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GROWTH OF BENGALI INFANTS BY FEEDING HABIT FROM BIRTH TO AGE TWELVE MONTHS

by S. Bandyopadhyay, K. Pakrasi, A. R. Banerjee and J. Banerjee née Chatterjee

(Indian Statistical Institute, Calcutta; Department of Anthropology, Calcutta University, Calcutta)

Abstract. In the paper an attempt has been made to examine for the first time how varying feeding habits before and after weaning affect postnatal growth of the Bengali infants from birth to age twelve months. A sample of 200 infants (107 males and 93 females) was studied anthropometrically following longitudinal method at six time intervals namely, at birth, 1 month, 3 months, 6 months, 9 months, and lastly at 12 months. At each time-interval along with the relevant measurements information about feeding habit, time of weaning and kind of substitute nourishments of breastmilk was systematically recorded during home visits. The mothers were classified into three socio-economic classes on the basis of average annual income of the family: (1) poor, (2) moderately well-off and (3) well-off. Total length, chest circumference, biacromial diameter, head length, head breadth and body weight of each child, male or female, were measured at each time-interval. For each character the distance curve, velocity curve and acceleration curve have been examined. The study has revealed that the babies who were on prolonged breast feeding and fed with high starch-low protein foods after weaning suffered relatively greatest order of malnutrition and consequently, it has been obtained from analyses, that the malnourished infants yielded lower mean values for all the six anthropometric characters at each age-interval than what were shown by the well nourished babies.

Key words: feeding habit, Bengali infants, weaning diet, socioeconomic level of mothers, birth weight, length, weigth, chest circumference, biacromial diameter, head length, head breadth.

Introduction

Continuing researches on different aspects of human growth all over the world have already affirmed that a considerable proportion of the mean differences in body size among populations is due to the effects of environmental conditions. Also, it is well accepted that some of the differences among individuals within a population are due to environmental differences. It has been pointed out that though many environmental factors influence rate of growth but in the final analysis most of them "hinge upon" the level of nutrition (Eveleth—Tanner 1976). Moreover, Tanner (1970) has meanwhile pointed out that the height, weight, or body built of a child or an adult reflects always the resultant effects of both the genetical and environmental factors with their necessary interactions.

In the above context one physical character, namely, body weight at birth has received extensive attention of a number of physical anthropologists, human biologists, paediatricians, child health specialists, nutrition experts and other scientists. Experiences of their researches reveal that this single character is truly and quite highly dependent on multiple biological and non-

biological factors like mother's age, body constitution, health and nutritional status, infant's parity, gestation period, sex, nutrition and socioeconomic level (KARN—PENROSE 1951, MILLIS—SENG 1954, NAMBOODIRI—BALAKSISHNAN 1958, BANERJEE—ROY 1962, BANERJEE 1969, PACHAURI et al. 1971, MANOCHA 1972, MORLEY 1973, WHO 1976, PUROHIT et al. 1977, OLIVIER et al. 1978).

In many developing countries important studies on growth of infants have clearly shown that post-natal weight and length values maintain during the first 6 months the same level as those in developed, industrialized countries, but diminish appreciably thereafter as a result of the interaction of undernutrition and infection. Further, it is observed that the "slowing down" in weight growth coincides with age of weaning and the substitution of human milk by high starch and low protein foods. Deficiency in lactating ability of the mother plays also a significant role to influence a satisfactory growth in the newborns.

From several growth studies some important lessons are obtained for further guidance: (i) undernutrition in the first 1 or 2 years of life may not necessarily lead to an adult deficit in body size, (ii) malnutrition during childhood delays growth, (iii) body shape is much more resistant to nutritional stress, or even disease, than in body size, (iv) overfeeding in the first year or 18 months after birth may have much to do with a tendency to become obese later, (v) bottle-feeding in place of breast-feeding carries with it the risk of excess, both in volume and in the concentration of foodstuffs, (vi) the time of adolescent spurt is a more sensitive indicator of nutritional deficiency than it is the growth rate at earlier periods, and (vii) children from different socioeconomic levels differ in average body size at all ages, but growth differences are more closely related to the home conditions, than to the strictly socioeconomic status of the families (TANNER 1962, EVELETH—TANNER 1976).

In infancy, especially during the first 3—4 months human milk is the natural food to supply the necessary nutrients and any deficiency in these nutrients is apt to influence infant's initial growth. In the present paper an attempt has been made to examine how differential feeding habits before and after weaning affect postnatal growth of the newborns during the first year of life.

Material and methods

In 1971—72 some anthropometric characters and pre- and post-weaning diets of 200 infants (107 males and 93 females) of the Bengali parentage, of mixed birth order, and of unequal socioeconomic levels were studied by adopting longitudinal methods at different time-intervals during the first twelve months since their birth at the maternity ward of Ramarkrishna Mission Seva Prathisthan (Hospital), Calcutta. Following GARN—SHAMIR (1958) eleven physical measurements of each infant were taken at birth, at one month, at 3 months, at 6 months, at 9 months and lastly, at 12 months of age. At each time interval when the relevant measurements were taken, the feeding habit, the time of weaning and the kind of substitute nourishments (liquid and/or solid) of human milk were also systematically recorded for each infant during several home visits by one of the authors (JB). All the infants were examined and measured at forenoon within allowable tolerance in days (GARN—SHAMIR 1958) in their respective home condition. Socioeconomic conditions of the

parents of each newborn, which were enquired and noted carefully earlier during expectant mother's first visit to the Hospital was further verified during home visits in the follow-up study (BANERJEE 1976).

