

Cephalo-caudal and Caudo-cephalic Direction of Growth Gradients of Yadava and Vadabaliya Boys of Visakhapatnam, Andhra Pradesh, India

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ABSTRACT The present study, based on a cross-sectional sample of 757 Yadava and 845 Vadabaliya boys in the age range of 1 to 20 years, confines to the evaluation of development-cum-maturational differences between Yadava and Vadabaliya boys with the help of twenty-one anthropometric measurements. Analysis of the data reveal that all the measurements show maturational differences in some age group between Yadava *versus* Vadabaliya boys. It can be inferred that the development-cum-maturation differences observed between these two groups may be due to genetic factor associated with socio-economic environment.

One way in which the organisation of growth shows itself is through the presence of maturity gradients' (Tanner, 1964) which have been studied by others as well (Bayley, 1962; Sidhu, 1969; Nath, 1972; Krishna Rao, 1981; Jhingon and Nath, 1985). The growth gradient of a measurement expresses the percentage of growth achieved at any age of its 'final' value as seen in a full grown adult. The present study deals with 21 anthropometric variables which studies to show the development-cum-maturational direction of rural and agricultural, Yadava and fishing Vadabaliya boys.

MATERIAL AND METHODS

The Yadava (Golla) of North Coastal Andhra region is traditionally a pastoral community occasionally engaged in farming.

Vadabaliya was one of the nine important fishing communities found in the North East Coastal tract of Andhra Pradesh. Data were collected, cross-sectionally on 757 Yadava boys and 845 Vadabaliya boys aged 1 through 20 years, from 23 villages of Bheemuni-patnam and Anandapuram mandals of Visakhapatnam district of Andhra Pradesh during January 1986 to June 1987. The age of each

individual was calculated to three decimal places after Tanner et al. (1966). These measurements of IBP basic list of 21 (Weiner and Lourie, 1969) were taken after Weiner and Lourie (1969).

RESULTS AND DISCUSSION

Percentage of growth gradients in nineteen age groups of Yadava and Vadabaliya boys have been depicted in the tables 1 and 2. It can be concluded from the tables that the percentage of growth gradients of these variables continuously and consistently increases throughout all age groups. All the twenty-one measurements investigated in the present study have been divided into six convenient groups (Fig. 1 a to f) viz. weight/height group, extremities and trunk group, chest-cum-extremities-circumferential group, torso group, cephalo group and facial group in order to facilitate the comparison of ontogenic development of these variables. The exclusion of stature and body weight from such an analysis, since these measure the total human body and are not indicative of parts of the body. By combining cephalo and facial groups, it is observed that head breadth and head length of cephalo group

Table 1 :Percentage of growth gradients in nineteen age groups (1.0 to 19.0 years) of Yadava boys obtained from adult value.

