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Prediction of Aggressive Tendencies from Facial Dimension and Ratios: A Study on Undergraduate Students of Northeastern Nigeria

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Abstract

The study aimed to determine how linear facial dimensions or ratios can specifically predict a self-reported form of aggression (physical, verbal, anger and hostility) among undergraduate students. A cross-sectional study design was adopted whereby a total of 400 (200 male and 200 female) adult undergraduate students aged between 16 to 30 years were randomly selected. A 2D facial images were used to determine facial biometrics (four linear facial dimensions ((n-sn, sn-gn, go-go and zy-gy) and five facial ratios {upper facial weight/lower facial height (UFW/LFH), upper facial weight/lower facial weight (UFW/LFW), upper facial weight/upper facial height (UFWUFH) and upper facial height/facial height (UFH/FH) and facial weight to height ratio (fWHR) - lower derived from the measured linear dimensions using a Sony digital camera DSC w380 and art face 3 software. Buss and Perry's aggression questionnaire was adopted, and scores for each aggression scale were recorded. Data analysis was done using IBM SPSS software version 22 and Cronbach's alpha for each scale above 0.70. Pearson's correlation analysis was used to determine the relationship of facial biometrics with aggressive tendencies. The study observed that lower facial height (sn-gn) significantly correlates with verbal aggression and anger irrespective of sex. Facial height (FH) also correlates with verbal aggression in both sexes, while fWHR correlates significantly with anger (AN) irrespective of sex. More so, lower facial height to facial height ratio (LFH/FH) correlates significantly with verbal aggression (VA) and anger (AN) irrespective of sex but correlates with the same in males only. Similarly, upper facial weight to lower facial height (UFW/LFH) correlates significantly with verbal aggression and anger irrespective of sex and with anger only in males. Stepwise multiple linear regression equations were formed for the parameters which showed a positive correlation with aggression and consequently UFW/LFH and UFW/LFW were the best predictors of aggressive tendencies ($P = 0.01$). Conclusively, facial characteristics are indicators of one's mood and can weakly predict aggressive tendencies in an individual and may be useful to predict suitable partners in marriage, friendship, or recruitment exercise.

Keywords: *Linear facial dimensions; Facial ratios; Aggressiveness; Northeastern Nigeria*

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1. Introduction

Human personality like aggressiveness, trustworthiness was previously attributed to one's facial characteristics (Zebrowitz, 2006) and some behaviors and personalities were also linked to such facial characteristics (Penton-Voak *et al.*, 2006). Facial photographs have been used over the years by many security agents and people to identify cheaters in certain games and competition (Verplaetse *et al.*, 2007). Roney *et al.* (2006) reported that women's judgments of men's interest in infants based on their faces predicted their actual interest in infants. Also facial information tells about one's fighting ability and strength even though the facial metrics used to make this

judgment is not clearly comprehensive (Sell *et al*., 2009). It has been reported recently that individual differences in the facial width-to-height ratio (FWHR) accounted for a significant proportion of variance in aggressive behavior in men, but not women (Carre´ & McCormick, 2008).

Facial study has been carried out in these decades for many applications such as: maxillofacial surgery, depict investigation, authentication, historical research, telecommunications or even games (Enrico & Federica, 2012). Face recognition is surely the largest branch of this diversified field, embracing subfields such as citizen's identification, recognition of suspects, corporate usages in access control and on-line banking. Since a new trend emerged to measure and evaluate 2D facial models, for the past decades two-dimensional facial data were obtained mostly by direct anthropometric measurements. Anatomical landmarks have been used for over a century by anthropometrists interested in quantifying cranial variations. A great body of work in craniofacial anthropometry is that of Leslie (Frakas, 1996) who created a database of anthropometric norms by measuring and comparing more than 100 dimensions (linear, angular and surface contours) and proportions in hundreds of people over a period of many years. These measurements include 47 landmark points to describe the face (Carnicky *et al*., 2006).

The human face is perhaps the most salient source of interpersonal information, especially with strangers. People can judge extroversion and conscientiousness accurately from the face at levels slightly above chance (Penton-Voak *et al*., 2006). Research has shown consensus in perceptions of facial trustworthiness (Zebrowitz, & Collins, 1996), but evidence for validity in these judgments is patchy.

There is little information documented on the use of facial linear dimension and ratios in relation to behavior of the population under study especially owing to the fact that the region suffers from a serious threat of aggressive associated criminalities including insurgency, banditry and gangterism. Therefore, the present study aimed at establishing this relationship through investigating the correlation that may exist between the facial linear dimension and ratios with self reported forms of aggression. The study further investigated the potential of facial dimensions in prediction of propensity for aggression.

2. Methodology

2.1 Study Area

The study was conducted at Faculty of Basic Medical Sciences, Bauchi State University Gadau, Northeastern Nigeria. The campus resides in Gadau, a village east of Itas-head quarter of Itas/Gadau LGA at 11*829'284"N 10*10'164634"E. It has an area of 1,398km^2 and a population of 229,996 as at 2006 census.