Birth weight and other body measurements of each newborn with normal health was initially recorded within 48 hours after birth by qualified paediatricians of the Hospital. The same measurements were repeated on each infant at every time-interval during follow-up visits to their homes.

For the purpose of the study socioeconomic position of the mothers has been ascertained at the outset on the basis of their relative pecuniary abilities to meet confinement charges for suitable bed in cabin, paying or freeward and other expenses for child delivery at the Hospital. In general, the expectant mothers who came from low income group preferred invariably bed in freeward and they had almost non financial burden to bear in meeting delivery expenses. In contrast, those pregnant mothers who came from high income class and well-to-do families selected bed in cabin to enjoy a separate chamber meant for a single occupant. They did not eventually find any constraints to pay due hospital expenses charged for delivery-operations. Apart from these two categories of mother a third category was formed by those pregnant women who took hospital admission in getting bed in paying ward. These mothers had to meet partially hospital expenses charged for delivery-operations. Thus, the mothers and their babies could be examined by three broad socioeconomic levels identified by bed-confinement affiliation and average annual income: (a) Level I: poor mothers of freeward (average annual income: Rs 1972/=), (b) Level II: moderately well-off mothers of paying ward (average annual income: Rs. 6894/=), and (b) Level III: well off mothers of cabin ward (average annual income: Rs. 12,510/=).

Out of 200 infants under examination 60, 90 and 50 belonged to the mothers of Level I, II and III, respectively. Sexwise breakdown of the newborns per socioeconomic level yields the following distributions: (i) 33 males and 27 females (Level I), (ii) 49 males and 41 females (Level II), and (iii) 25 males and 25 females (Level III).

In the house-to-house follow-up survey, 11 measurements were initially taken on each infant at each time-interval (BANERJEE 1976). But for the present study the following 6 measurements have been utilized: (1) Total length, (2) Chest circumference, (3) Biacromial diameter, (4) Head length, (5) Head breadth, and (6) Weight (MARTIN—SALLER 1957). The weights of the infants were noted in grams and all other body measurements in milimetres (BANERJEE—BANERJEE 1978).

Prolongation of breast-feeding (and thereby the time of weaning and subsequent substitution of low/high starch and low/high protein foods) has been studied in terms of four broad stages: (a) Stage 1: weaning-time at 3 months or earlier, (b) Stage 2: weaning time after 3 months but within 6 months, (c) Stage 3: weaning time after 6 months but within 12 months, and (d) Stage 4: weaning time after 12 months.

Weaning diets have been examined by three broad categories: (a) Category I: *Liquid diets* (cow's milk, sago, barley, fruit juice), (b) Category II: *Solid diets* (rice, fish, cereal, mashed potato, boiled vegetables, bananas, and other fruits, and (c) Category III: *Baby food* (dried milk product manufactured commercially). Weaning diets as were reported by the mothers of different socioeconomic level, may be considered as the normal foods which are usually given

to ghe growing babies in Bengali families. It is strongly presumed that there was no reporting bias since the female investigator checked the relevant diet information in her personal visits to the mothers for several times.

When the newborns are classified by the socioeconomic level of mothers and the time of weaning the following distributions are obtained for the male infants and the female infants respectively:

Male infant

Weaning time (Stage)	Socioeconomic level of mother			Total
	I	II	III	
1	0	27	22	49
2	5	11	3	19
3	16	4	0	20
4	12	7	0	19
Total	33	49	25	107

Female infant

Weaning time (Stage)	Socioeconomic level of mother			Total
	I	II	III	
1	4	19	15	38
2	4	13	8	25
3	13	7	2	22
4	6	2	0	8
Total	27	41	25	93

Moreover, frequency distributions of infants by weaning diet, sex and time of weaning have been set out in Table 1. In Table 2 frequency distributions of infants by weaning diets, sex and socioeconomic level of mother have been presented to indicate the pattern of feeding habits involving differential nutrition intake of the babies in three socioeconomic groups. These tables incorporate basic data related to the magnitude of the newborns in several stages of breast-feeding, and weaning diets among poor, moderately well-off and well-off mothers.

Table 1

Frequency distribution of infants by weaning diet, sex and time of weaning

Sex	Time of weaning code (X)	Diet code*					Total
		ML	MS	MLF	MSF	BM	
Male	1	—	—	—	49	—	49
	2	—	5	1	13	—	19
	3	11	7	1	1	—	20
	4	—	—	—	—	19	19
Sub-total		11	12	2	63	19	107
Female	1	1	1	—	36	—	38
	2	—	12	—	13	—	25
	3	5	12	—	5	—	22
	4	—	—	—	—	8	8
Sub-total		6	25	0	54	8	93
Total		17	37	2	117	27	200

* Explanation of diet codes:

A. ML stands for mixed liquid foodstaffs consisting of milk (cow, goat etc.) sago, barley and fruit juice.

B. MS stands for mixed solid foodstaffs consisting of those shown under ML and rice, fish, cereal, vegetable, sweets, fruits and egg yolk.

C. MLF stands for mixed liquid foodstaffs and baby food (dried milk) (Formula based milk powder).
MSF stands for mixed solid foodstaffs and baby food (dried milk food).
BM stands for breast milk only.

With immediate reference to such basic data it is expected that the merits of the findings of the present paper can be well appreciated.

For each character under study the distance curve, velocity curve and acceleration curve have been examined and presented in Figs. 1—6. Each set of Figures covers the distance curves, the velocity curves and the acceleration curves of the male infants. The curves of the female infants show a very similar tendency.

