

The Dynamics of Monthly Increments in the First Postnatal Year: A Pure Longitudinal Study of Punjabi Infants in Chandigarh

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ABSTRACT 154 Punjabi infants (86 boys; 68 girls), born in Chandigarh between 1978 and 1981, have been measured every month during the first year of life for body weight, crown-heel length and head circumference. The statistics of the variables and their increments in terms of average increases during the first and last halves of the year as well as over the whole year, and some of the correlations have been discussed.

Somatometric measurements are the widely recognized indicators of health status in growing children. A meaningful appreciation of the current status of children's health can be provided by their rate of growth (velocity). In monitoring infant growth, the distribution of growth velocities derived from serial (longitudinal) measurements carried out every month on normally growing infants is believed to be immensely helpful (Boryslawski, 1988; Healy et al., 1988).

In this report, we present the statistical values of three measurements (body weight, crown-heel length and head circumference) and their monthly increments alongwith their correlation coefficients.

MATERIAL AND METHODS

The sample consists of 154 infants (84 male; 68 female) of Punjabi parentage living in the Union Territory of Chandigarh, North India. These subjects, born between 1978 and 1981, were followed up at one monthly intervals with a tolerance of 3 days. Some aspects of the growth of these subjects, 92.2% being first-borns, have already been reported (Bhalla et al., 1985 a, 1986; and Bhalla et al., 1987).

The data are presented at monthly intervals in terms of the mean and standard deviation (SD) for three measurements -body weight (BW), crown-heel length (CHL) and head circumfer-

ence (HC), and their increments according to gender. Some of the correlation coefficients have also been given.

RESULTS AND DISCUSSION

Average Increase in Body Size During the First and Last Halves of Infancy (after Meredith, 1978)

Body growth is much more rapid during the first 6 months after birth than during the succeeding 6 months. The average gains from birth to the middle of first year are about 4 kg. (M=4.4 kg.; F=4.03 kg.) in BW, near 17 cm. (M=17.2 cm.; F= 16.4 cm) in CHL and about 8.3 cm. (M = 8.7 cm.; F = 8.0 cm.) in HC. Between age 6 and 12 months the average increases are less than half as large for the three measures.

Growth Rate

The increments (velocities) of the three traits are generally higher in male than female infants.

Table 1: Mean and Standard Deviation of body weight, crown-heel length and head circumference in 86 Punjabi male infants

Age months	Body weight (kg)		Crown-heel length (cm)		Head circumference (cm)	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
0	2.94	0.35	49.06	1.74	33.96	1.02
1	3.84	0.48	53.84	2.33	36.55	1.11
2	4.81	0.58	57.45	2.36	38.26	1.03
3	5.61	0.66	60.49	2.40	39.63	1.10
4	6.31	0.72	62.81	2.42	40.77	1.44
5	6.86	0.84	64.61	2.44	41.73	1.17
6	7.35	0.90	66.22	2.40	42.64	1.23
7	7.70	0.97	67.78	2.40	43.28	1.26
8	8.00	1.07	69.02	2.50	43.78	1.23
9	8.26	1.05	70.23	2.51	44.21	1.25
10	8.50	0.90	71.49	2.52	44.68	1.24
11	8.75	1.00	72.67	2.50	45.06	1.24
12	8.95	1.02	73.87	2.49	45.61	1.74

Table 2: Mean and Standard Deviation of body weight, crown-heel length and head circumference in 68 Punjabi female infants

Age months	Body weight (kg)		Crown-heel length (cm)		Head circumference (cm)	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
0	3.00	0.34	48.97	1.64	33.72	0.93
1	3.80	0.58	53.52	1.87	35.95	1.06
2	4.63	0.55	57.04	2.27	37.71	1.17
3	5.36	0.63	59.70	2.46	38.94	1.36
4	5.95	0.69	61.82	2.51	39.91	1.32
5	6.54	0.72	63.76	2.29	40.96	1.33
6	7.03	0.87	65.36	2.28	41.73	1.38
7	7.36	0.94	66.80	2.51	42.41	1.36
8	7.66	0.94	68.06	2.53	42.84	1.43
9	7.91	0.96	69.44	2.64	43.34	1.41
10	8.18	0.97	70.53	2.71	43.72	1.38
11	8.47	0.98	71.60	2.67	44.13	1.41
12	8.73	0.96	72.78	2.58	44.39	1.42