2.2 Subjects

Forty (400) participants who are students comprising of 200 males & 200f emales aged between 16 to 30 years, belonging to the Faculty of Basic Medical Sciences, Bauchi State University Gadau, Northeastern Nigeria participated. Thus the effects of age on facial measurement were controlled, male with excessive facial hair, which obscures some of the facial landmarks, and craniofacial anomalies were excluded from the study. Any subjects outside these inclusion criteria were also excluded from the study. Before the commencement of the research, ethical approval was sought from ethical committee of Faculty of Basic Medical Sciences, Bauchi State University Gadau, Nigeria. Informed consent was sought from the participants and persons whose photograph appears in the study.

2.3.1 Facial photography

To obtain the frontal photographs, individuals were asked to sit and look directly at the camera in front of them, keeping an upright and normal posture, with both arms free along the body (Moorrees *et al*., 1994). The head position corresponds to the Broca's natural head Position (Ferrario *et al.*, 1993). Behind the subjects, a white screen was placed to standardize the background. The camera was placed on a tripod stand (WT3570, China) to standardize the distance (100 cm) between it and the subject as well as adjust the camera according to sitting height of the subject (Figure 1). In addition, the tripod stands helped to avoid undesirable movements of operator and camera while taking photographs (MorosiniI *et al*., 2012). Before capturing the face, the operator ensured that glasses had been removed; the participant's forehead, neck, and ears were clearly visible during the process (Reddy *et al*., 2011). After the images were captured, those images were downloaded to a personal computer and stored in jpeg format for processing and analyses (Figure 2). A Digital Vernier Calliper (Neiko 01407A Stainless Steel SAE-Metric Conversion, China) was used as a direct anthropometric method for measurement of error where by participants were asked to sit with their head in neutral head position and linear facial dimensions were taken (Table 1). This was to help in the determination of the factor to be used for real size measurements on the photographs.

2.3.2 Facial Landmark Identification and facial linear dimension

Standard anatomical landmarks (Table 2) and reference points were used according to previous works and recognized using Bioanalyzer (a software developed using Microsoft visual basic version 6) for facial analysis (Gibelli *et al.*, 2012) while facial linear dimensions were obtained as the distance between one anatomical landmark and another (Adamu *et al*., 2017).

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Table 1: Linear facial dimensions and ratios with their corresponding landmarks

S/N	Facial linear distance	Landmark	Facial ratios	Descriptions
1	Upper facial height (UFH)	n-sn	UFW/LFW	Upper facial width to lower facial width
2	Lower facial height (LFH)	sn-gn	UFWUFH	Upper facial weight to upper facial height
3	Special upper face height	g-sn	LFH/FH	Lower facial height to facial height
4	Upper facial width (UFW)	zy-zy	UFW/LFH	Upper facial weight to lower facial height
5	Lower facial Weight (LFW)	go-go	LFW	Lower facial weight
6	Height of lower third of the face	sto-gn	HLTF	Height of lower third of the face
7	Facial height (FH)	n-sn+sn-gn	UFH+LFH	Upper face height plus lower face height
8	FWHR-Lower	Zy-zy/n-sn+sn-gn	UFW/FH	Upper face weight to facial height

Table 2: Anatomical landmarks used for measurement of facial dimension

S/N	Landmark	Abbreviation	Anatomical description
1	Alar	al	This is the most lateral point of the nasal wings
2	Endocanthion	en	This is the inner corner of the eye fissure at the meeting points of eyelids
3	Exocanthion	ex	It is the outer corner of the eye fissure where the eyelids meet
4	Glabella	g	This is most prominent point in the median sagittal plane between the supraorbital ridges
5	Gnathion	gn	It is the lowest point on the lower border of the chin, in the midline
6	Gonion	go	Midpoint of the mandibular angle
7	Labiale inferious	li	Midpoint of the lower vermilion line
8	Labiale superious	ls	Midpoint of the upper vermilion line
9	Nasion	n	This is the midpoint of the nasofrontal suture
10	Palpebrale inferious	pi	Lower eyelid center
11	Palpebrale superious	ps	Upper eyelid center
12	Stomium	sto	Midpoint of the mouth orifices
13	Subnasale	sn	It is the junction between the lower border of the nasal septum and the cutaneous portion of the upper lip, in the midline
14	Trachion	tr	The mid point of the hair line at the top of forehead
15	Vertex	v	This is the highest point on the head with the head in the Frankfort horizontal plane
16	Zygoma	zy	This is the most lateral point on the zygomatic arch

2.3.3 Measurement of Error

Intra observer error was tested using 30 randomly selected subjects and their facial dimensions and other measures were measured two weeks after the first 30 set of measurement. Additionally, inter observer error was also tested by the research assistant using the same 30 randomly selected subjects and the data of the research assistant were correlated with that of the researcher using Pearson correlation. Those dimensions with much difference between the first and the second measurements were discarded (i.e. not repeatable measurements). The entire variables in this study are within the acceptable measurement error.