Table 2

Frequency distribution of babies by weaning diet, sex and socioeconomic level of mother

Socioeconomic level of mother (Bed type)	Sex	Weaning code (X)	Diet code*					Total
			ML	MS	MLF	MFS	BM	
I (Free bed)	Male	1	—	—	—	—	—	0
		2	—	3	—	2	—	5
		3	9	7	—	—	—	16
		4	—	—	—	—	12	12
Sub-total			9	10	0	2	12	33
I (Free bed)	Female	1	1	—	—	3	—	4
		2	—	3	—	1	—	4
		3	5	8	—	—	—	13
		4	—	—	—	—	6	6
Sub-total			6	11	0	4	6	27
II (Paying bed)	Male	1	—	—	—	27	—	27
		2	—	2	1	8	—	11
		3	2	—	1	1	—	4
		4	—	—	—	—	7	7
Sub-total			2	2	2	36	7	49
II (Paying bed)	Female	1	—	1	—	18	—	19
		2	—	5	—	8	—	13
		3	—	3	—	4	—	7
		4	—	—	—	—	2	2
Sub-total			0	9	0	30	2	41
III (Cabin bed)	Male	1	—	—	—	22	—	22
		2	—	—	—	3	—	3
		3	—	—	—	—	—	0
		4	—	—	—	—	—	0
Sub-total			0	0	0	25	0	25
III (Cabin bed)	Female	1	—	—	—	15	—	15
		2	—	4	—	4	—	8
		3	—	1	—	1	—	2
		4	—	—	—	—	—	0
Sub-total			0	5	0	20	0	25
Total			17	37	2	117	27	200

* For Diet code see table 1.

Results: Analysis of growth curves

Growth curves of both male and female infants from birth to 12 months are compared for the six features, namely, total length (height), body weight, chest circumference, biacromial diameter, head length and head breadth with respect to the 4 Stages of weaning.

1. Total length

During the first twelve months since birth distance curves are increasing, with the rate of increase (velocity) gradually decreasing with age. Deviation from this general pattern is observed for both male and female infants who continued breast feeding beyond 12 months where the rate of increase in length during 9 to 12 months was slightly larger than the rate during 6 to 9 months.

Though the velocity generally decreases, the rate (acceleration) of decrease has a decreasing trend up to the age of 6 months and then an increasing trend i.e. the acceleration curves have a convex trend towards age axis. Deviation from this pattern is observed for female infants who weaned within 3 months and for male infants who weaned after 3 months but within 6 months where the acceleration curves are always increasing. Acceleration for female infants who weaned after 3 months but within 6 months decreased after 9 months (Fig. 1).

2. Body weight

Increasing of body weight, for both male and female infants weaning at various times, seems to be very stable and similar. The weight increased during first twelve months at an increasing rate up to 3 months and then generally at a decreasing rate up to 9 months and there was a small increase in the velocity thereafter. However for female infants at the first or second Stage of weaning i.e. weaning within 6 months, velocity slightly decreased even after 9 months. This indicates that after 9 months the body weight is gained almost at a constant rate. The rate of velocity change follows the same general pattern of curve as in the case of total length i.e. convex towards age axis (Fig. 2).

3. Chest circumference

Growth of chest circumference is not as stable as body weight for male and female infants at various stages of weaning. The chest circumference increased at an increasing rate up to 3 months for male infants weaning after 3 months whereas for females the same feature is observed for those weaning within 6 months. For others, velocity decreased during this period. The velocity decreased after 3 months, except for female infants who continued breast-feeding beyond 12 months the velocity increased during 6 to 9 months.

Acceleration curves show a pattern similar to those of body weight. Deviation is observed for male infants who weaned within 3 months and for female infants who continued breast-feeding beyond 12 months where the acceleration decreased after 9 months (Fig. 3).

