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Original Article

Association between Facial Types and Handedness among Students of Faculty of Basic Medical Sciences Bayero University, Kano.

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Abstract

Background: Generally, a person's dominant hand is a simple and precise determinant of his preference for hand use in fine manual tasks. The main tools used in forensics are derived from the relationships between anthropometric features with important physical and /or biological traits. **Objective:** This study was to determine the association between facial types and handedness among students of the Faculty of Basic Medical Sciences of Bayero University, Kano. **Methodology:** Cross-sectional study design with a consecutive sampling of 400 (180 males and 220 females) students (aged 18 and above) of the Faculty of Basic Medical Sciences Bayero University, Kano was carried out. Facial height (FH) and facial width (FW) were measured using established landmarks and the facial index (FI) was calculated from them. The dominant handedness of each participant was determined using the writing component of the Edinburgh Handedness Inventory. This procedure involved asking the participants to mention which of their hands was dominant. The participant was then asked to write a sentence regarding the activities he/she was carrying out at the point of recruitment to ascertain the claim made by the participants. The sentence was written separately using each hand. All the data obtained were analyzed using statistical software (SPSS version 20.0). **Results:** The study population was relatively young (21.76 ± 2.77 years). Right-handedness was the commonest hand dominance observed in both males (90.7%) and females (91.7%). The commonest types of face were the hypereuriproscopic 2 (0.5%), Euriproscopic 41 (10.3%), Mesoproscopic 78 (19.5%), Leptoproscopic 127 (31.8%) and Hyperleptoproscopic 152 (37%) facial types. The majority of the participants were right-handed and this was regardless of gender. The prediction of handedness based on facial types ($\chi 2 = 1.39$, Df =3, P = 0.85) or facial index (P = 0.92, OR=0.99, CI = 0.82 – 1.19) was not statistically significant. **Conclusion:** The facial types identified among the study population were not associated with their handedness and thus it was not a good predictor of handedness.

Keywords: Dominant hand; Facial index; Facial type; Forensics; Prediction.

Introduction

The most natural approach for identifying a person in everyday life is based on facial characteristics.[1] Facial anthropometry provides an indication of the variations in facial shape in a population and the distinctive features of faces in that population.[1] Scientifically, faces can be described using morphological and metric assessments of facial features.[3] Facial index (FI) is the ratio of facial height to facial width and it had been applied in categorizing facial forms into five groups (Barnister's classification): Hypereuriproscopic (very broad face, FI <80), Euriproscopic (broad

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face, FI: 80-85), Mesoproscopic (round face, FI: 85-90), Leptoproscopic (long face, FI: 90-95, Hyperleptoproscopic (very long face, FI : >95).[4] Sexual dimorphism in the male and female facial indices has been reported in Nigerians, and Manipales but not in the Nepalese population, and it (sexual dimorphism) has been attributed to the male hormone; Testosterone which causes changes in facial appearance.[5]

The preferential use of one hand for most fine manual tasks is described as handedness, thus when the right hand is involved, it is called right-handedness (90% of the population) and when the left hand is involved, it is called left-handedness (10% of the population).[6] Being able to use both hands equally (known as ambidextrous) is extremely rare in the population and the handedness of an individual determines the dominant hand of that individual.[7] Men are slightly more likely to express a strongly dominant left hand than women.[8] There are several theories of how handedness evolves and researchers have studied fetuses in uterine life and determined that handedness in the womb was a very accurate predictor of handedness after birth.[9] Genetically, handedness is inherited from a complex set of genes.[10] The current study aimed to determine the association between facial types and handedness among students of the Faculty of Basic Medical Sciences of Bayero University, Kano. The results from this study can enrich the literature regarding the study subject as well as improve the tools available to forensic scientists for appropriate evaluations.

Materials and Method

Materials

A digital vernier caliper (Neiko l01407A, China), Proforma; Pencil HB; Pen; Paper (ARIA A4 70).

Methodology

Informed consent

Verbal consent from all the subjects was obtained after a proper explanation of the objectives of the study to them.

Study Location and Duration

This research was conducted at Bayero University Kano, in the Faculty of Basic Medical Sciences, which comprised of Anatomy, Biochemistry, Nutrition, Dietetics, and Physiology departments. The recruitment of the study participants was carried out over six weeks (one and a half months).

Study subjects

The total number of students (400) included in the study was calculated from the formula.

$N = Z^2pq/d^2$.[11] The participants recruited included 180 male and 220 female students.

Inclusion criteria

1. The subject must be from the Faculty of Basic Medical Sciences.
2. Subject without any congenital or traumatic accidents involving hands or face.
3. Subjects that were able to write.