Measurements	Age groups (year) (mid-value)																		
	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0
Stature	36.27	43.64	49.07	54.18	59.80	63.87	67.76	71.35	74.22	77.83	79.83	81.84	84.67	87.61	92.39	94.90	96.19	97.37	98.68
Sitting height	47.64	52.86	57.88	61.11	65.64	69.15	72.15	75.33	77.47	79.95	80.89	82.76	85.17	88.33	93.16	95.53	97.44	98.36	99.11
Height of anterior superior iliac spine	29.08	36.38	43.04	48.96	56.08	60.57	65.24	69.33	73.13	77.11	79.49	81.88	85.04	88.34	92.76	94.98	96.60	98.10	99.33
Total arm length	34.11	40.83	46.15	51.02	56.34	60.51	63.99	68.25	71.25	75.45	78.89	80.81	84.21	86.68	91.77	95.31	96.62	97.90	99.03
Biacromial diameter	37.95	43.27	47.70	51.87	56.59	60.30	63.31	67.66	69.89	72.66	74.37	76.23	79.67	83.35	87.99	93.12	96.43	97.77	99.09
Transverse chest	50.79	57.94	59.32	60.51	62.02	64.80	66.39	69.52	72.02	73.69	75.83	78.21	80.79	83.81	86.78	91.82	93.77	96.31	98.17
Antero-posterior chest	49.58	53.82	57.17	61.46	63.82	65.34	68.38	69.52	71.99	75.03	76.39	77.85	79.84	83.45	88.53	91.62	96.75	97.90	98.59
Biliocrystal diameter	45.33	49.98	54.87	57.71	61.76	63.69	66.45	69.18	70.62	74.87	76.43	78.04	80.24	82.36	88.66	93.67	94.71	96.71	98.76
Nose height	52.13	59.15	62.76	66.17	71.91	74.47	78.08	80.42	83.19	85.11	86.81	88.72	90.85	92.98	95.32	98.08	99.57	99.79	100.00
Nose breadth	60.45	67.51	68.36	72.03	74.86	77.68	79.38	80.79	82.20	83.33	85.31	85.59	87.29	91.24	92.09	96.33	98.59	99.72	100.00
Morphological facial height	52.71	59.70	64.21	68.54	74.52	76.91	78.47	81.05	82.70	85.65	86.57	87.95	89.79	92.09	94.30	96.96	98.53	99.91	100.00
Wrist breadth	46.81	48.55	50.48	54.16	59.19	62.67	65.76	69.05	72.73	75.63	77.56	81.24	84.14	87.62	92.65	94.39	95.55	96.32	98.26
Head length	75.58	83.12	85.56	87.74	88.91	89.75	90.50	91.56	92.25	92.99	93.74	94.53	95.17	96.28	97.08	98.46	98.99	99.47	99.73
Head breadth	77.76	85.32	86.84	89.61	91.57	92.37	92.95	93.31	93.75	94.33	94.77	95.20	96.07	96.95	97.82	98.98	99.20	99.49	99.78
Bizygomatic diameter	65.86	71.31	74.84	77.00	79.09	81.97	83.25	85.50	86.62	87.42	88.06	89.02	90.14	91.02	92.55	96.15	97.35	98.08	98.40
Bicondylar femur	41.49	44.96	49.52	53.12	56.47	59.35	61.15	64.03	67.98	68.82	72.54	73.74	75.78	79.26	84.65	89.45	93.64	96.52	99.76
Upper arm circumference	53.21	56.23	57.94	59.29	60.46	61.09	61.63	62.93	65.20	68.01	69.47	72.03	74.97	78.49	84.11	89.39	94.34	97.27	98.87
Calf circumference	48.01	52.51	56.63	59.47	62.44	64.17	67.11	69.69	72.63	75.57	77.30	79.29	81.51	85.63	88.73	93.57	95.98	96.57	97.52
Triceps skinfold	117.20	118.30	125.80	122.30	100.10	87.13	84.32	82.17	78.02	82.30	82.30	82.57	82.84	86.73	95.44	80.83	88.60	92.63	96.51
Subscapular skinfold	75.96	73.23	72.74	70.38	63.94	62.45	62.33	61.83	63.69	65.43	65.92	66.42	67.04	69.89	73.98	77.57	83.27	89.22	94.67
Body weight	10.00	14.97	18.92	22.40	26.42	29.34	32.77	37.03	41.07	45.88	47.44	51.47	56.52	63.41	73.33	81.28	89.39	92.98	96.66
Body weight in kg	All other measurements in cm																		
Triceps, Subscapular skinfolds in mm	All other measurements in cm																		