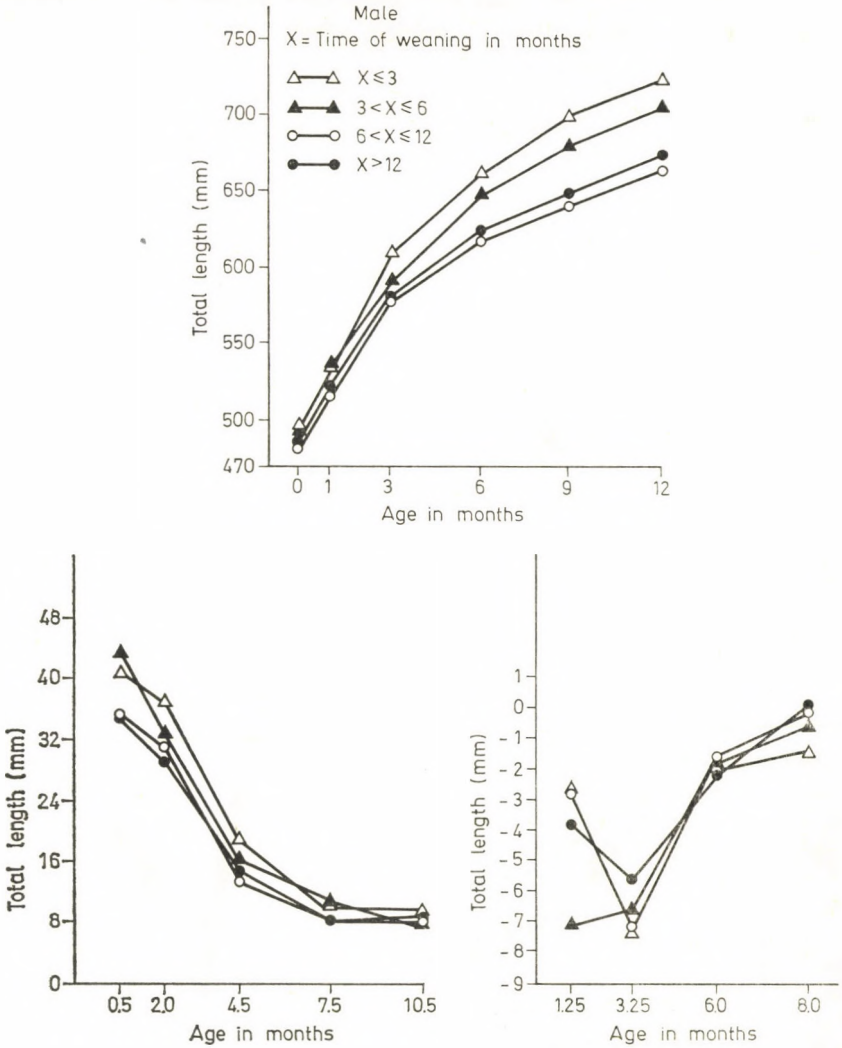

Fig. 1. Growth in total length (height) of the Bengali male infants from birth to twelve months by time of weaning, followed by different substitutive foods. Distance curves, velocity curves and acceleration curves

4. Biacromial diameter

In all age levels growth for biacromial length is observed to decrease at a decreasing rate among both male and female infants. But an exception was registered by those female babies whose weaning time was beyond 12 months (Stage 4) and for male infants weaning after 6 months but not beyond 12 months growth at biacromial dimension increased at an increasing rate between ages 9 and 12 months. On the other hand, among the male infants who were

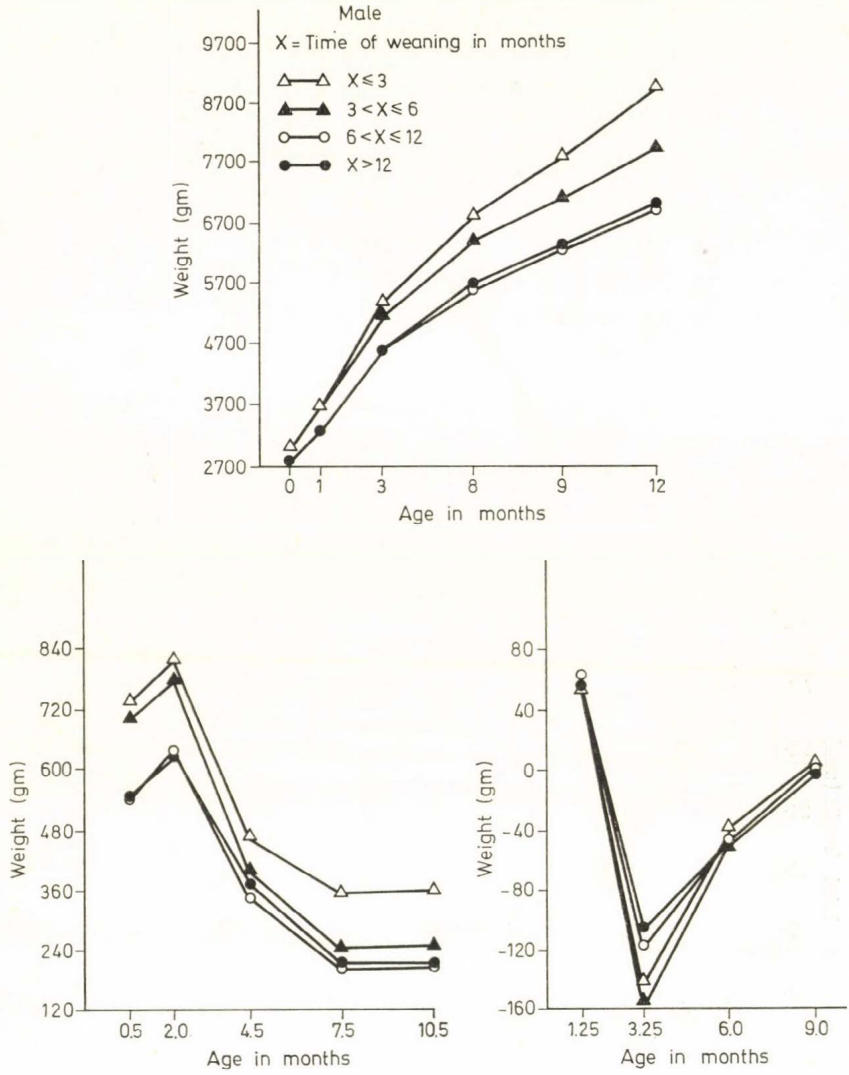

Fig. 2. Growth in body weight of the male Bengali infants from birth to twelve months by time of weaning, followed by different substitutive foods. Distance curves, velocity curves and acceleration curves

given substitute foods after weaning at 3 months or before the rate of increase in this physical trait was constant after their age of 6 months. For both male and female newborns the velocity of growth is found to decrease at a decreasing rate, that is, acceleration was increasing with age, except for the females enjoying the 4th Stage of weaning time (beyond 12 months) since only among them the rate of velocity is found to decrease between ages 3 and 6 months (Fig. 4).