Exclusion Criteria

1. The subject who do not consent to the study.
2. Subjects who are pregnant.
3. Subjects who have an illness related to the face including lesions
4. Study participants with a disparity in their self-report and observational assessment regarding their dominant hand.
5. Subjects with hand pathologies

Study design

The study design was a cross-sectional study, with study participants recruited using the consecutive sampling technique.

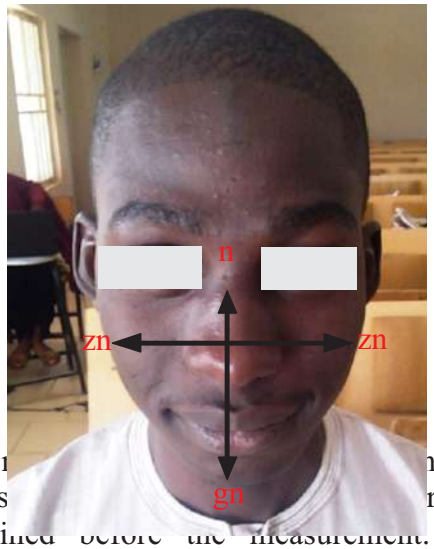
Anthropometric measurements

The anthropometric evaluation began with the identification of the landmark locations of the study participants. The study participants were measured in a sitting position, relaxed with the head oriented in an eye-ear plane. Anthropometric points were measured using a digital vernier caliper.

The anatomical landmarks used for evaluating facial dimension included:

a. Nasion (n): point on the root of the nose where the mid-sagittal plane cuts the nasofrontal suture
b. Gnathion (Gn): the lowest point of the mandible where its lower margin is intersected with the mid-sagittal plane.
c. Zygion (Zn): the most lateral point on the zygomatic arch

Plate I: Pictorial representation of landmarks for measuring facial dimension [Gnathion (Gn); Nasion (n); Zygion (Zn)]



The r ned to each of the s rmission was obtained before the measurement. The facial landmarks were used to determine the face length and breadth using a Vernier caliper. Facial height was measured as the distance between nasion (n) to gnathion (Gn). Face width was measured as the straight distance between the right and left zygion (zn) and it is also called the bizygomatic breadth.

Determination of handedness

The following tests were conducted to identify the functionally dominant hand in line with the first component of the Edinburgh Handedness Inventory (EHI)

Asking study participants: "What hand is your dominant hand?"

a) Observing patients while performing handwriting: Asking the participant to write a short sentence to explain the immediate activity he was involved in just before recruitment for the study.

Statistical Analysis

The data were analyzed using Statistical Package for Scientific Solutions (SPSS) software version 20.0. A chi-square test was carried out to determine the association between facial types and handedness. An Independent t-test was used to evaluate the level of difference in facial height and facial width based on gender. The evaluation of the association between the facial measurements of height and width with facial types was done in two formats. The first format involved the evaluation using four facial types with the broad and very broad categories of the facial type's merged into one, while the second format required that the entire facial types were categorized into two only. Multinomial logistic regression was used for evaluating the association in the first format while binary logistic regression was used for the second format.

The test of association between the categorical variables of facial types and handedness was carried out using the Chi-square test and the evaluation was carried out with facial types categories of 4 groups (format 1), 3 groups and 2 groups (format 2) respectively. The P value ≤ 0.05 was considered to be the level of statistical significance.

Results

Descriptive Statistics and sexual dimorphism

The mean age of males was 22.41±3.293 years while for females was 21.17±2.259 years. Among the male participants, there were 17 (9.3%) left-handed individuals and 166 (90.7%) of them were right-handed. Among the females, there were 198(91.7%) right-handed individuals and 18 (8.3%) left-handed individuals. (Table 1).

Table1: Descriptive statistics, handedness, and facial types based on gender

Variables	All (n=398)	Males (n = 182)	Females (n = 216)	Statistics
Mean Age (years)	21.76 ± 2.77	22.41±3.293	21.17±2.259	
Right handedness	364 (91.7%)	166 (91.7%)	198 (91.8%)	df =1, X2 = 0.027, P = 0.871
Left-handedness	34 (8.3%)	16 (8.3%)18	(8.3%)	
1FH (mm)	104.20 ± 6.43	105.51 ± 7.18	103.13 ± 5.56	17.785 < 0.001
1FW (mm)	111.71 ± 10.02	112.77 ± 9.36	111.35 ± 7.29	12.677 < 0.001
Hypereuriproscopic	2 (0.5)	1 (0.6)	1 (0.5)	
Euriproscopic	41 (10.3)	18 (10)	23 (10.5)	
Mesoproscopic	78 (19.5)	30 (16.7)	48 (21.8)	
Leptoproscopic	127 (31.8)	55 (30.6)	72 (32.7)	

