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Age And Sex Related Variations In The Maxillary Sinuses Of South East Nigerians

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ABSTRACT

Craniofacial growth is believed to be a multifactorial process involving both genetic and epigenetic factors and how epigenetic functional matrices stimulate the transduction of regulatory signals. This study tested the relationship between the variation in maxillary sinus dimensions with sex and age. Lateral and anteroposterior radiographs of 74 males and 46 female of South Eastern Nigerians taken from 18[th] August 2003 to 12[th] July 2004 with ages ranging from 9 75 years were measured. The length, width and height of the sinus were measured using defined anatomical landmarks and analyzed. Data were analyzed using excel package of a tabletop computer, employing chi square test (X^2) to determine the association between sinus dimensions and age or sex. The evidence to associate maxillary sinus dimensions with age and sex was lacked. Thus establishing values for age and sex were not possible. Therefore prediction on the dimensions of maxillary sinus giving the age or sex of individual is statistically unreliable.

Key word: Age, Sex, Maxillary Sinus, Pneumatization.

Maxillary sinus was first described and illustrated by Leonardo da Vinci in 1489. The physiological purpose of maxillary sinuses is still very poorly understood, and attempts to link maxillary sinus patterns with specific influences, such as the environment have been inconclusive. This ambiguity may be due in part to lack of understanding of the phylogenetic distribution of sinuses across taxa (Rae et al., 2002) Maxillary sinus dimensions scales differently in different individuals. Investigations have shown that enlargement of maxillary sinus may be produced by; hallowing out of the alveolar process (alveolar recess), excavation of the floor of the nasal fossa by extension of the alveolar between the plates of the hard palate (palatal recess), encroachment of the sinus in the frontal process of the maxilla, hallowing out of zygomatic process of the zygomatic bone (Malar recess), extension to and appropriation of an air cell within the orbital process of the palatine bone (palatal recess). Reduction of the maxillary sinus on other hand may follow; imperfect absorption of cancellous bone on the floor of the sinus or secondary thickening of its walls, encroachment due to approximation of the facial and nasal walls, unusual depression of the canine fossa, excessive bulging of the lateral nasal wall or imperfectly erupted teeth.

The biochemical regimes associated with diet that differ in occlusal loading may also have an effect on paranasal sinus size, although the relationship between masticatory stress and pneumatization is unclear at present (Rae et al., 2003) Variation in the frontal sinus has been suggested to be attributable to both sex (Buckland-Wright, 1970) and biological affinity (Brothwell, et al., 1968). Geography and maxillary sinus volume were correlated in humans; among native arctic populations, individuals situated farther from the equator possess a smaller maxillary sinus volume, possibly as a consequence of an increase in the size of the nasal cavity (Shea, 1977).

Understanding the manner of growth, direction, and approximate extent of the sinuses at any particular age is of importance in carrying out the operation of sinus washout, for allowance must be made for the probable position of the sinus at any particular stage in its development (Colman, 1992) and in treatment of chronic sinusitis (Shanker et al, 1994). In paleontology, if it can be shown that sinus pneumatization is correlated with age and sex, it adds an additional factor to the puzzle of the meaning of infra orbital development. As Shea (1977) stated that nasal cavity and maxillary sinus spaces make up the width of lower face.

There is paucity in the literature on the dimensions of the sinuses in Nigeria or Africa in general. The aim of this study was to demonstrate the relationship of age and sex with the dimensions of maxillary sinus.

MATERIALS AND METHOD

A total of 120 radiographs (74 males and 46 females) with age ranging from 9 75 years taken within

August, 2003 and July 2004 with lateral, Caldwell and Waters' view were measured at Ebonyi State Teaching Hospital, Abakiliki, University of Nigeria Teaching Hospital Enugu and Hansa Clinics Enugu. Although the samples of radiographs used were collected from different places, the focus film distance used was the same (90cm as indicated from the centers where the sample were collected) This introduces an enlargement factor of about 15.8% by induction, Hass factor (Hass 1952) in addition to the radiographs measured in this study, other material used for the study include a radiograph viewing screen, mathematical set containing pair of divider, metric rule calibrated in millimeters and pencil. Radiographs of sinus used include those reported normal by the radiologists and those not affected by any pathological conditions. Those excluded from the study were in the following categories:

1. All cases of tumors and polyps from radiologist reports.
2. All cases with previous sinus operation
3. Patients without proper data from radiologist reports.
4. Patient with incomplete views
5. Poorly taken films example Radiographs with blurred images.