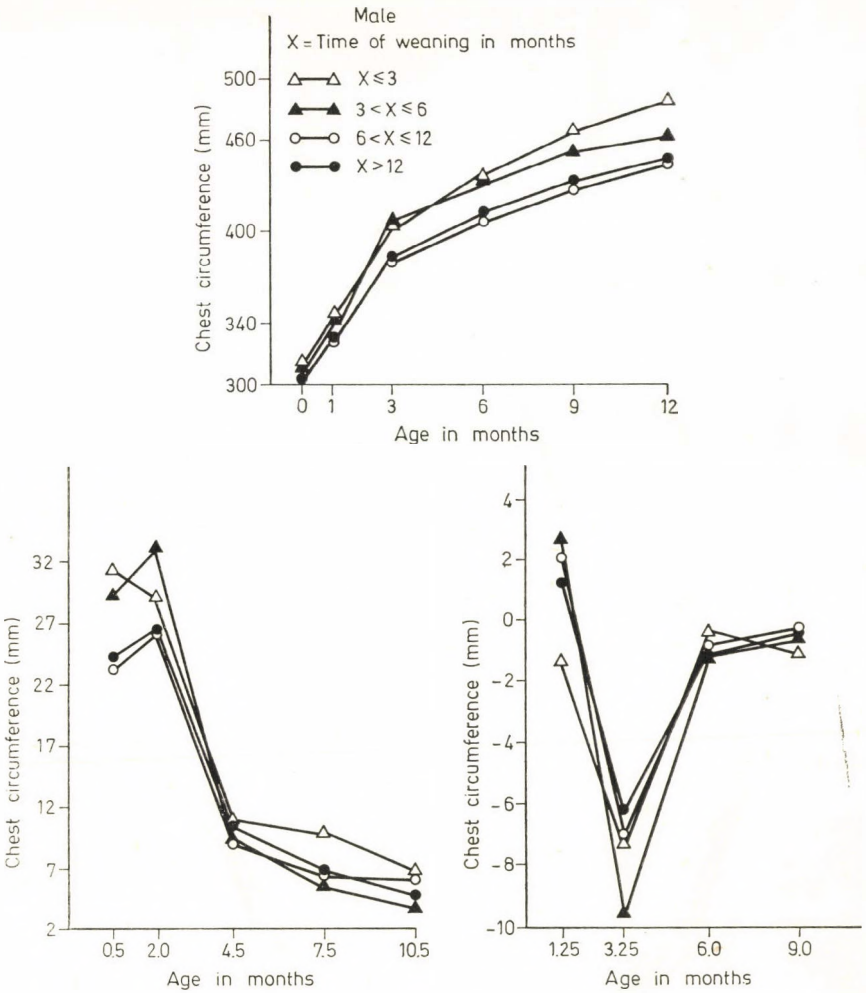

Fig. 3. Growth in chest circumference of the Bengali male infants from birth to twelve months by time of weaning, followed by different substitutive foods. Distance curves, velocity curves and acceleration curves

5. *Head length*

Through out the given period of growth both the male and the female infants experienced increase in head length at a decreasing rate. This general trend of growth was, of course, at a variance among those males only who were at the 3rd Stage of weaning-time and again, among those females only who were at the 4th Stage of weaning time. Among these two particular sub-groups of infants head length maintained increase at an increasing rate especially between the ages 9 and 12 months. On the other hand, velocity of growth is observed to decrease at an increasing rate, that is, acceleration rate does increase with age among both male and female infants in all age classes (Fig. 5).