SD = standard deviation; FH = facial height; FW = facial width; N = number / frequency; % = percentage; [1] P < 0.05

The evaluation of the mean measurements of facial height and width based on gender revealed a statistically significant difference (Table 1). Specifically, the mean facial height among males was 105.51± 7.18 which was statistically (P< 0.001) higher than the mean facial height of 103.13 ± 5.56 obtained among females. For the facial width, the mean facial width among males was 112.77 ± 9.36 which was statistically (P< 0.001) higher than the mean facial height of 111.35 ± 7.29 obtained among females. There are several facial types based on the values obtained from the calculated facial index and they included 2 (0.5%) Hypereuriproscopic (very broad), 41 (10.3%) Euriproscopic (broad), 78 (19.5%) Mesoproscopic (round), 127 (31.8%) Leptoproscopic (long) and 152 (38%) Hyperleptoproscopic (very long) facial types (Table 1).
The evaluation of the association between measurements of facial height and width with facial types in this study suggested that the facial measurements were significantly ($P \leq 0.05$) associated with facial types irrespective of the number of categories for facial type imputed in the analysis (Table 2).

Table 2: Association between facial dimensions (height and width) with different facial types when categorized in different formats.

		B	S.E.	Wald	Df	Sig.	Exp(B)
Format 1 for facial very broad + height	Intercept	13.981	3.177	19.365	1	0.00001	
(Reference is broad very long*)	Facial height	-0.146	0.031	22.560	1	0.000002	0.864
Round	Intercept	14.289	2.681	28.398	1	0.000	
	Facial height	-0.143	0.026	30.491	1	3.35E-8	0.867
Long	Intercept	6.332	2.289	7.653	1	0.006	
	Facial height	-0.062	0.022	8.147	1	0.004	0.940
Format 1 for facial width very broad + width	Intercept	-36.802	3.941	87.186	1	9.87E-12	1.366
(Reference is broad very long*)	Facial broad	0.312	0.034	84.939	1	3.08E-20	
Round	Intercept	-21.065	2.752	58.577	1	1.95E-14	
	Facial width	0.185	0.025	56.300	1	6.22E-14	1.203
Long	Intercept	-13.739	2.321	35.033	1	0.000	
		0.123	0.21	34.226	1	0.000	1.131
Format 2 for facial height Binary Facial type	Facial height	0.113	0.021	29.780	1	0.000	1.120
(Reference is very long + long)	Constant	-10.948	2.137	26.247	1	0.000	0.000
Format 2 for facial width Binary Facial type	Facial width	-.146	0.018	64.481	1	0.000	0.864
(Reference is very long + long)	Constant	17.282	2.077	69.224	1	0.000	3.2 x107

Note: Binary facial type = very broad + broad + broad vs Long + very long; *Very long is the reference category for format 1; Long + very long is the reference category for format 2.

The assessment of the association between facial types (in categories) and handedness was carried out in three formats to identify if there was any potentially significant relationship between the test variables, Nevertheless, none of the results was observed to be statistically significant (Table 3).

Table 3: Association between facial types and handedness based on left and right-handers among students of the Faculty of Basic Medical Sciences.

	Handedness					
	Facial classification	**Left**	**Right**	**df**	**x2**	**P-value**
Format 1	Hypereuriproscopic	0	2	4	1.393	0.845
	Euriproscopic	2	28			
	Mesoproscopic	5	72			
	Leptoproscopic	12	115			
	Hyperleptoproscopic	17	147			
Format 2	Broad	2	30	2	1.217	0.544
	Round	5	72			
	Long	29	262			
Format 3	Broad + very broad + round	120	8	1	1.014	0.314
	Long +very long	246	25			

N = 400; df = degree of freedom x^2 = chi-square value

Furthermore, the assessment of the association between facial index values and handedness was carried out to identify if there was any potentially significant relationship between the test variables (quantitative format regressed on the binary categories for handedness). Nevertheless, the results were observed not to be statistically significant (Table 4).

