

Cross-sectional Growth of Seven Cephalofacial Dimensions in the Urban Bengali Boys, Calcutta

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MATERIALS AND METHODS

ABSTRACT The paper deals with cross-sectional growth of seven cephalofacial traits, namely head length (n=772), head breadth (n=772), head circumference (n=775), morphological facial height (n=771) and nose breadth (n=770) of the Bengali boys from 7.0 to 16.0 years. Besides head breadth, other six dimensions show marked increment of population means during the years of adolescence (particularly between 12.0 to 13.0 years). The growth trend of the dimensions confirm well with the cephalofacial pattern. The findings can usefully utilized as the base-line reference cephalofacial data for the Bengali population.

Data were collected under a cross-sectional growth study of twenty six body dimensions, carried out from the Indian Statistical Institute on the Bengali school-going boys of Calcutta during 1982-1983 (Pakrasi et al., 1988).

The subjects were chosen from among the students enrolled in one of the oldest and biggest schools for the boys known as Scott's Church Collegiate School, situated in the northern part of Calcutta. The school was established by a Christian Missionary in 1832.

The school enrolled over 4,000 Bengali students, distributed from class I to X. They belong to the middle and upper-middle class Hindu families with varying caste affiliation (Brahmin, Baidya, Kayastha and scheduled caste etc. groups). Altogether 856 boys, aged 7.0 to 16.0 years, were participated in the study. From this sample, 84 boys were excluded due to major or minor illness or other kinds of physical inconvenience during the measurement session. Thus, the final sample size remained to be 775, on which the analysis was performed. Age distribution of the subjects according to the measurements, are shown in table 1.

INTRODUCTION

Scientific and clinical importances of cephalofacial growth data is widely recognized in the auxological literature (Krogman, 1970; Meredith, 1960; Goldstein, 1936; Shuttleworth, 1939; Roche et al., 1986). From the recent bibliography on growth studies of Indian children (Bharati and Bharati, 1990), it is evident that cephalofacial growth data on the Bengali population are scarce. In view of this, the aim of the present communication is to report cross-sectional growth patterns of seven cephalofacial traits in the Bengali boys between 7 to 16 years.

Table 1 : Distribution of the sample by age and anthropometric measurements

Measurements	Age (in years)										Total
	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	
Head length	58	82	95	67	94	93	92	98	70	32	772
Head breadth	58	82	95	67	94	93	92	89	70	32	772
Head circumference	58	82	93	95	94	92	89	89	70	33	775
Morphological facial height	59	82	93	67	94	93	92	89	69	32	770
Bizygomatic breadth	58	82	95	67	92	93	92	89	70	32	770
Nose height	59	82	93	67	95	93	92	89	69	32	771
Nose breadth	59	82	93	67	95	93	91	89	69	32	770

Two major sets of data were collected during the survey :

(i) Socioeconomic and (ii) Anthropometric. Socioeconomic data from 600 households were collected by the author through house visits and by canvassing questionere schedules to the guardians of the students. The items were (1) Date of birth of subjects with documentary evidence, (2) Age of the parents, (3) Size of the family, (4) Size of sibship, (5) Parity of birth order of the boy, (6) Number of younger and elder sibs of the subjects, (7) No. of earners in the families, (8) Per month expenditure of the family. In addition, data on the frequencies and qualities of foods and drinks taken by the subject in last twentyfour hours were collected by a recall questionere method, recommended by Weiner and Lourie (1969).

Ascertainment of Age : Correct assessment of age was the prerequisite of this study. Age of the school boys was ascertained from the discharge certificate issued by the hospital or nursing home (as the case might be). This was verified in two occassions : one during their house-visit and the other, during the time of measurements.

Collection of the Anthropometric Data : Anthropometric data were taken from the school boys, with prior intimation through call letters and subsequently the subjects were asked to be present at the time of measurement with their birth certificates. Following the full list of Weiner and Lourie (1969), the measurements were taken by the author during the school hours and also in holidays inside the school premises. Head length, Head breadth and Bizygomatic breadth were measured with the spreading calliper. Morphological facial height, nose height and nose breadth were measured with the slide calliper and Head circumference was measured with a steel tape.

Measurement Session : Target date of measurement was generally birth days for all the subjects. Due to some organisational restraints, it was not always possible to maintain this target. Nevertheless, 30 per cent of the subjects

were measured exactly on their respect birth days, while rest of the boys were measured 3 days before or after the dates of birth. Because of strict adherence of this condition of determining appropriate measurement of a subject according to his birthday, session of the anthropometric measurements had to be kept continued throughout the period extending from April 1982 to September 1983. Accordingly, the result of the study has been referred to exact age points (7.0, 8.0 years... etc.) and not to age classes.