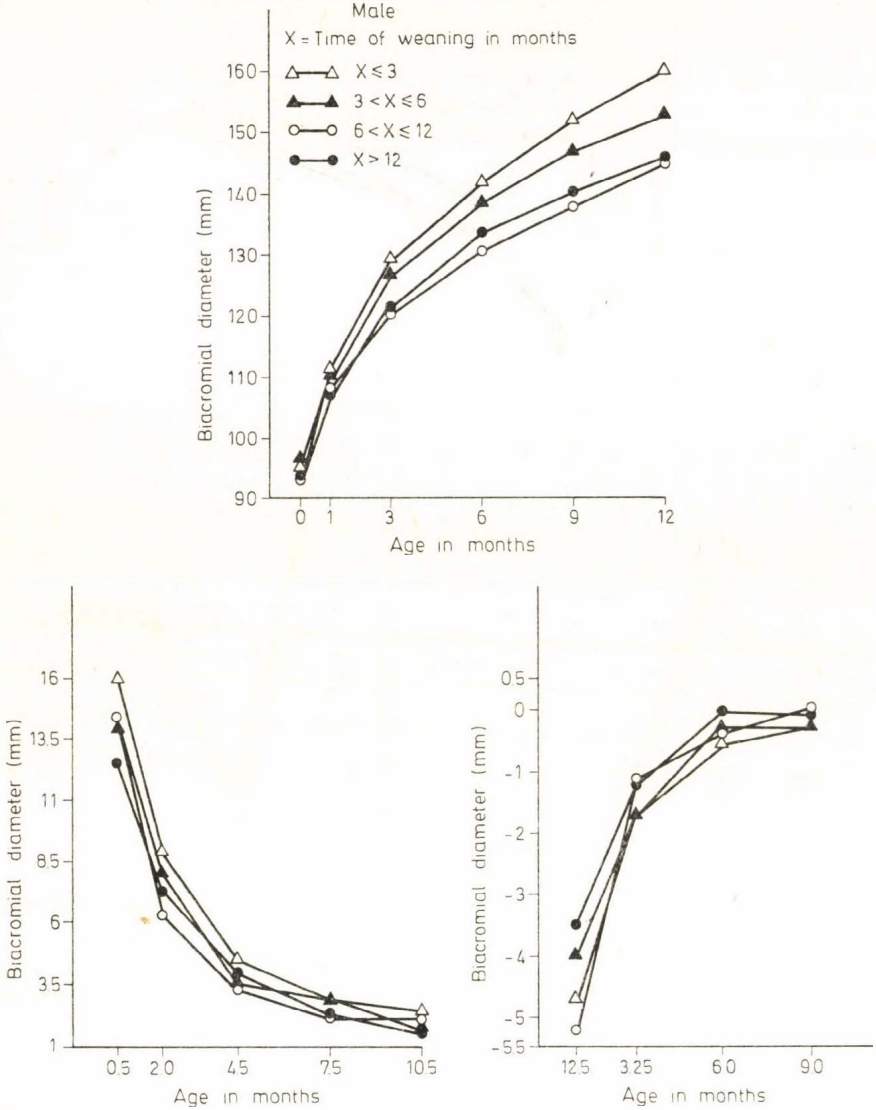

Fig. 4. **Growth in biacromial diameter of the Bengali male infants from birth to twelve months by time of weaning, followed by different substitutive foods. Distance curves, velocity curves and acceleration curves**

6. Head breadth

Growth curves reveal that among the male babies who were at the 2nd Stage of weaning-time and again, among the female babies who were reported to be at the 1st, 2nd, or 3rd Stage of weaning time the physical character of

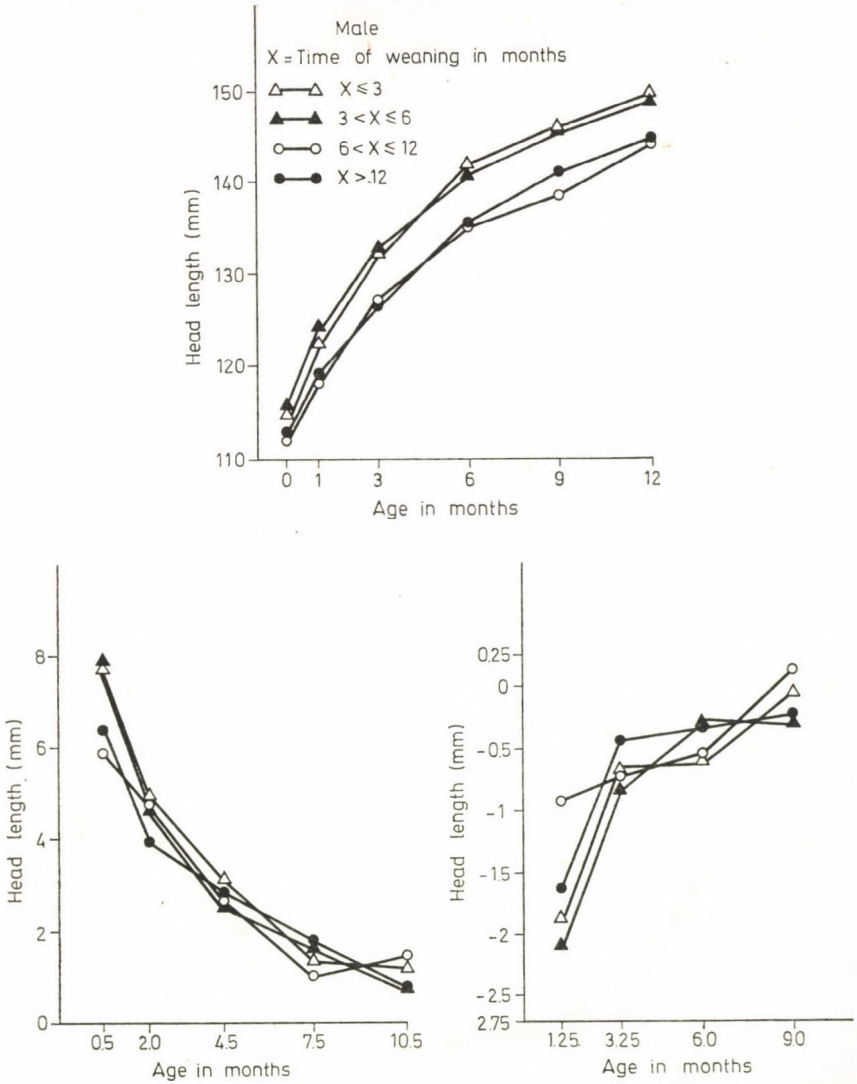

Fig. 5. Growth in head length of the Bengali male infants from birth to twelve months by time of weaning, followed by different substitutive foods. Distance curves, velocity curves and acceleration curves

head breadth increased at a decreasing rate throughout the period of growth considered.

A careful look into all curves would detect at once some interesting patterns of development and they are as follows: (a) for the male infants who were weaned relatively at 3 months of earlier (1st Stage of weaning time) growth in head breadth shows increase at an increasing rate especially between the ages 9 and 12 months; (b) for the male babies who were at the 3rd Stage of