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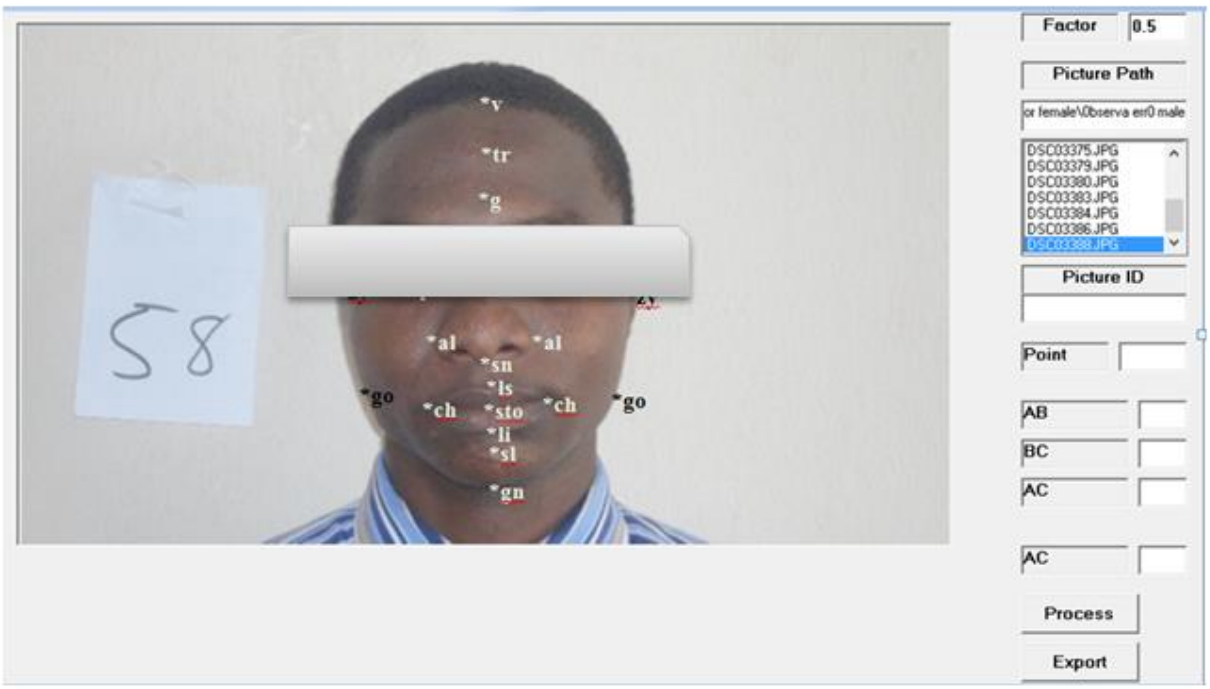

Figure 1: Facial Landmarks

2.4 BUSS and PERRY Aggressive Test

The students were administered with the questionnaire and asked to answer the questions contained therein, after being explained the meaning of some expressions in the questionnaire (Figure 3). The submitted questionnaires were used to obtained an online aggression scores from the BAP Aggressive test and the answer tabulated according its individual form of aggression. Four items on aggressive behavior were investigated as follows: physical aggression, verbal aggression, hunger and hostility.

