

# Anthropometrical Association of the Craniofacial Dymorphology with Schizophrenia

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## ABSTRACT

**Background:** Dymorphology is more concentrated in the craniofacial region of Schizophrenic Patients. So, an early anthropometric assessment of the physical dimensions of the cranium and the face may indicate a potential clue of Schizophrenia.

**Aims:** To study the craniofacial dymorphology in schizophrenic patients and in healthy controls of the Agra region and to find out whether its evaluation could be used as a tool in the early diagnosis of schizophrenia.

**Setting and Design:** This was a case-control, cross-sectional study .

**Subjects and Methods:** Schizophrenic Patients well diagnosed by consultant psychiatrists on the basis of the DSM IV criteria of the S.N. Medical College Agra and the Institute of Mental health, Agra and healthy controls of Agra were selected for the study. The total facial height (trichion to gnathion), the upper facial height

(trichion to subnasale) and the lower facial height (subnasale to gnathion) were measured among the various groups of patients and the controls. The mean data were statistically correlated by using the t test for the independent variables.

**Results:** The total facial height (trichion to gnathion) was elongated in the Schizophrenic male patients as compared to the controls. When we compared the schizophrenic patients on the basis of the family history of schizophrenia, it was found that there was an elongation of the total facial height in the patients with a positive family history of schizophrenia as compared to the patients without a family history of schizophrenia. There was also a significant elongation of the upper facial height (trichion to subnasale ) in the schizophrenic male and female patients.

**Conclusions:** There was total facial elongation and upper facial region elongation in the schizophrenia patients as compared to the controls.

**Key Words:** Craniofacial dymorphology, Anthropometry, Psychiatry, Schizophrenia

## INTRODUCTION

The face and the brain develop from the same ectodermal tissue during the 5<sup>th</sup> to the 13<sup>th</sup> weeks of gestation [1-3]. If a disturbance in the foetal neurocranial development occurs at this critical time, the process of dymorphology may also possibly leave lingering "fossil marks" in the cranial and the anterior facial regions, as well as in the corresponding parts of the brain. Waddington et al., [2] theory of facial dymorphology. The neurodevelopmental approach to schizophrenia professes that both genetic and environmental factors contribute to the structural and the functional changes in the brain and the face, not only in the intrauterine and the perinatal period but also in childhood and young adulthood. The detailed model of the neurodevelopmental basis [2] of schizophrenia which was put forth on the basis the quantitative measurements of various facial diameters (craniofacial dymorphological study) showed that these neurodevelopmental disorders are often concentrated in the craniofacial region of schizophrenia. So, an early assessment of the physical developmental anomalies may indicate potential clues of these neurodevelopmental disorders like schizophrenia [4-6].

Simple linear anthropometric measurements which were made with measuring tapes and calipers have shown that schizophrenic patients have more craniofacial disproportionality than do the healthy control subjects. These deviations include an overall elongation and narrowing of the mid and the lower facial regions and widening of the skull base.

Thus, anthropometry can become an important tool in the study of genetic disorders, particularly as a diagnostic aid for clinical geneticists. However, many practising physicians do not do the anthropometry of the patients because of several reasons like the unavailability of the appropriate measurements and the concerned data, but the cooperation among physicians, psychiatrists, geneticists, and anthropologists for the assessment of the patients and collection of the data is essential for an early diagnosis of heterogenous neurodevelopmental and behavioural disorders like schizophrenia, autism, the foetal alcohol syndrome, sensory impairments and learning disabilities. So, this study was done to measure various facial diameters in schizophrenic patients with and without a family history of schizophrenia and the data were statistically compared to find whether there was a linkage of the craniofacial dymorphology with schizophrenia in Indian subjects (because no such study has been done in India) and whether its evaluation could be used as a tool among diagnostic criterias in making an early diagnosis of schizophrenia.

## MATERIALS AND METHODS

Fifty eight patients (30 males and 28 females) of schizophrenia who were well diagnosed on the basis of the DSM-IV criteria by a consultant psychiatrist of S.N. Medical college, Agra and the Institute of Mental Health, Agra, UP, India after getting written consents from their attendants and 58 controls (28 males and 30 females) were taken up for this study.

**SELECTION OF THE CASES:** The cases, both males and females, who were 18 to 60 years of age and from the Agra region, had no chronic physical illness or psychiatric illness other than schizophrenia and they also had no any congenital or hereditary disorders. Migrants from other regions or states were excluded to avoid a geographical bias.

**SELECTION OF THE CONTROLS:** The controls were selected, based on the same criteria. In addition, it was specifically ensured that the controls were not the blood relatives of the schizophrenic patients. The purpose of this exclusion criteria was to avoid the possibility of the anthropometric measurements being affected by the illness which was under study.