Measurements	Age groups (year) (mid-value)																		
	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0
Stature	36.81	44.44	50.16	55.50	60.55	65.60	68.77	72.42	75.97	78.19	80.51	81.80	84.82	90.38	94.33	97.99	98.90	99.62	99.96
Sitting height	46.91	53.12	57.63	61.75	65.66	69.02	71.70	74.28	77.01	79.01	80.82	81.73	84.59	88.27	92.47	95.80	97.24	98.59	99.25
Height of anterior superior iliac spine	28.67	37.56	44.38	50.19	56.31	61.42	65.87	70.09	74.06	76.80	80.17	81.86	85.03	90.66	95.24	99.10	99.67	99.88	99.99
Total arm length	33.99	41.75	46.31	51.38	56.11	60.60	64.71	68.32	72.13	74.69	76.62	78.52	82.30	88.78	93.01	96.34	98.63	99.29	99.80
Biacromial diameter	36.27	43.57	48.62	52.42	56.21	60.25	62.84	66.83	70.11	72.12	73.70	75.91	79.52	84.68	89.84	93.64	96.52	98.82	99.41
Transverse chest	50.71	58.78	60.20	61.47	62.66	64.95	67.32	69.42	72.35	74.25	75.39	76.54	79.55	84.26	88.45	93.59	97.23	98.30	99.37
Antero-posterior chest	46.73	53.02	58.54	61.96	63.65	65.29	66.72	68.51	70.50	72.34	74.08	75.97	78.12	84.46	90.59	93.61	96.01	98.16	99.18
Bilioacral diameter	46.62	52.45	57.33	60.39	63.12	66.14	69.00	70.81	73.63	75.28	77.13	78.74	81.32	87.28	91.67	95.53	97.74	98.71	99.52
Nose height	55.24	60.70	64.63	68.12	73.14	75.98	77.73	79.69	82.75	83.84	84.28	87.34	89.74	92.36	93.45	97.16	98.47	99.34	100.00
Nose breadth	60.22	64.98	67.79	70.31	73.67	75.35	76.47	77.87	80.39	82.63	83.47	85.15	86.27	89.07	93.28	95.52	97.48	98.88	100.30
Morphological facial height	55.95	61.10	65.88	72.35	76.85	79.01	80.79	82.10	84.63	85.28	85.85	87.25	89.31	90.91	94.28	96.72	98.03	98.87	99.62
Wrist breadth	45.76	49.31	51.68	54.04	58.18	63.31	55.88	68.84	72.58	73.96	76.53	80.67	84.42	90.53	93.49	97.24	98.42	99.21	100.00
Head length	75.41	81.55	85.34	87.60	88.86	89.65	90.96	91.22	91.80	92.38	92.90	93.48	94.11	94.64	96.48	96.90	97.42	98.48	99.26
Head breadth	76.41	84.18	87.15	88.46	90.57	91.36	92.89	93.54	93.98	94.27	94.70	95.28	95.79	96.52	97.60	98.33	99.27	99.71	99.85
Bizygomatic diameter	67.97	72.22	76.06	78.10	80.64	83.25	84.80	85.62	86.36	87.17	87.74	88.48	89.70	91.50	93.22	96.57	98.20	99.10	99.59
Bicondylar femur	43.88	48.93	54.60	59.14	62.55	65.32	66.33	68.85	72.89	75.03	77.55	80.20	82.34	88.90	92.69	95.84	99.75	99.87	100.00
Upper arm circumference	53.41	56.36	58.94	60.79	61.72	62.01	62.77	63.07	65.81	66.86	67.75	70.61	75.42	80.06	84.57	91.53	94.73	98.61	99.32
Calf circumference	47.34	52.01	56.39	60.06	62.91	65.67	66.77	68.43	71.58	73.04	74.76	77.81	80.82	86.63	92.28	94.84	97.79	99.16	99.93
Triceps skinfold	131.30	132.10	148.00	154.90	133.00	111.90	103.40	94.80	90.08	92.91	94.33	95.75	98.90	102.3	103.70	101.70	105.30	104.	

are first to mature than bizygomatic diameter of the facial group among Yadavas, but in Vadabalijas only head breadth matured first than bizygomatic and head length. This is suggestive of a cephalo-caudal gradient of growth among Yadava and Vadabalija boys. This cephalo-caudal gradient becomes still clearer when the cephalo-facial measurements are compared with the torso measurements among these two castes. In other words, all the head (except head length in Vadabalijas) and face measurements are maturing in advance than the torso group of measurements (except subscapular skin fold in Vadabalijas) suggesting clearly the cephalo-caudal gradients among these two caste groups.

The caudo-cephalic gradient or reversal phenomenon is clearly visible when we observe the biiliocrystal diameter which matures earlier than biacromial diameter among Vadabalijas than Yadavas. Further on comparing the sitting height (99.11%) with total arm length (99.03%), the height of anterior iliac spine (99.33%) with total arm length (99.03%) in total, one gets a further indication of caudo-cephalic gradient of growth among Yadavas. A similar trend is observed among Vadabalijas on comparing the sitting height (99.25%) with total arm length (99.80%), the height of anterior-iliac spine (99.99%) with total arm length (99.80%) in total. In the present study as mentioned above the constituent segments of facial, trunk and extremities group clearly speak in favour of the 'reversal phenomenon'.