Technical Error of the Anthropometric Measurements : In anthropometric studies, importance of obtaining intra or inter-observer error of the measurements becomes necessary in order to check the reliability of the data (Malina et al., 1987; Bogin and Mcvean, 1981a). Therefore, intra-observer or technical errors of the measurement were computed for the five measurements. A number of subjects ranging from 8 to 10 years were measured by the author twice a day with 1 to 4 hours apart from the time of initial measurement. The following formula has been used to calculate technical error (T.E.) of the measurements.

$$T.E. \text{ of measurement} = \sqrt{\frac{\sum D^2}{2N}}$$

Where N = sample size; D = Difference in measurement between the two occassions. Values of T.E. of the measurements have been in table 2.

Age-specific means, and standard deviations of all seven cephalofacial traits, between 7 to 16 years, have been computed in order to show the cross-sectional growth pattern. In addition, three indices— Cephalic index, Morphological facial index and Nasal index were derived from

Table 2: Technical error of the anthropometric measurements

Measurement	N	T.E. (cm)
Head length	8	0.01
Head breadth	8	0.01
Head circumference	10	0.07
Morphological facial height	9	0.06
Bizygomatic breadth	8	0.01

the measurements to show the change in head, face and nose shapes, during the same age periods.

All computations have been performed by using the Biomedical data processing package (Dixon et al., 1990).

RESULTS AND DISCUSSION

Cross-sectional growth of seven cephalofacial traits are presented in table 3. Mean value of these traits, as a whole, increases steadily from 7.0 to 16.0 years, but with few exceptions (e.g. head breadth between 9 to 10 years and between 15.0 to 16.0 years; nose height between 9.0 to 10.0 years etc.). The decline of means appears to be due to cross-sectional nature of the data set.

Total population increment (between 7.0 to 16.0 years) for head length, head breadth, head circumference are 1.21 cm 0.42 cm and 3.14 cm, respectively. Such small magnitude of increase is biologically expected, because it is known that more than 96% of adult values of

and 0.55 cm, respectively). In the facial dimensions, total population increment for morphological facial height, bizygomatic breadth, nose height, and nose breadth are 1.69 cm, 1.40 cm, 1.01 cm and 0.59 cm, respectively. This is noteworthy that bizygomatic breadth and morphological facial height manifests more or less similar increments till between 11.0 to 12.0 years. Thereafter, *i.e.* from 12.0 to 13.0 years, a considerable difference is noticed between the values (0.42 cm and 0.24 cm for bizygomatic breadth and morphological facial height, respectively). Further, between 15.0 to 16.0 years, the increment for bizygomatic breadth is smaller than morphological facial height (0.01 cm and 0.12 cm, respectively). Thus it confirms that growth of face ends earlier in width than length (Miklashevaskaya, 1966). Unlike cephalic index, mean facial index increases with age (table 4) which suggests a gradual lengthening of face. With respect to growth of nose, adolescent acceleration is less distinct for width than length. The decline of mean nasal index (Table 4) suggests a gradual elongation of nose shape.

Table 3 : Cross-sectional growth of cephalofacial dimensions of the Bengali boys (in cm)

Age (yrs)	Head length		Head breadth		Head circumference		Morphological facial height		Bizygomatic breadth		Nose height		Nose breadth	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
7.0	16.84	0.64	14.41	0.60	49.20	1.52	9.52	0.51	11.61	0.50	4.05	0.42	2.95	0.20
8.0	17.04	0.59	14.49	0.59	50.01	2.35	9.75	0.47	11.84	0.46	4.22	0.39	3.06	0.20
9.0	17.14	0.76	14.68	0.59	50.08	1.34	9.90	0.55	12.04	0.44	4.35	0.45	3.08	0.20
10.0	17.36	0.79	14.65	0.47	50.45	1.41	9.97	0.48	12.14	0.45	4.33	0.40	3.12	0.21
11.0	17.41	0.60	14.68	0.52	50.74	1.58	10.10	0.55	12.27	0.50	4.46	0.39	3.17	0.22
12.0	17.46	0.69	14.74	0.61	50.92	1.50	10.28	0.61	12.41	0.54	4.54	0.41	3.21	0.21
13.0	17.75	0.67	14.83	0.53	51.61	1.40	10.70	0.52	12.65	0.45	4.82	0.36	3.30	0.25
14.0	17.78	0.65	14.85	0.56	51.66	1.51	10.83	0.59	12.77	0.53	4.91	0.40	3.41	0.27
15.0	18.03	0.65	14.95	0.64	52.21	1.58	11.09	0.59	13.00	0.52	5.03	0.39	3.52	0.27
16.0	18.05	0.53	14.83	0.63	52.34	1.31	11.21	0.47	13.01	0.56	5.06	0.38	3.54	0.26