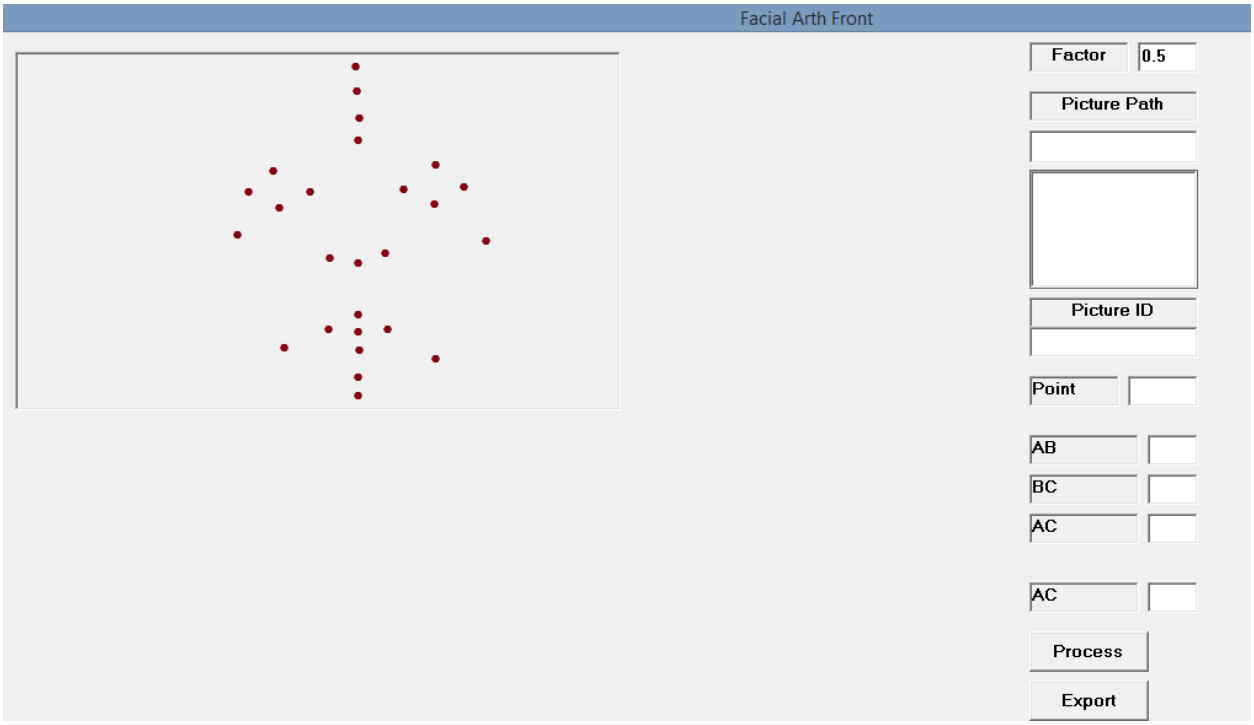

Figure 2: Art Face 3 interface for Facial Dimensions Analysis

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Figure 3: Buss and Perry Aggression Questionnaire

2.5 Statistical Analysis

The data were expressed using mean ± standard deviation (SD), frequency and percentage. Independent-samples t-test was used in assessing sexual dimorphism. Pearson's correlation was used to determine the relationship between the facial parameters and aggression. The step wise multiple regression analyses was employed to determine the best predictor of aggression among the facial dimension and ratio. The data were analyzed using Statistical Products and Service Solution IBM SPSS Version 22 Software (IBM Inc, 2010). $P < 0.05$ was set as level of significance.

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3. Results

The correlation of male inter-observer measurements of facial dimensions is presented on Table 3. There was more than 70% correlation (r > 0.7) in 19 of the variables except for pairs 3, 6, 7, 14, 19 and 25 which were having correlations of less than 70% (r < 0.7) and were discarded. This shows that 19 dimensions in this study were repeatable (Osvaldo *et al*., 2012).

There was more than 70% correlation (r > 0.7) in 19 variables except for pairs 6, 7, 14 17, 18, and 24, which were having correlations of less than 70% (r < 0.7) and were discarded. This indicates that 19 facial measurements were repeatable (Table 4).

Table 5 shows the correlations of female inter-observer observer measurements of facial dimensions. Out of the 25 paired variables, 16 had more than 70% correlations but not in the pairs of 3, 6, 7, 10, 12, 13, 14, and 25, which were having less than 70%correlations and were not included in the analyses. This indicates that 16 dimensions were repeatable.

There was more than 70% correlation in 16 of the variables except for pairs of 6, 12, 14, 16, 19, and 25 which were having less than 70%correlations and were discarded (Table 6). This indicates that the measurements were repeatable. Descriptive statistics of different aggressive behaviors for males and females participants shows that between each test group there is statistically significant difference for each aggressive behavior with males generally having higher mean values than females (Table 7). From the Table 8, it was observed that there is statistically significant difference between male and female in all the facial dimensions and facial ratios except upper facial height (n-sn) and female have higher mean values for lower facial height (sn-gn) than male, while males have higher mean values for upper facial weight and lower facial weight than females . for facial ratios, males have higher mean values for all the facial ratios than female except LFH/FH ratios.

From Table 9, height of the lower face (sn-gn) dimension significantly and inversely correlated with verbal aggression (r = -0.112, p<0.05)and anger inrespective of sex(r= -0.138, p<0.01). Facial height (FH) also inversely correlated with verbal aggression in all sexes (r= -0.106, p<0.05) while facia weight to height ratio lower (fWHR- L)postivelyand significantly correlated with anger (AN) in respective of sex (r=0.150, p<0.01). Furthermore, lower facial height to facial height ratio (LFH/FH) significantly and inversely correlated with verbal aggression (VA) (r = -0.103, p<0.05) and anger (AN) (r=-0.154, p<0.01) in respective of sex but inversely and significantly correlated with only male (r= -0.180, p<0.05). Similarly, upper facial weight to lower facial height (UFW/LFH) correlated significantly with verbal aggression (r = 0.120, p<0.05), and anger (r = 0.174, p<0.01) in respective of sex but appeared significantly correlated with anger only in male(r= 0.154, p<0.05).