The circumferences reveal satisfactory view about the growth gradients which are both cephalo-caudal or caudo-cephalic. The cephalo-caudal gradient of growth can be clearly observed when we compare the upper arm circumference (98.87%) with calf circumference (97.52%) which is well advanced among Yadavas, but in Vadabalijas caudo-cephalic gradient of growth is observed when we compare the upper arm circumference (99.32%) with calf circumference (99.93%).

In the present study of the constituent measurements of the trunk, *i.e.* biiliocrystal diameter (99.52%) over biacromial diameter (99.41%) in Vadabalijas. The extremities, namely the height of anterior iliac spine over total arm length in both cases and the triceps skin-fold over subscapular skinfold in both the cases which mature earlier reveal of caudo-cephalic (*i.e.*, reversal of cephalo-caudal) gradient of growth. Perhaps this is the reason why Tanner (1964) speaks of the smaller area gradients (as) being 'more complicated'. Tanner's expression, 'more complicated' is now to be viewed in the sense of 'caudo-cephalic gradients' instead of 'cephalo-caudal gradients'. This may, for the sake of brevity, be called reversal phenomenon. In the present study as mentioned above the constituent segments of trunk and extremities groups clearly speak in favour of the 'reversal phenomenon' *i.e.* the caudo-cephalic gradient of growth. The present study is in agreement with the works of Sidhu (1969), Nath (1972), Krishna Rao (1981), Jhingon and Nath (1985) in terms of growth gradients. The growth differences observed between the Yadava and Vadabalija boys need to be explained at this juncture. The social status of both the caste groups in the prevailing Hindu caste system is low. The Vadabalija community in particular is very poor, their occupation (fishing) is not as dignified as that of the Yadavas (agriculturists), they occupy a low position in the society, living mostly outside the villages, and are educationally backward. Both the groups are of lower income groups. The factors associated with socio-economic environment may play a role in limiting growth potential throughout the growth period. The socio-economic status of Yadava community is considerably better than the Vadabalija. However, owing to the occupation it is obvious that Vadabalijas have easy access to and may consume fish and other sea foods abundantly as also shown by other studies (Busi et al., 1987). This high consumption of protein rich food of Vadabalijas may have resulted in better growth.