these dimension is reached by 10 years of age (Tanner, 1962). The decline of mean cephalic indices is suggestive of faster growth in length than breadth (Miklashevaskaya, 1966). For head circumference, although the population mean increment is highest during 7.0 to 8.0 years (0.81 cm), nevertheless, between 12.0 to 13.0, the increments are also notable (0.69 cm

Evidence for the existence of growth spurts in different cephalofacial dimensions are available from the longitudinal studies (Tanner, 1962; Roche, 1977; Burke and Hughes-Lawson, 1988). But this is important to note that in this cross-sectional study, besides head breadth, the remaining traits have manifested consistently greater population increments during the years

Table 4 : Cross-sectional growth of cephalofacial indices of the Bengali boys

Age (in years)	Cephalic index			Morphological index			Nasal index		
	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.
7.0	58	85.7	4.34	58	81.9	4.23	59	73.4	8.61
8.0	83	85.1	4.20	83	82.4	3.83	83	73.1	8.58
9.0	95	85.7	4.15	93	82.3	4.70	93	71.4	7.89
10.0	67	84.5	4.15	66	82.3	3.98	67	72.6	8.35
11.0	94	84.4	3.82	92	82.5	4.51	95	71.6	7.53
12.0	93	84.5	4.51	93	82.9	4.43	93	71.2	7.10
13.0	92	83.6	4.10	92	84.6	4.71	91	68.9	7.64
14.0	89	83.6	3.92	89	84.9	4.25	89	69.8	6.78
15.0	70	83.0	4.05	69	85.3	4.92	69	70.5	7.77
16.0	32	82.2	4.10	32	86.2	4.72	32	70.2	6.95

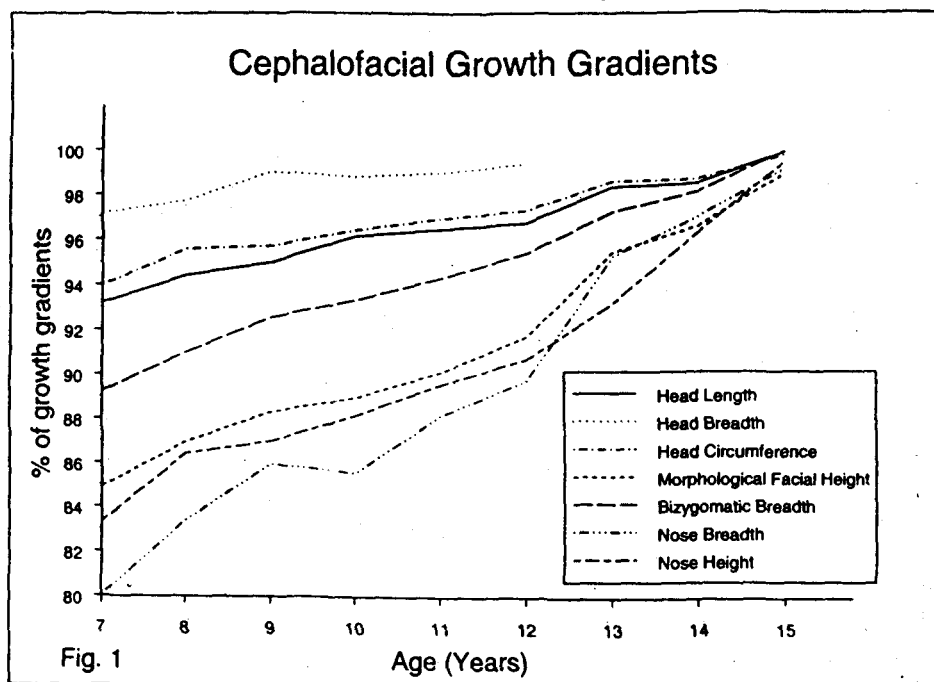
of adolescence (average peak height velocity of this population has been estimated to be 13.0 years).

Standard deviation values of the traits are found to be slightly larger during the adolescent years. However, they are also longer for the indices than for the direct measurements.