The three parameters involved are length (L), width (W) and height (H) of maxillary sinus. The length and width of maxillary sinus were taken from the lateral view radiographs. The sinus appears as a quadrilateral shadow in this view (Yanagisawa and smith, 1976). The length was taken as a vertical height from the floor of the sinus at the second molar teeth to the roof of the sinus at the mid point posteriorly using pair of divider and then measured on metric rule. The maxillary sinus width which is also the anteroposterior dimension was measured from the anteriorly sinus wall medially at the inferior border of the inferior turbinate bone (conchae) to the junction of the posterior wall and the inferior turbinate bone. In some cases where this is not clearly shown on the posterior wall of the sinus, the lower edge of the triangular space created by the pterygo maxillary fissure was taken. The maxillary sinus height was taken from the anteroposterior radiographs. The height was taken from the medial wall of the sinus at the superior edge of the inferior turbinate bone to the apex of the sinus in the zygomatic process of the maxilla using a pair of divider and then measured on the metric rule.

Volume of maxillary sinus

The maxillary sinus has been documented in the literature as a pyramidal cavity (Romanes 1981 Sinnatamby 2000). Their volumes are therefore calculated with the following formular:

Volume of pyramid = ? h x base area

V of maxillary sinus = ? h x L x W

To convert from mm^3 to ml

$1\ cm^3 = 1ml$

$1000mm^3 = 1\ cm^3$

$V/ml = \frac{V(mm^3)}{1000}$

Statistical Analysis

Using tabletop computer, the age, length, width and height of the maxillary sinuses were condensed in groups. Cross tabulations were done on these groups for both sex and age. This continued with chi square test (x^2) designed to test the degree of association between length, width, height and volume of the sinus by age and sex. When the chi square computed value was less than the statistical table value at = 0.05 (95% confidence), the evidence to reject the null hypothesis of no association between the two variables under analysis was lacked.

RESULT AND DISCUSSION

The relationship between sex and dimensions of the maxillary sinus was shown in table 1(A, B, C and D). Also the relationship between age and dimension of maxillary sinus was shown in Tables 2 (A B C D). Comparing the relationship of length, width, height and volume by sex or age showed that the evidence to reject the null hypothesis of no association was lacked.

Table 1A: Relationship Of Sex And Maxillary Sinus Length

MAXI. SINUS LENGTH mm	MALE	FEMALE	TOTAL
21 – 25	1	1	2
26 – 30	13	4	17
31 – 35	17	19	36
36 – 40	16	11	27
41 – 45	21	10	31
46 – 50	6	1	7
Total	74	46	120

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.131[a]	5	.211
Likelihood Ratio	7.417	5	.191
Linear-by-Linear Association	.907	1	.341
N of Valid Cases	120		

[a] 4 cells (33.3%) have expected count less than 5. The minimum expected count is .77.
x^2 table value (α 0.05) = 11.070.

Table 1B: Relationship Of Sex And Maxillary Sinus Width

MAXI. SINUS WIDTH mm	MALE	FEMALE	TOTAL
21 – 25	1		1
31 – 35	2	1	3
36 – 40	21	24	45
41 – 45	37	19	56
46 – 50	9	2	11
51 – 55	3		3
56 – 60	1		1
Total	74	46	120

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.772[a]	6	.135
Likelihood Ratio	11.585	6	.072
Linear-by-Linear Association	4.957	1	.026
N of Valid Cases	120		

[a] 9 cells (64.3%) have expected count less than 5. The minimum expected count is. 38.
x^2 table value (α0.05) = 12.592.

Table 1C: Relationship Of Sex And Maxillary Sinus Height

MAXI. SINUS HEIGHT mm	MALE	FEMALE	TOTAL
16 – 20	9	5	14
21 – 25	26	15	41
26 – 30	28	20	48
31 – 35	6	4	10
38 – 40	4	2	6
41 – 45	1		1
Total	74	46	120

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.016[a]	5	.961
Likelihood Ratio	1.361	5	.929
Linear-by-Linear Association	.001	1	.980
N of Valid Cases	120		

[a] 5 cells (41.7%) have expected count less than 5. The minimum expected count is. 38.
x^2 table value (α0.05) = 11.070.

Table 1D: Relationship Of Sex And Maxillary Sinus Volume

MAXI. SINUS VOLUME mm	MALE	FEMALE	TOTAL
5 – 9	13	8	21
10 – 14	27	23	50
15 – 19	23	10	33
20 – 24	10	5	15
25 – 29	1		1
Total	74	46	120

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.924[a]	4	.571
Likelihood Ratio	3.276	4	.513
Linear-by-Linear Association	1.090	1	.297
N of Valid Cases	120		

[a] 2 cells (20.0%) have expected count less than 5. The minimum expected count is. 38.
x^2 table value (α0.05) = 9.488.