Tables 10 shows multiple regression analyses between aggression and facial dimensions irrespective of sex. Multivariate analyses were conducted with facial dimensions and ratios as the independent variables and specific form of aggression that has been proven to be correlated with the dimensions from Table 9 as the dependent variable, and through model optimization by Akaike Information Criterion (AIC) stepwise backward elimination, the analyses yielded a statistically significant best minimal model (Adjusted r = 0.175, F-stat = 12.56, P<0.001) with anger as the dependant variable. The formula becomes AN = 0.068 × UFWLFH + 0.327 and from the r-value of 0.121 with verbal aggression as the dependent variable, the formula becomes VA=0.42 × UFWLFH+0.363, and for 0.183 r-value and verbal aggression as the dependent variable the formula becomes VA=0.67×UFWLFH+(-0.197) ×UFWLFW+0.523 this implies that out of the entire facial dimensions, only UFW/LFH,UFW,/LFW are best predictors of both verbal aggression and anger.

Table 3: Paired Samples Correlations of inter-observer measurements of male facial dimensions

Pair	Variables	N	Correlation coefficient	*P*-Value
Pair 1	v-en1 & v-en2	15	0.966	<0.001
Pair 2	en-gn1 & en-gn2	15	0.966	<0.001
Pair 3	tr-n1 & tr-n2	15	0.696	0.004
Pair 4	n-sn1 & n-sn2	15	0.642	0.003
Pair 5	sn-gn1 & sn-gn2	15	0.845	<0.001
Pair 6	v-tr1 & v-tr2	15	0.376	0.167
Pair 7	tr-g1 & tr-g2	15	0.462	0.083
Pair 8	g-sn1 & g-sn2	15	0.826	<0.001
Pair 9	en-en1 & en-en2	15	0.924	<0.001
Pair 10	al-al1 & al-al2	15	0.907	<0.001
Pair 11	zy-zy1 & zy-zy2	15	0.982	<0.001
Pair 12	sn-ls1 & sn-ls2	15	0.709	0.003
Pair 13	go-go1 & go-go2	15	0.918	<0.001
Pair 14	sn-sto1 & sn-sto2	15	0.578	0.024
Pair 15	sto-gn1 & sto-gn2	15	0.875	<0.001
Pair 16	ls-li1 & ls-li2	15	0.975	<0.001
Pair 17	ch-ch1 & ch-ch2	15	0.834	<0.001
Pair 18	ls-sto1 & ls-sto2	15	0.791	<0.001
Pair 19	sto-li1 & sto-li2	15	0.499	0.060
Pair 20	p avrg1 & p avrg2	15	0.785	0.001
Pair 21	ex avrg1 & ex avrg2	15	0.890	<0.001
Pair 22	Zy-v avrg1 &zy-v avrg2	15	0.982	<0.001
Pair 23	Zyg-avg1 &zyg-avrg2	15	0.940	<0.001
Pair 24	Ama1 & Ama2	15	0.826	<0.001
Pair 25	Ns Ang1 & Ns Ang	15	0.351	0.199

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Table 4: Paired Samples Correlations of intra-observer measurements of male facial dimensions

Pair	variable	N	Correlation coefficient	*P*-value
Pair 1	v-en1 & v-en2	15	0.947	<0.001
Pair 2	en-gn1 & en-gn2	15	0.974	<0.001
Pair 3	tr-n1 & tr-n2	15	0.778	0.001
Pair 4	n-sn1 & n-sn2	15	0.931	<0.001
Pair 5	sn-gn1 & sn-gn2	15	0.888	<0.001
Pair 6	v-tr1 & v-tr2	15	0.603	0.017
Pair 7	tr-g1 & tr-g2	15	0.642	0.010
Pair 8	g-sn1 & g-sn2	15	0.904	<0.001
Pair 9	en-en1 & en-en2	15	0.949	<0.001
Pair 10	al-al1 & al-al2	15	0.934	. <0.001
Pair 11	zy-zy1 & zy-zy2	15	0.977	<0.001
Pair 12	sn-ls1 & sn-ls2	15	0.835	<0.001
Pair 13	go-go1 & go-go2	15	0.969	<0.001
Pair 14	sn-sto1 & sto-gn1	15	-0.211	0.451
Pair 15	ls-li1 & ls-li2	15	0.931	<0.001
Pair 16	ch-ch1 & ch-ch2	15	0.760	0.001
Pair 17	ls-sto1 & ls-sto2	15	0.444	0.097
Pair 18	sto-li1 & sto-li2	15	0.515	0.049
Pair 19	p avrg1 & p avrg2	15	0.908	<0.001
Pair 20	ex avrg1 & ex avrg2	15	0.828	<0.001
Pair 21	zyv avrg1 &zyv avrg2	15	0.952	<0.001
Pair 22	zyg avg1 &zyg avrg2	15	0.959	<0.001
Pair 23	Ama1 & Ama2	15	0.810	<0.001
Pair 24	Ns Ang1 & Ns-ang2	15	0.623	0.013