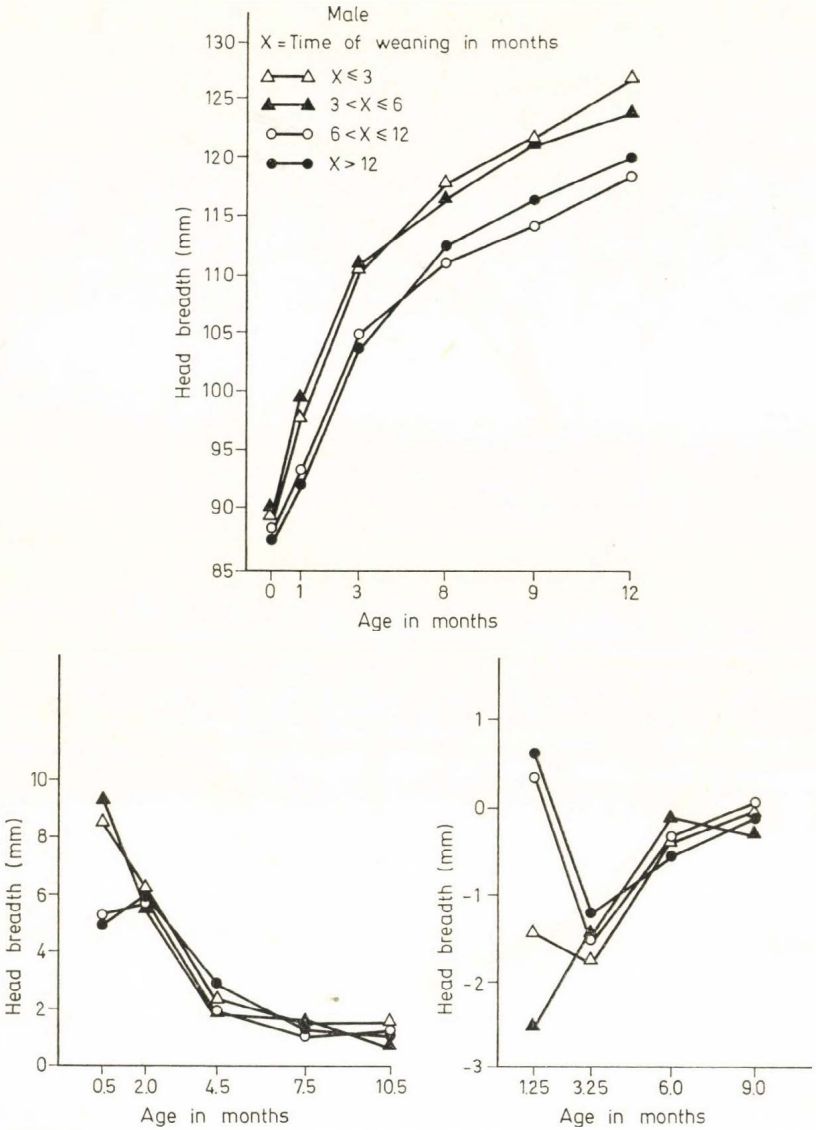

Fig. 6. Growth in head breadth of the Bengali male infants from birth to twelve months by time of weaning, followed by different substitutive foods. Distance curves, velocity curves and acceleration curves

weaning time the above feature is also true but only in the ages from 1 to 3 months; (c) for the males who were at the 4th Stage of weaning time the feature of growth as found for the (b) sub-group is repeated; and again, (d) for the female infants who were at the 4th Stage of weaning time the feature of growth strikes almost identically a semblance with what is found for the male infants of the above (a) sub-group.

Among both male and female infants velocity rate is noticed to be decreasing between their ages 0 to 6 months, while such rate is noted to be generally increasing between their ages 6 and 12 months. Some exceptions to the general convex trend towards age axis can be pointed out: (a) among the male infants who were at the 1st Stage of weaning time (3 months or before) velocity rate decreases at an increasing rate throughout the period of growth in infancy, and (b) among the male babies who were weaned beyond 12 months (4th Stage of weaning time) maintained the same velocity rate as shown by their counterparts of this (a) sub-group but in later ages between 9 and 12 months (Fig. 6).

It is to be noted that the velocity curves which help to study the rate of growth, conforms in general with the biological norm is showing decrease from birth onwards. On the other hand, the distance curves are observed to maintain a fairly regular order in increments of growth by age and nutritional status of the babies with reference to various physical dimensions. The rate of growth of several characters (including the six characters studied here) are being analysed and a report on the same is expected soon.

Discussion

The present study has been aimed especially with an eye to some internationally accepted facts, namely, (i) a child's growth rate reflects, "better than any other single index.", his state of health and nutrition, (ii) in growth it is still not clear how much of mean differences in body size is due to heredity and how much to environment, and (iii) children from different socioeconomic levels do differ in average body size at all ages, the upper groups being always more advanced along the course to maturity (TANNER 1951, MEREDITH 1951, HAMMOND 1957, WHITACARE—GRIMES 1959, REA 1971, EVELETH—TANNER 1976). Utilizing longitudinal data for the newborns of the Bengali parentage we have tried to explain the growth rates of the infants by stage of weaning and category of weaning feed during the first post-natal year. It is expected that the study would help to understand how infant's growth takes place during the first post-natal year under the impact of prolonged or limited breast-feeding followed by weaning diets with unequal nutritional values.

In terms of breast-feeding the infants can be placed under four nutritional groups, namely (1) limited breast-feeding for a few weeks only with prolonged bottle-feeding, (2) moderately prolonged breast-feeding for 13 weeks to 6 months with limited bottle feeding, (3) prolonged breast-feeding for more than 6 months up to 12 months with minimum bottle feeding, and (4) highly prolonged breast-feeding beyond 12 months with no bottle-feeding. These four groups did differ very little in respect of birth weight as may be observed from Fig. 2, but differences in weight gain were so marked by the end of 12 months that the newborns (male or female) of the first nutritional group turned to be heaviest babies (males at birth: 2.98 kg and at one year: 8.89 kg; females at birth: 2.95 kg and at one year 8.24 kg). In contrast, the newborns of the fourth and last nutritional group is found to be the "lightest" babies (males 2.81 kg at birth and at one year: 6.98 kg; females at birth: 2.76 kg and at one year: 6.59 kg) (c.f. Table 6). Now it has been seen earlier (Table 2) that the newborns of the first nutritional group belonged to the well-off mothers (socioeconomic level III) who gave more balanced food staff (rich in strach, protein,