Table 4: Binary logistic regression for the continuous values of facial index regressed on the categorical measurement for handedness

							95% EXP(B)	C.I.for
	B	S.E.	Wald	Df	Sig.	Exp(B)	Lower	Upper
Facial index values	-0.010	0.095	0.011	1	0.915	0.990	0.821	1.193
Constant	-2.397	0.203	139.913	1	0.000	0.091		

Discussion

In the current study, 183 (45%) of the participants were males and 216 (55%) of them were females. The mean (22.41 years) ages of the male study participants and female (21.17 years) study participants were observed to be relatively young. The handedness in males was observed to be; 9.3% left-handed and 90.7% right-handed, while in females it was; 8.3% of left-handedness and 91.70% right-handed. The proportion of left-handed participants in the entire study participants was 8.3%. Nevertheless, there was no statistical difference in the distribution of the handedness based on gender and this was similar to an earlier report in the literature.[12]

The values for the measurements of facial height (FH) and facial width (FW) in Males were statistically higher than those in females and this result was similar to the ratio (facial index) from these measurements. Sexual dimorphism for facial anthropometric features of facial height, width, and the index had been reported in earlier studies.[13] It has been suggested that facial sexual dimorphism, is determined by a balance during adolescents, between testosterone which promotes the growth of check-bones, jaw bone as well as brow ridges, and estrogen hormone which inhibits the growth of these features.[14] The aforementioned statement regarding facial sexual dimorphism for facial height appeared to be true for the values of facial height obtained in the current study; male average facial height (105.51 ± 7.18mm) or female facial height (103.13 ± 5.56 mm). Facial sexual dimorphism was also reported in an earlier study carried out in a population of study participants aged 3 – 18 years who were of Ijaw origin, in addition, the study identified age-related changes in the craniofacial measurements.[15] Although the current study was centered on students from a university in northern Nigeria with an average higher age (males= 22.41 years, females = 21.17 years) the similarity in finding regarding sexual dimorphism for measurement of facial dimension with the aforementioned literature report was clear.

The computation of the facial indices allowed for the categorization of the different results obtained into different categories of facial types in line with standards earlier established by Barnister.[4] In the current study, the facial types observed included hypereuriproscopic 2 (0.5%), Euriproscopic 41 (10.3%), Mesoproscopic 78 (19.5%), Leptoproscopic 127 (31.8%) and Hyperleptoproscopic 152 (37%) facial types. A similar distribution of facial types was obtained when the dimensions obtained were categorized based on gender. A literature report for the assessment of facial type among students of the University of Maiduguri revealed that all the facial types including hypereuryproscopic 3 (1.5%) Euryproscopic 17 (5.1%), Mesoproscopic 37 (11.1%) Leptoproscopic 51 (15.4%) and Hyperleptoproscopic 222 (66.9%) facial types were represented in the recruited study population.[16] The proportion of facial types based on gender was similar to the assessment obtained for the combined population. Specifically, the females' students recruited from the University of Maiduguri had all the facial types including hypereuryproscopic 3 (2.1%) Euryproscopic 7 (4.9%), Mesoproscopic 28 (19.6%) Leptoproscopic 23 (16.1%) and Hyperleptoproscopic 82 (57.3%) types. The male students recruited from the same university had all the facial types including the hypereuryproscopic 2 (1.0%) Euryproscopic 11 (5.5%), Mesoproscopic 19 (9.5%) Leptoproscopic 28 (14.0%) and

Hyperleptoproscopic 140 (70.0%) types (16). Thus, the facial types identified in the literature was similar to the finding in the current study and the results were similar even when the facial types were assessed among the two different genders of the study participants. Thus, the current result of facial type among the students of Bayero University Kano was similar to the result from another University in Maiduguri. The similarity in finding may be because both studies were among students in federal universities located in the Northern part of the country and thus comprised a similar extent of population composition.

There is a paucity of studies in the literature that evaluated the association between facial height or width with facial morphological types or facial index values. Nevertheless, the role of facial height or facial width measurement in facial perception as regards gender and other human characteristics including bite force as well as personality have been documented.[17,18] There was a significant association between the facial types with the individual measurements for facial height and width in the current study and this finding was irrespective of the classification pattern adopted for facial type. A similar report has been made in the literature as thus; the association between the measurement of facial height and width with facial types in respect of their facial index was significant.[19] This validates the relationship between the facial measurements and the facial index itself. Thus, supporting the use of the facial index in the interpretation of facial types and gender.

There was no association between the handedness of study participants with their facial types in the current study. The result remained the same whether the evaluation was done with the categorical format of the facial types and the handedness or when the evaluation was carried out for the quantitative values for the facial index for the different categories of handedness. This type of statistical association was not evaluated in the literature. Nevertheless, the current findings as well as literature reports suggest that although both the development of handedness as well as facial types are innately controlled by endogenous features, the relationship between them may not be intimate, and thus, one cannot predict the other. It also promotes a hypothesis for an independent influence(s) by yet-to-be-identified endogenous and/or environmental factors for the development of handedness or facial type.

Conclusion

The current study failed to establish an association between facial types (regardless of how the categorization was done), with handedness among Students of the Faculty of Basic Medical Sciences Bayero University, Kano. Nevertheless, the relationship between facial dimension measurements and facial index remained stable irrespective of gender.

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Conflict of interest

The authors have no conflict of interest to declare.

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