Table 5: Paired Samples Correlations of inter-observer measurements of female facial dimensions

Pair	variable	N	Correlation coefficient	*P*-value
Pair 1	v-en1 & v-en2	15	0.730	0.002
Pair 2	en-gn1 & en-gn2	15	0.982	<0.001
Pair 3	tr-n1 & tr-n2	15	0.552	0.033
Pair 4	n-sn1 & n-sn2	15	0.632	<0.001
Pair 5	sn-gn1 & sn-gn2	15	0.911	<0.001
Pair 6	v-tr1 & v-tr2	15	0.400	0.139
Pair 7	tr-g1 & tr-g2	15	0.198	0.478
Pair 8	g-sn1 & g-sn2	15	0.885	<0.001
Pair 9	en-en1 & en-en2	15	0.867	<0.001
Pair 10	al-al1 & al-al2	15	0.451	0.091
Pair 11	zy-zy1 & zy-zy2	15	0.912	<0.001
Pair 12	sn-ls1 & sn-ls2	15	0.308	0.264
Pair 13	go-go1 & go-go2	15	0.527	<0.001
Pair 14	sn-sto1 & sn-sto2	15	0.595	0.019
Pair 15	sto-gn1 & sto-gn2	15	0.879	<0.001
Pair 16	ls-li1 & ls-li2	15	0.915	<0.001
Pair 17	ch-ch1 & ch-ch2	15	0.895	<0.001
Pair 18	ls-sto1 & ls-sto2	15	0.795	<0.001
Pair 19	sto-li1 & sto-li2	15	0.710	0.003
Pair 20	p-avrg1 & p-avrg2	15	0.893	<0.001
Pair 21	exavrg1 & exavrg2	15	0.799	<0.001
Pair 22	zvavrg1 &zyv avrg2	15	0.887	<0.001
Pair 23	Zygavg1 &zyg avrg2	15	0.913	<0.001
Pair 24	Ama1 & Ama2	15	0.776	0.001
Pair 25	NsAng1 & NsAng2	15	0.342	0.212

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Table 6: Female Measurements of Intra Observer Error

Pair	variable	N	Correlation coefficient	*P*-value
Pair 1	v-en1 & v-en2	15	0.868	<0.001
Pair 2	en-gn1 & en-gn2	15	0.984	<0.001
Pair 3	tr-n1 & tr-n2	15	0.524	<0.001
Pair 4	n-sn1 & n-sn2	15	0.488	<0.001
Pair 5	sn-gn1 & sn-gn2	15	0.951	<0.001
Pair 6	v-tr1 & v-tr2	15	0.330	0.230
Pair 7	tr-g1 & tr-g2	15	0.793	<0.001
Pair 8	g-sn1 & g-sn2	15	0.666	<0.001
Pair 9	en-en1 & en-en2	15	0.849	<0.001
Pair 10	al-al1 & al-al2	15	0.731	0.002
Pair 11	zy-zy1 & zy-zy2	15	0.941	<0.001
Pair 12	sn-ls1 & sn-ls2	15	0.598	0.018
Pair 13	go-go1 & go-go2	15	0.525	<0.001
Pair 14	sn-sto1 & sn-sto2	15	0.560	0.030
Pair 15	sto-gn1 & sto-gn2	15	0.917	<0.001
Pair 16	ls-li1 & ls-li2	15	0.540	0.060
Pair 17	ch-ch1 & ch-ch2	15	0.845	<0.001
Pair 18	ls-sto1 & ls-sto2	15	0.823	<0.001
Pair 19	sto-li1 & sto-li2	15	0.598	0.019
Pair 20	p avrg1 & p avrg2	15	0.893	<0.001
Pair 21	ex avrg1 & ex avrg2	15	0.806	<0.001
Pair 22	zyv avrg1 &zyv avrg2	15	0.904	<0.001
Pair 23	zyg avg1 &zyg avrg2	15	0.889	<0.001
Pair 24	Ama1 & Ama2	15	0.825	<0.001
Pair 25	Ns Ang1 & Ns Ang	15	0.352	0.198

***. Significant at the 0.0001 level
**. Significant at the 0.001 level
*. Significant at the 0.01 level

Table 7: Sexual dimorphism in the tested forms of aggressive behavior

	Male(n=200)	Female(n=200)		
Parameters	Mean ± SD	Mean ± SD	t	P value
PA	0.45 ± 0.16	0.39 ± 0.12	3.97	<0.001
VA	0.48 ± 0.14	0.41 ± 0.12	5.02	<0.001
HO	0.48 ± 0.16	0.42 ± 0.13	4.10	<0.001
AN	0.48 ± 0.16	0.44 ± 0.13	2.84	0.004788

