted Permanent canines and premolars in a Japanese population. Int J Orthod Dentofacial Orthop, 2011; 81(6): 938-944.
17. Prabhu S, Acharya AB, Muddapur MV. Are teeth useful in estimating stature? J. Forensic Leg. Med, 2013; 20: 460-464.
18. Acharya A, Mainali S. Univariate sex dimorphism in the Nepalese dentition and the use of discriminant functions in gender assessment. Forensic Sci Int, 2007; 173: 47–56.
19. Hashim MA, Murshid ZA. Mesiodistal tooth width: A comparison between Saudi males and females. Egypt Dent J, 1993; 39: 343-6.
20. Ibeachu CP, Amasiatu VC, Amah AT. Sex estimation by odontometric study of maxillary canine teeth using discriminant function analysis. Dent, 2018; 8: 6.
21. Oghenemavwe EL, Ezugwu OS. Odontometric Sex Variation in the Maxillary Incisors and Canines of the Okrikas and Ekpeyes of Nigeria: Implication for Sex Prediction. J Anat Sci, 2007; 8(1).
22. Khamis MF, Taylor JA, Malik SN, Townsend GC. Odontometric sex variation in Malaysia with application to sex prediction. Forensic Sci Int, 2014; 234: 183-184.
23. Rastogi P, Jain A, Kotian S, Rastogi S. Sexual dimorphism: An Odontometric approach. Anthropol, 2013; 1: 104.
24. Larissa CCF, Carolina VLV, Julyana de Araújo O, Paloma RG, Bianca MS, Patrícia MR. Odontometric analysis of molars for sex determination. Braz. J Oral Sci, 2016; 15(1): 35-38.
25. Staka G, Bimbashi V. Sexual dimorphism in permanent maxillary canines. Int J Pharm Biol Sci, 2013; 4: 927-932.
26. Nayak P, Acharya A, Padmini A, Kaveri H. Differences in the palatal rugae shape in two Indian populations. Arch Oral Biol, 2007; 52: 977-82.
27. Alvesalo L, Tammisalo E, Hakola P. Enamel thickness in 47, XYY males' permanent teeth. Ann Hum Biol, 1985; 12: 421-7.
28. Fincham AG, Bessem CC, Lau EC, Pavlova Z, Shuler C, Slavkin HC, and Snead ML. Human developing enamel proteins exhibit a sex-linked dimorphism. Calcif Tissue Int, 1991; 48: 288- 90.
29. Plavcan, J. M., and Van Schaik, C. P. (1992). Intrasexual competition and canine dimorphism in anthropoid primates. Am J Phys Anthropol, 1992; 87(4): 461–477.