**A CRANIOFACIAL MORPHOMETRIC STUDY** was done by taking these dimensions by using a manual spreading caliper according to the landmarks which were defined by the standard anthropometric guidelines [7] and we measured the larger overlapping distances rather than the smaller distances. The quantitative measurements were taken to two decimal digits and the following diameters were measured:

- The total facial height (D1) i.e. the distance from the trichion to the gnathion (cms)
- The upper facial region (D2) ie the distance from the trichion to the subnasale (cms)
- The lower facial region (D3) ie the distance from the subnasale to the gnathion (cms)

After the selection of the cases and the controls, the following groups were made for the further evaluations

- ST = Total schizophrenic patients irrespective of their family history
- S = Schizophrenic patients without a family history of schizophrenia
- SF = Schizophrenic patients with a positive family history of schizophrenia
- C = Control M = Male F = Female

The ratio of d3 to d2 was taken to find out the relative regional elongation of the face. The data were statistically compared by using the Student's t test for two independent variables and the p value was estimated to know the level of significance by using the computer software, GraphPad software [8] and with the help of the statistician of S.N. medical college, Agra, UP, India.

## RESULTS

When the schizophrenic patients were compared to the controls, the distance from the trichion to the gnathion (the total facial height) -D1 was found to be increased in the total schizophrenic male patients and in the schizophrenic male patients with and without a family history of schizophrenia [Table/Fig-1]. This was highly significant [Table/Fig-2]. While it was reduced in the total schizophrenic female patients and in the schizophrenic female patients with a positive family history of schizophrenia [Table/Fig-1] and was insignificant [Table/Fig-2], this distance was also reduced significantly in the female patients without a family history of schizophrenia [Table/Fig-1 and 2].

When the schizophrenic patients were compared to the controls, the distance from the trichion to the subnasale (D2) (the upper facial region) was found to be increased in the total schizophrenic male patients and in the schizophrenic male patients with a positive family history [Table/Fig-1] and it was highly significant [Table/

Subject #	Sex	Observed Diameter	X	S.D.	S.E.
ST	M	D1	19.23	1.006	.184
		D2	12.16	.719	.131
		D3	7.09	.576	.105
	F	D1	17.14	.853	.161
		D2	10.89	.759	.143
		D3	6.29	.359	.068
S	M	D1	18.88	.827	.207
		D2	11.94	.512	.128
		D3	6.97	.591	.148
	F	D1	16.81	.794	.205
		D2	10.67	.825	.213
		D3	6.21	.392	.101
SF	M	D1	19.64	1.064	.284
		D2	12.42	.847	.226
		D3	7.22	.549	.147
	F	D1	17.49	.781	.217
		D2	11.15	.610	.169
		D3	6.38	.306	.085
C	M	D1	17.65	.763	.144
		D2	11.35	.556	.105
		D3	6.34	.772	.146
	F	D1	17.52	.738	.135
		D2	11.63	.633	.116
		D3	5.89	.577	.105

[Table/Fig-1]: Showing Distance from the Trichion to Gnathion (cms) (D1), distance from Trichion to subnasale (cms) (D2) and distance from subnasale to Gnathion (cms) (D3) in three groups of schizophrenic cases and controls.  
 #ST –Total Schizophrenic Patients,  
 # S- schizophrenic patients without family history of schizophrenia,  
 #SF- Schizophrenic Patients with positive family history of schizophrenia  
 #c- Contols  
 X = mean , SD= Standard Deviation and SE= standard error of mean

Fig-2]. It was also found to be increased in the schizophrenic male patients without a family history [Table/Fig-1] and was significant [Table/Fig-2]. This distance was reduced in the total schizophrenic female patients and in the schizophrenic female patients with and without a family history [Table/Fig-1] and was significant [Table/Fig-2].

When the schizophrenic patients were compared to the controls, the distance from the subnasale to the gnathion (D3) (the lower facial region) was found to be increased in the total schizophrenic male and female patients and in the schizophrenic male and female patients with and without a family history of schizophrenia [Table/Fig-1] and it was significant [Table/Fig-2]. But an increase in this distance in the schizophrenic female patients without a family history was statistically insignificant [Table/Fig-2].

When the schizophrenic male and female patients with a positive family history of schizophrenia were compared with the patients without a family history, it was found that there was an increase in D1 (the distance from the trichion to the gnathion) in both the male and female patients with a positive family history [Table/Fig-1] and it was statistically significant [Table/Fig-2]. But the increase in the distances, D2 and D3 in both male and female patients with a positive family history of schizophrenia was found to be statistically insignificant. [Table/Fig-1 and 2]. This showed that a family history definitely had a significant role in the elongation of the face.