AN: Anger, PA: Physical aggression, VA: Verbal aggression, HO: Hostility

Table 8: Sexual dimorphism in facial linear dimensions and facial ratios

	Male (n=200)	Female (n=200)		
Parameters	Mean ± SD	Mean ± SD	t	P-value
Upper facial height	41.27 ± 5.03	40.30 ± 6.16	1.73	0.084
Lower Facial height	54.30 ± 9.42	58.58 ± 12.87	-3.80	<0.001
Upper Facial weight	109.62 ± 11.68	103.86± 13.73	4.52	<0.001
Lower facial weight	102.44 ± 8.30	99.81 ± 13.45	2.35	0.019
Facial height	95.57 ± 10.77	98.87 ± 15.90	-2.44	0.015
fWHR	1.16 ± 0.16	1.06 ± 0.10	7.33	<0.001
UFW/LFW	1.07 ± 0.09	1.05 ± 0.11	2.45	0.014
UFW/UFH	2.67 ± 0.28	2.60 ± 0.31	2.44	0.015
LFH/FH	0.57 ± 0.05	0.59 ± 0.05	-4.93	<0.001
UFW/LFH	2.08 ± 0.43	1.81 ± 0.25	7.65	<0.001

fWHR: facial weight to height ratio, UFW/LFW; upper facial weight to lower facial weight ratio, UFW/UFH: Upper facial weight to upper facial height, LFH/FH: Lower facial height to facial height, Upper facial weight to lower facial height.

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Table 9: Correlation between facial dimensions and different forms of aggression

	All				Male				Female			
Parameters	PA	VA	HO	AN	PA	VA	HO	AN	PA	VA	HO	AN
n-sn	-0.030	-0.029	0.003	0.051	-0.06	-0.01	-0.01	0.12	-0.04	-0.09	-0.02	-0.03
sn-gn	-0.080	-.112*	-0.031	-.138**	-0.11	-0.14	-0.07	-.141*	0.01	-0.02	0.08	-0.10
zy-zy	-0.026	-0.038	-0.016	0.064	-0.07	-0.10	-0.09	0.06	-0.08	-0.09	-0.03	0.00
go-go	-0.010	0.011	-0.014	0.028	0.02	0.04	-0.06	0.03	-0.08	-0.06	-0.02	0.00
FH	-0.079	-.106*	-0.025	-0.095	-0.12	-0.12	-0.07	-0.07	0.00	-0.05	0.06	-0.09
fWHR	0.072	0.083	0.037	.150**	0.05	0.02	0.00	0.11	-0.09	-0.03	-0.10	0.11
UFWLFW	-0.026	-0.066	-0.012	0.030	-0.10	-.170*	-0.06	0.03	0.00	-0.04	-0.01	0.00
UFW/UFH	0.017	-0.019	-0.015	0.008	0.01	-0.11	-0.08	-0.07	-0.03	0.02	0.01	0.05
LFH/FH	-0.065	-.103*	-0.042	-.154**	-0.05	-0.11	-0.05	-.180*	0.03	0.04	0.09	-0.05
UFW/LFH	0.093	.120*	0.055	.174**	0.06	0.07	0.02	.154*	-0.07	-0.03	-0.11	0.10

* P <0.05, **P <0.01, AN: Anger, PA: Physical aggression, VA: Verbal aggression, HO: Hostility, fWHR: facial weight to height ratio, UFW/LFW; upper facial weight to lower facial weight ratio, UFW/UFH: Upper facial weight to upper facial height, LFH/FH: Lower facial height to facial height, Upper facial weight to lower facial height.

Table 10: Stepwise multiple linear regression analysis for prediction of aggressive behavior from facial dimensions

Step	Model	R	R^2	SEE	F	P
1	AN = 0.068 × UFWLFH + 0.327	0.175	0.031	0.15	12.56	<0.001
1	VA=0.42 × UFWLFH+0.363	0.121	0.015	0.13	5.88	0.016
2	VA=0.67×UFWLFH+(-0.197) ×UFWLFW+0.523	0.183	0.033	0.13	6.86	0.001

4. Discussion

Previous studies establish a strong relationship between some facial linear distances like FH, and facial ratios with aggression negatively or positively in either sex. Faces with smaller height were perceived as less more aggressive compared to faces with bigger height which was perceived as more trustworthy, more feminine and less aggressive (Costar *et al.*, 2017).