Table 2A: Maxillary Sinus Length Lenth by Age Group

		Maxillary Sinus length (mm)						TOTAL
		21 – 25	26 – 30	31 – 35	36 – 40	41 – 45	46 – 50	
Age group	9 – 15		4	5				9
	16 – 22	1	1	3	1	2	1	9
	23 – 29	1	5	9	5	8	2	30
	30 – 36		6	5	8	4	1	24
	37 – 43		1	7	3	3	1	15
	44 – 50			1	4	3	1	9
	51 – 57			3	3	1	1	8
	58 – 64			1	2	2		5
	65 – 71			2		7		9
	72 – 78				1	1		2
Total		2	17	36	27	31	7	120

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.924[a]	4	.571
Likelihood Ratio	3.276	4	.513
Linear-by-Linear Association	1.090	1	.297
N of Valid Cases	120		

[a] 54 cells (90.0%) have expected count less than 5. The minimum expected count is. 03.
x^2 table value (α0.05) = 61.656.

Table 2b: Maxillary Sinus Width By Age Group

		MAXILLARY SINUS WIDTH MM							TOTAL
		21 – 25	31 – 35	36 – 40	41 – 45	46 – 50	51 - 55	56 – 60	
Age group	9 – 15			5	4				9
	16 – 22			4	5				9
	23 – 29	1	2	14	9	2	2		30
	30 – 36		1	7	9	5	1	1	24
	37 – 43			5	9	1			15
	44 – 50			3	6				9
	51 – 57			1	6	1			8
	58 – 64			2	2	1			5
	65 – 71			4	4	1			9
	72 – 78				2				2
Total		1	3	45	56	11	3	1	120

Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	33.011[a]	54	.989
Likelihood Ratio	36.179	54	.970
Linear-by-Linear Association	1.504	1	.220
N of Valid Cases	120		

Table 2C: Maxillary Sinus Height By Age Group

		Maxillary Sinus Height (mm)						TOTAL
		16 – 20	21 – 25	26 – 30	31 – 35	36 – 40	41 – 45	
Age group	9 – 15	2	4	3				9
	16 – 22	1	5	1	2			9
	23 – 29	2	14	10	3	1		30
	30 – 36	5	7	7	2	3		24
	37 – 43	2	7	3	1	1	1	15
	44 – 50	1	1	6		1		9
	51 – 57		1	6	1			8
	58 – 64	1		4				5
	65 – 71		2	6	1			9
	72 – 78			2				2
Total		14	47	48	10	6	1	120

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	46.024[a]	45	.430
Likelihood Ratio	49.526	45	.297
Linear-by-Linear Association	3.677	1	.055
N of Valid Cases	120		

[a] 54 cells (90.0%) have expected count less than 5. The minimum expected count is. 02.

x^2 table value (α0.05) = 61.656.

The result in table 1 and 2 (A, B, C, D) showed in comparing the association of the maxillary sinus dimensions with sex or age in the population, that the evidence to reject the null hypothesis of no association was lacked. This finding therefore supports that of Koppe and Nagai (1997), which stated that no sexual dimorphism could be established in maxillary sinus size of *Macaca fuscata*. Thus establishing values for the age groups and sex were not possible, Singha (1992) states that in dealing with medical and biological data it may be necessary sometimes to make prediction on the basis of available information provided by the data. Though the condition for such prediction to be meaningful is that both the variable should be related or has a high value of correlation coefficient. Age may vary with sinus at developmental stage. Schaeffer (1960) stated that from birth as the maxillary increases in size, there is increasing pneumatization at the rate of 2mm per year for eight years in the vertical plane, 3mm., per year for eight years anteroposteriorly but lateral expansion is less rapid owing to the close relationship of the developing teeth to the orbit. The transverse limit of expansion is reached in the ninth year, when the sinus penetrates the molars bone, thereafter progress is slow and ceases at 15 years, except the inferior angle, which descends after eruption of the third molar (Alberti, 1976). Therefore prediction on the dimensions of maxillary sinus giving the age or sex of individual should not be done in adult because such prediction is statistically unreliable or dangerous. Nevertheless, this result does not mean that there is no association between age or sex and maxillary sinus dimension. It means that this relationship may be very weak but not linear.

In this study radiographs were used, since in Nigeria most of the diagnosis of inflammatory and neoplastic diseases of the sinuses and adjacent structures are being performed with the aid of radiographs.

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