Sexual dimorphism (after Wolanski, 1965) indicates that differences between male and female infants according to age are not unidirectional for absolute values (Bhalla et al., 1985 b) as well as for increments. Higher male ascendancy is seen during early months after birth (upto 4 months), while female ascendancy is visible beyond 9 months. In the Zurich infants, Gasser et al. (1991) found that boys had a higher velocity for the first 6 months or so in all variables considered and approached that of girls in the second half of infancy. This had earlier been indicated by Heierli (1960) as well as by Tanner et al. (1966) and Kantero and Tiisala (1971).

With the exception of the earliest months of life, the increments generally decrease with age. In both male and female infants the increments in BW are higher in the second than during the first month. For CHL and HC the greatest increments are seen between birth and first month of life in both sexes. Thereafter, the growth velocity generally slows down (Tables 3 and 4).

Using the 'structural average curve' technique (Gasser et al., 1990; Kneip and Gasser, 1989 a,b) Gasser et al. (1991), in their Zurich longitudinal growth study, detected that the overall pattern for all variables considered during infancy is that velocity drops sharply after birth, followed by a kink to a more gradual development between 7 and 12 months. Using a different statistical method, Karlberg et al. (1987) also

Table 3: Mean and Standard Deviation of monthly increments of body weight, crown heel length and head circumference in 86 Punjabi male infants

Age intervals, months	Body weight (kg)		Crown-heel length (cm)		Head circumference (cm)	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
0-1	0.90	0.38	4.77	2.23	2.59	1.10
1-2	0.97	0.27	3.61	1.72	1.71	0.56
2-3	0.80	0.30	3.03	1.06	1.37	0.56
3-4	0.70	0.24	2.32	0.86	1.13	0.77
4-5	0.55	0.27	1.80	0.79	0.97	0.85
5-6	0.49	0.29	1.61	0.77	0.91	0.46
6-7	0.34	0.21	1.57	0.76	0.64	0.30
7-8	0.30	0.23	1.24	0.99	0.50	0.27
8-9	0.27	0.19	1.21	0.76	0.42	0.23
9-10	0.23	0.21	1.26	0.68	0.47	0.25
10-11	0.25	0.20	1.17	0.64	0.39	0.32
11-12	0.20	0.27	1.21	1.29	0.54	1.27

Table 4: Mean and Standard Deviation of monthly increments of body weight, crown-heel length and head circumference in 68 Punjabi female infants

Age intervals, months	Body weight (kg)		Crown-heel length (cm)		Head circumference (cm)	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
0-1	0.80	0.50	4.35	1.55	2.22	0.95
1-2	0.83	0.41	3.72	1.08	1.76	0.68
2-3	0.73	0.26	2.66	1.07	1.23	0.58
3-4	0.59	0.26	2.11	0.95	0.97	0.45
4-5	0.59	0.26	1.94	0.97	1.05	0.43
5-6	0.48	0.28	1.60	0.82	0.77	0.29
6-7	0.33	0.24	1.45	0.75	0.68	0.33
7-8	0.30	0.17	1.26	0.55	0.44	0.29
8-9	0.24	0.21	1.38	0.62	0.50	0.30
9-10	0.28	0.29	1.09	0.57	0.37	0.23
10-11	0.29	0.22	1.07	0.60	0.41	0.33
11-12	0.26	0.21	1.18	0.73	0.26	0.43

found a similar pattern in their Swedish longitudinal growth study, but identified a spurt in the period of most drastic change not seen in the Zurich data.

The general trend of deceleration in the rates of growth for the three variables considered here from one month onwards does not depict a regular and rapid tendency as reported by Roche et al. (1989) for weight and recumbent length in the Fels longitudinal study.

The SD values of BW generally increase with age upto 8 months in male infants and upto 11 months in female infants (Tables 1 and 2). The

SDs for CHL increase among male infants during the first quarter of infancy followed by a general decrease with age over the next four months. For female infants, the SDs for CHL depict an increase with age upto the first 4 months to be followed by a decrease during the next two months. An increase between 7 and 10 months is followed by a decreasing tendency in the next two months. A similar undulating tendency in the SD values for HC is visualized for both sexes.