In fact, faces with smaller upper height (UFH) have been shown to display more bite force which may play a crucial role in survival (Proffit *et al.*, 1983; Raadsheer *et al.*, 1999). As a consequence, it is possible that faces with such characteristics may be perceived and judged as more aggressive. Here, incoherently with this literature, it has been demonstrated that faces with either small or large upper facial height (n-sn) do not have relationship with any aggressive behaviour even though less feminine this could have been due to the type of aggressive test employed. Despite mixed findings in the literature, results of this research demonstrate a robust positive link between fWHR-lower and aggression specifically anger form (r=0.150**).,even though the facial weight to height ration here used is zy-zy/n-sn+sn-gn which is usually the FWHR-Lower as used by the Lafevre *et al.*, (2012) and Hodges-Simeon *et al*., (2016). This was also consistent with the work of Lefevre CE *et al*., 2014, where anger correlated with fWHR in male (r=0.37**) and inrespective of sex (r= 0.28**) suggesting that fWHR is a reliable marker (and signal) of aggression irrespective of sex. The differences in fWHR measurement seems to account for variation in degree of relationship of the said dimension and aggressive tendencies, as stated above many used zy-zy/n-sn(upper facial weight/upper facial height) as the landmark, others use zy-zy/g-li(upper facial weight/special upper face height) and others use zy-zy/n-sn+sn-gn(upper facial weight to lower face height) which is the one adopted here. As seen in this study also and also evidenced from structural and functional neuroimaging suggest that individuals within the age bracket used might be a key time for neurocognitive maturation circuitry for reactive aggression, like region underlying emotional reactivity, decision making and social cognition (Blackemore & Mills, 2014; Crone & Dalh, 2012). Secondly individuals at puberty tend to have spurt of testosterone secretion which is said to activate the amygdale enhancing its emotional activity and its resistance to prefrontal restraining control (Batrinos, 2014). It also activates the subcortical areas of the brain to produce aggression while cortisol and serotonin act antagonistically with testosterone to reduce its effects (Batrinos, 2014). Thirdly testosterone spurt at puberty increases facial development and thus influences facial ratios like FWHR (Hodges-Simeon *et al.*, 2016). Some previous studies have not found associations between the BPAQ and fWHR (Carre *et al*., 2013). Indeed, it has been already argued that the presence of fat facial tissue in cheekbones makes fWHR difficult to measure (Kramer, *et al*., 2012). Hence, upper facial height would be a less variable feature and thus easier to perceive from a face than facial width.

This work has also established that upper facial width (zy-zy) and lower facial width (go-go) were not positively correlated with aggression of any king, regardless of the sex identity. These results are incoherent with previous literature showing that during puberty under the influence of testosterone, males would get larger facial width and that, in return, the faces with larger width would be perceived as more aggressive (Lefevre *et al*., 2013). Hence, testosterone can be considered as a potential modulator of both physical (width of the face) and behavioural aspects (Weston *et al*., 2007; Penton-Voak *et al*., 2004). Based on a previous literature, faces with higher fWHR are judged as less trustworthy, more aggressive and less feminine (Stirrat *et al*., 2012).

LFH/FH another facial ratio that shows negative correlation with verbal aggression irrespective of sex (r= -0.103*) and

anger (r= -0.154**), with anger also in male (r= -0.180*). UFW/LFH also shows positive correlation with verbal aggression and anger with r-value of 0.120* and 0.174* respectively irrespective of sex and correlates with anger (r=0.154) in male. UFW/LFW also correlates negatively with verbal aggression (r= -0.170*) in Male. These findings are unprecedented as little or no data has been reported elsewhere correlating the specific variables with the said forms of aggression, this also implies that aggression is related to not only the facial dimensions previously discovered but to other dimensions.

It has been established here that anger can be best predicted by UFW/LFH with r-value of 0.17 and verbal aggression can be best predicted by UFW/LFH and a combination of UFW//LFH and UFW/LFW with an r-value of 0.121 and 0.183 respectively irrespective of sex, This is similar to another finding which states that for men, face ratio predicted 15 per cent of unique variance in aggressive behavior (R2=0.18) (Justin *et al*., 2008).

Notably, angry facial expressions consist of lowering the brow and raising the upper lip, a facial movement that inevitably increases the facial WHR and, by implication, increases the saliency of the ‘‘signal’’ advertising propensity for aggression Thus, it is also possible that the relationship between facial WHR and aggression reflects social conditioning whereby a person’s aggressive behavior has been shaped by others’ expectations of their aggressive behavior. Furthermore, it may be some other cue in the face correlated with the facial WHR that is influencing estimates of aggression (Justin *et al*., 2008).

5. Conclusion

The study indicates that there is a relationship between linear facial dimensions and facial ratios (other than fWHR) and a self-reported measure of aggressive tendencies especially anger and verbal aggression using Buss and Perry aggressive scale (BPAQ). The prediction of aggression and its relation with facial dimensions estimation in this case can supplement other methods of identifying propensity for aggression and in diagnosis of Psychiatric disorders such as affective disorders. The findings of this study also indicate that males have higher values of facial measurements than female. Facial characteristics are indicators of one’s mood and can weakly predict aggressive tendencies in an individual and may be useful to predict suitable partners in marriage, friendship, or recruitment exercise.

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Conflicts of Interest

There are no conflicts of interest

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