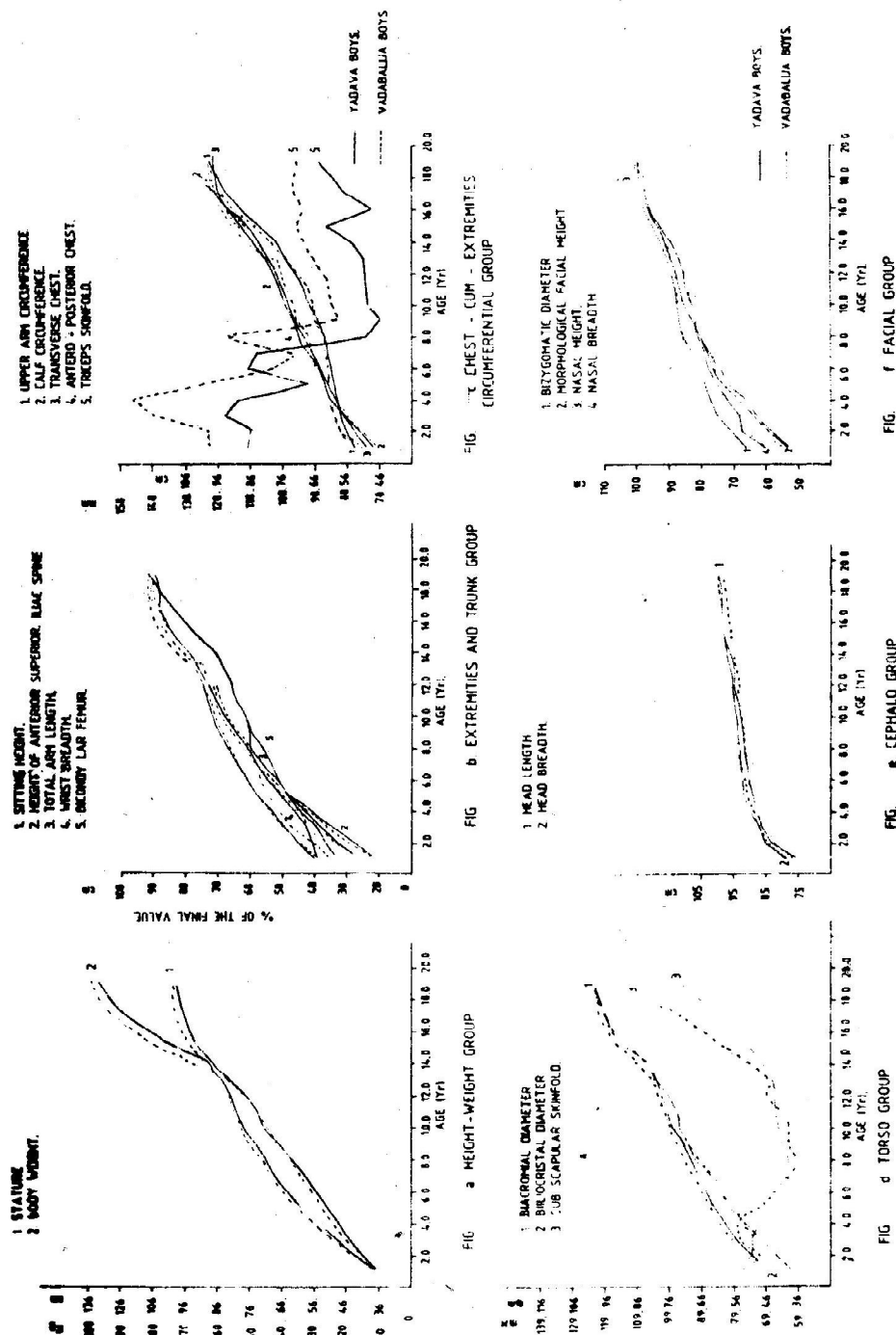


Fig. 1. Maturity gradients

Regarding the genetic differences, both Yadava and Vadabaliya are reproductively isolated from one another and also strictly endogamous. Raja Rajeswari (1988) in her study observed some difference between these two communities in their demographic, genetic and other characters. These inherent genetic factors affecting the velocity of growth which give the Vadabaliya boys a characteristic cross-sectional growth patterns in many variables which is quantitatively different from that observed in Yadava boys. This would be consistent with what is known of genetic factors affecting growth and development (Tanner, 1962) and comparative growth studies of different ethnic groups (Eveleth and Tanner, 1976).

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REFERENCES

- Bayley, N : Discussion of J.M. Tanner's paper entitled: "Assessment of ossification" dealing with "Methods of sealling Skeletal Development". In : *Modern Problems in Pediatrics*, A. Hotinger and H. Berger (Eds.) 7: 64 (1962)
- Busi, B.R., Saileela, M., Rector Babu, A.D.W. and Jyothi, G.M.: Food, dietary intake and feeding practices in urban slums of Visakhapatnam. *Ind. J. Nutr. Dietet.*, 24: 163-169 (1987).
- Eveleth, P.B. and Tanner, J.M.: *World-wide Variation in Human Growth*. Cambridge University Press, London (1976).
- 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).
- Krishna Rao, U.V.: *Physical Growth Among the Brahmin Boys of Visakhapatnam- A Cross-sectional Study*. Doctoral thesis, (Unpublished) Andhra University, Waltair (1981).
- Nath, S. : *A Study of Age Change of Different Biological Variables in the Jat Boys of Meerut (U.P.)*, Doctoral thesis (Unpublished), University of Delhi, Delhi (1972).
- Sidhu, L.S.: *Biological Survey of Punjabi Males with Special Reference to Age Changes*. Doctoral thesis (Unpublished), Punjab University, Chandigarh (1969).
- Tanner, J.M. *Growth at Adolescence*, Blackwell Scientific Publications, Oxford (1962).
- Tanner, J.M.: Chapters 19-24 entitled "Human Growth and Constitution" 11 pp. 289-397 : In : *Human Biology*. G.A. Harrison, J.S. Weiner, J.M. Tanner and N.A. Barnicot (Eds.). Oxford University Press, Oxford (1964).
- Tanner, J.M. Whitehouse, R.H. and Takaishi, M.: Standards from birth to maturity for height, weight, height velocity and weight velocity, British children 1965 (Part 1). *Arch. Dis. Child.*, 454-471 (1966).
- Weiner J.S. and Lourie, J.A.: *Human Biology IBP Handbook No.9*. Blackwell Scientific Publications, Oxford and Edinburgh (1969).