The SDs of increments (Table 3 and 4), thus, generally show a decreasing tendency with age and no perceptible sex differences are seen. As pointed out by Boryslawski (1988), this suggests that the child tends to remain in his or her individual development 'canal'.

Correlations

Correlations for BW, CHL and HC at birth and the following monthly intervals are depicted in table 5. Correlation values for these three variables for both male and female infants show a general decrease with age upto around 8 months followed by a general stationary tendency upto the end of the first year of life. Correlations according to monthly ages during infancy in females for BW and CHL are generally higher while those for HC are lower than those for the male infants.

Correlations between increments in successive age intervals depict no general trend (Table 6); in the successive age intervals both the value

and the direction of the correlations alter. This may indicate, following Boryslawski (1988), a confirmation of the compensation of developmental retardation in infants who were once removed out of their genetically determined canal. This seems to receive further support from the negative and significant correlations of CHL and HC in the first month of life with those at birth in both the sexes (Tables 5 and 6). This would suggest that a newborn with a bigger body size in terms of CHL and HC, achieved due to the benevolent intrauterine environment, sooner returns to his or her developmental canal during the first month of extrauterine life. Increments of the more labile variable represented by BW do not correlate with BW at birth among the Punjabi infants of the present study.

Table 6: Correlation coefficients for increments of body weight, CHL and HC in subsequent age intervals

Intervals	Males (n = 86)			Females (n = 68)		
	Body weight	CHL	HC	Body weight	CHL	HC
0-1 v 1-2	0.07	-0.41	-0.37	-0.61	-0.09	-0.08
1-2 v 2-3	0.20	-0.12	-0.04	0.20	-0.16	0.0004
2-3 v 3-4	0.05	-0.18	-0.06	0.07	-0.15	-0.18
3-4 v 4-5	0.19	-0.12	-0.73	0.16	-0.15	0.08
4-5 v 5-6	0.12	-0.21	0.03	0.21	0.13	0.14
5-6 v 6-7	-0.04	-0.90	0.06	-0.09	-0.10	-0.15
6-7 v 7-8	-0.79	-0.13	0.13	0.02	-0.25	-0.02
7-8 v 8-9	-0.13	-0.29	-0.02	-0.21	-0.11	-0.21
8-9 v 9-10	0.05	0.12	-0.08	-0.01	0.02	0.02
9-10 v 10-11	-0.08	-0.03	-0.07	-0.04	0.09	0.04
10-11 v 11-12	0.004	-0.15	-0.23	-0.08	0.01	-0.37

Table 5: Correlation coefficient for body weight, crown-heel length and head circumference at birth and monthly increments of these traits

Inter-vals	Males			Females		
	Birth weight	Birth CHL	Birth HC	Birth weight	Birth CHL	Birth HC
0-1	-0.12	-0.33	-0.45	-0.07	-0.31	-0.36
1-2	0.07	0.06	-0.03	0.14	0.23	-0.10
2-3	0.07	0.13	0.03	-0.11	0.09	0.11
3-4	0.05	-0.03	0.18	0.12	-0.12	-0.17
4-5	0.08	-0.09	-0.17	0.04	-0.22	-0.21
5-6	-0.07	0.05	-0.04	0.22	-0.07	0.01
6-7	0.02	-0.06	-0.05	0.31	0.27	-0.08
7-8	0.02	-0.02	-0.06	-0.22	-0.18	0.21
8-9	-0.12	-0.14	-0.23	0.15	0.07	-0.19
9-10	-0.12	0.01	0.06	-0.13	0.20	-0.05
10-11	-0.02	-0.004	0.005	0.08	0.30	-0.09
11-12	0.08	-0.12	0.06	0.04	-0.39	-0.02

Healy et al. (1988) point out to the existence of a high correlation between mean values in subsequent age intervals, which become quite low for increments in the subsequent age intervals. An indication to this phenomenon may be visible in our study in the values of correlation coefficient for the three physical variables considered between birth and one-month (Table 5) and for increments in the successive monthly age intervals (Table 6).

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