subjects	Sex	comparison	Diameter compared	t vaue	p value	Level of significance
ST	M	C M	D1	6.702	<.0001	HS
SF	M	CM	D1	6.969	<.0001	HS
S	M	CM	D1	4.990	<.0001	HS
S	M	SF M	D1	2.198	.0365	S
ST	F	CF	D1	1.817	.0746	NS
SF	F	CF	D1	.120	.905	NS
S	F	CF	D1	2.967	.0049	S
S	F	SF F	D1	2.28	.0311	S
ST	M	C M	D2	4.774	<.0001	HS
SF	M	CM	D2	4.92	<.0001	HS
S	M	CM	D2	3.48	.0012	S
S	M	SF M	D2	.909	.371	NS
ST	F	CF	D2	4.04	.0002	HS
SF	F	CF	D2	2.31	.026	S
S	F	CF	D2	4.33	.0001	HS
S	F	SF F	D2	.988	.332	NS
ST	M	C M	D3	4.212	<.0001	HS
SF	M	CM	D3	3.801	.0005	HS
S	M	CM	D3	2.820	.0073	S
S	M	SF M	D3	1.190	.244	NS
ST	F	CF	D3	3.143	.0027	S
SF	F	CF	D3	2.878	.0063	S
S	F	CF	D3	1.931	.0601	NS
S	F	SF F	D3	1.26	.2189	NS

**[Table/Fig-2]:** Showing statistical analysis to show level of significance among various data HS- highly significant, S- significant, NS-non significant

Subject	Sex	D3/D2 Mean	S.D.	S.E.
ST	M	.585	.059	.011
	F	.580	.056	.011
S	M	.585	.057	.014
	F	.586	.072	.018
SF	M	.584	.065	.017
	F	.573	.031	.009
C	M	.561	.085	.016
	F	.508	.063	.011

**[Table/Fig-3]:** Showing ratio of D3 distance from subnasale to Gnathion to D2 distance from Trichion to sabnasale in three groups of schizophrenic patients and controls.  
X= mean , SD= standard deviation ,SE= standard error of mean

Subject	Sex	Comparison	t value	p value	Significance
ST	M	CM	1.256	.214	NS
SF	M	CM	.888	.379	NS
S	M	CM	1.005	.321	NS
ST	F	CF	4.59	<.0001	HS
SF	F	CF	3.52	.0011	S
S	F	CF	3.73	.0006	HS

**[Table/Fig-4]:** Showing significance value for ratio of D3 to D2 among various groups  
CM- control male , CF- control female  
S- significant ,NS= non significant ,HS- highly significant

When the ratio of (the subnasale to the gnathion)- D3 to D2 -(the trichion to the gnathion) was compared to show the regional elongation of the face, it was found that this ratio was increased in both the schizophrenic male and female patients of all the three groups as compared to the controls [Table/Fig-3 and 4]. But the results were insignificant in all groups of the schizophrenic male patients [Table/Fig-4]. This showed that there was a significant

elongation of the lower face as compared to the upper face in the schizophrenic female patients of all the three groups as compared to the female controls.

## DISCUSSION

The total facial height (D1) was increased i.e. A total facial elongation was seen in the schizophrenic male patients of all the three groups as compared to the controls [9]. A three dimensional morphometric study of the craniofacial shape in schizophrenia showed that the schizophrenic patients exhibited an elongation of the face which was relative to that in the healthy controls [3]. The dysmorphologic changes in the schizophrenic and the bipolar patients in the frontonasal regions were seen as an overall widening and a vertical shortening of the face in both the groups. In our study, there was a reduced facial height (vertical shortening of the face) in the schizophrenic female patients of all the three groups and this reduction was statistically significant in case of the schizophrenia female patients without a family history of schizophrenia as compared to the healthy female controls. But we have found that there was a significant elongation of the face in both schizophrenic male and female patients of all the three groups with a positive family history as compared to the patients without a family history of schizophrenia. This showed that a family history of schizophrenia definitely had a significant role in the elongation of the face in schizophrenia.

Simple linear anthropometric measurements which were made with measuring tapes and calipers have shown that schizophrenic patients had more craniofacial disproportionality than had the healthy controls and that this deviation have elongation of the mid and the lower facial regions [4-6]. Henriksson KM et al., [10] used a 3 D morphometric MRI method and found that the schizophrenic male patients had significantly longer mid and lower facial heights.

We found significant elongations of D2 - the upper facial region and D3 - the lower facial region in all the three groups of the schizophrenia male patients. The lower facial region - D3 was also elongated significantly in the schizophrenic female patients but in case of the schizophrenic female patients without a family history, it was statistically insignificant.

A detailed model of the neurodevelopmental basis of schizophrenia was made by measuring the head and the facial dimensions by using head and neck calipers and it was found that the schizophrenic male patients had lesser upper facial (trichion-glabella) and lower facial (subnasale - gnathion) distances as compared to the controls [2]. Our study showed a statistically significant shortening of D2 - the upper facial region, only in the schizophrenic female patients of all the 3 groups. Crompton et al., [11] too found that the male schizophrenic patients had lesser upper facial (trichion-glabella) and lower facial (subnasale-gnathion) distances as compared to the male controls, but their study was restricted only to African- Americans.

The elongations of D2 and D3 i.e. the upper and the lower facial regions were more in the schizophrenic male and female patients with a positive family history of schizophrenia as compared to the patients without a family history. The elongation of the lower facial region -D3 which was relative to the upper facial region- D2 in schizophrenic male and female patients with a positive family history of schizophrenia was again more as compared to that in the patients without a family history. This showed that a positive family history of schizophrenia played an important role in the total and regional elongation of the face in schizophrenia .

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