Fig. 1 shows growth gradients of the traits estimated from the values of percentage of growth attained at each age. This is clear from

the figure that breadths of head and face are ahead of their respective lengths although during 7.0 to 16.0 years. This caudocephalic growth gradients have also been recently reported in the data on Vadabalija and Yadava boys and girls of Andhra Pradesh (Dharma Rao and Busi, 1993a, 1994) and on the Worli boys of Maharashtra (Jhingon and Nath, 1985).

Mean head circumference of the Calcutta boys during 7.0 to 16.0 years are observed to be

**Fig. 1. Cephalofacial growth gradients**

slightly smaller than the Indian Boys represented as the national standard (Indian Council of Medical Research, 1972). When compared with other Bengali samples, rural Satchashi Boys of West Bengal (Kundu, 1984) are found to be showing larger means than the Calcutta boys in the linear measures of face. This trend, however, is not noticed for the transverse measures, like head breadth, bizygomatic breadth and nose breadth etc. In most of the cephalofacial dimensions, Yadava and Vedabalija boys of Andhra Pradesh (Dharma Rao and Busi, 1993b) are showing larger means than the Calcutta boys during the comparable ages.

Findings of the present report would be of relevance as reference population data in the context of future growth surveys related to cephalofacial traits of the Indian children.

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REFERENCES

- Bharati, S. and Bharati, P. : *Growth Studies in India : Series in Bibliographies on Human Genetics in India*. The Indian Society of Human Genetics (1990).
- Burke, P.H. and Hughes-Lawson, C.A. : The adolescent growth spurt in the soft tissues of the face. *Ann. Hum. Biol.*, **15** : 253-262 (1988).
- Dharma Rao, B. and Busi, B.R. : Growth and maturity gradients in the head and face dimensions among Yadav Girls of North coastal Andhra Pradesh, India. *J. Hum. Ecol.*, **4** : 149-151 (1993a).
- Dharma Rao, B. and Busi, B.R. : Cephalofacial and caudocephalic direction of growth gradients of Yadav and Vedabalija boys of Visakhapatnam, Andhra Pradesh, India. *J. Hum. Ecol.*, **4** : 279-284 (1993b).
- Dharma Rao, B. and Busi, B.R. : Cephalofacial growth in the Chenchu tribal girls of Andhra Pradesh. *J. Hum. Ecol.*, **5** : 105-109 (1994).
- Dixon, W.J., Brown, M.B., Engelman, L. and Jennrich, R.I. : *BMDP-University of California Press, USA* (1990).
- Goldstein, M.S. : Changes in the dimensions and forms of the face and head with age. *Am. J. Phys. Anth.*, **22** : 37-89 (1936).
- Indian Journal of Medical Research : *Growth and Physical Development of Indian Infants and Children*. Technical Report Series No. 18, ICMR, New Delhi, India, 1972.
- Jhingon, B. and Nath, S. : Trends of growth and maturation among the Warlis : A tribal population of Maharashtra, India. *Ind. J. Phys. Anthropol. Hum. Genet.*, **11** : 39-45 (1985).
- Krogman, W.N. : Growth of head, face, trunk and limbs in Philadelphia White and Negro children of elementary and high school age. *Monog. of the Soc. for Res. on Child Dev.*, **35** : 1-80 (1970).
- Kundu, R. : Adolescent growth of Satchasi boys in West Bengal. *H.M. Sci.*, **33** : 68-79 (1984).
- Malina, R.M. Brown, K.H. and Zavaleta, N. : Relative lower extremity length in Mexican - American and in American Black and White youth. *Am. J. Phys. Anth.*, **72** : 89-94 (1987).
- Meredith, H.V. : Changes in the form of head and face during childhood. *Growth*, **24** : 215-264 (1960).
- Miklashevskaya, N.M. : Growth of the head and face in boys of various ethnic groups in the U.S.S.R. *Hum. Biol.*, **38** : 231-250 (1966).
- Pakrasi, K., Dasgupta, P., Dasgupta, I. and Majumder, P.P. : Growth in height, weight and skinfold thickness of Bengali boys of Calcutta, India. *Anthrop. Anz.*, **46** : 1-14 (1988).
- Roche, A.F., Mukherjee, D. and Guo, S. : Head circumference growth patterns : Birth to 18 years. *Hum. Biol.*, **58** : 893-906 (1986).
- Shuttleworth, F.K. : The physical and mental growth of girls and boys aged six to nineteen in relation to age at maximum growth. *Monog. Soc. Res. Child.*, **4** : 3 (1939).
- Tanner, J.M. *Growth at Adolescence*. Blackwell, Oxford (1992).
- Weiner, J.S. and Lourie, J.A. : *Human Biology : A Guide to Field Methods*. IBP Handbook 9, Blackwell, Oxford (1969).