Table 3

Mean birth weights in some selected population of several places in India

Population (place)	Mean weight (kg)		Reference Year
	Boys	Girls	
Calcutta (all income levels)	2.91	2.82	1971
Calcutta (well-off)	3.11	2.97	1971
Calcutta (poor)	2.80	2.72	1971
Delhi (well-off)	3.30	3.10	?
Delhi (poor)	2.80	2.75	?
Madras (well off)	2.95*		1962
Madras (poor)	2.74*		1962
Hyderabad	2.77	2.65	1971
Maharashtrians	2.70	2.50	1970

* Both sexes combined.

and vitamins) as weaning diets for a relatively longer period during the first post-natal year. On the other hand, the newborns of the last nutritional group were the progenies of the poor mothers (socioeconomic level I) who were not able to sustain balanced nutrient feeds as weaning diets. Such differences on socioeconomic level of the mothers has obvious effects on the feeding habit of the newborns and ultimately, differential feeding habits do cause perceptible variations in body growth of the infants. This phenomenon is well reflected in the growth pattern of the infants with respect to each one of six physical characters examined here by feeding habit during the first year of their life. Gain in body weight, length, chest circumference, biacromial diameter, head length or head breadth was relatively more pronounced always in the babies of the first nutritional group and relatively lower in the babies of the fourth nutritional group. Nevertheless, from the nature of growth patterns it is evident that the newborns of the first and the second nutritional groups marked in general a coherent semblance, while the babies of the last two nutritional groups came much closer. It means that the newborns who were weaned at 6 months or before and subjected to relatively more nutritious diets maintain a better growth increase in contrast to those who were for most of the time breast fed even after 6 months or later and were given poor feeds.

With respect to higher body weight gain by the babies exposed to prolonged bottle-feeding tallies well with previous studies (David Hewitt and Stewart 1952) which show that the breast-fed babies remain lighter than bottle-fed babies at the age of twelve months. In this context, one would like to note that since a child's physical development is intimately related to his health and nutrition, in any appraisal of these two specific issues an assessment of the pattern of his physical growth is *sine qua non* and an important single method of confirming the adequancy of a baby's food intake revolve round the accurate measurement of his gain in weight (Illingworth 1957). As the weight is a composite of other measurements and is an over-all measure of body size we have given greater emphasis on the discussion of the trend of progress in weight gain by feeding habits among the Bengali infants. Moreover, it is already shown that malnutrition has a considerable effect on growth, affecting the weight more than the height.

We know that a moderate correlation exists between the child's size at birth and his subsequent body build. The smaller the size of the baby at birth, as found in his birth weight, the smaller he is likely to be in later childhood, and the larger he is at birth the larger he is likely to be in later childhood. Eventually, the infants who were at Stage I of weaning-time and belonged to the 1st nutritional group are obvious to yield larger body size in later ages (12 months) in comparison to their counterparts at Stage II, III or IV of weaning time and again, in the 2nd, 3rd or 4th nutritional group which is considered in the paper.

At birth the mean length of the male newborns was 49.1 cm against 48.5 cm of the female newborns. But as soon as these newborns were examined by the Stage of weaning-time and nutritional group an interesting profile of the growth pattern in total body length over different time-intervals during the first postnatal year were observed (Fig. 1). The *male* newborns of the first nutritional group and at the Stage I of weaning-time average body length at different age intervals in the following order were recorded: 49.6 cm (0 month), 60.9 cm (3 months), 66.4 cm (6 months), 70.0 cm (9 months) and finally 72.4 cm (12 months). In clear contrast, the male newborns of the fourth nutritional group (poorest) yielded mean body length over the same age-invervals in the following manner: 48.9 cm (0 month), 58.1 cm (3 months), 62.5 cm (6 months), 64.9 cm (9 months) and 67.5 cm (12 months). Such noticeable differences in mean body length between the *female* babies of the given two

Table 4

Mean length, weight, chest circumference, biacromial diameter, head length and head breadth by sex and age-interval among the Bengali infants (No. of sample: Male 107 and Female 93)

Age (in month)	Total length (mm) (1)		Weight (g) (2)		Chest circumference (mm) (3)	
	M	F	M	F	M	F
0	491.24	484.78	2909.33	2822.53	310.57	306.96
1	530.22	525.24	3572.90	3457.53	338.75	334.67
3	597.07	591.29	5064.02	4908.06	396.33	391.81
6	645.68	637.81	6305.14	6106.45	426.72	423.67
9	677.08	668.98	7142.99	6916.13	450.33	445.15
12	701.42	693.54	7999.06	7696.23	467.28	458.43

Age (in month)	Biacromial diameter (mm) (4)		Head length (mm) (5)		Head breadth (mm) (6)	
	M	F	M	F	M	F
0	94.88	95.38	113.99	111.86	88.99	87.57
1	109.60	108.89	121.15	119.10	96.41	94.69
3	125.51	123.24	130.37	129.12	108.49	107.28
6	137.72	136.08	139.21	137.76	115.60	114.46
9	145.67	144.05	143.71	142.85	119.80	118.95
12	152.22	149.81	147.39	146.53	124.00	123.09

Table 5

Mean weight (W), length (L) and chest (C) of *boys* from birth to one year of age in some selected developing and developed countries

Country	People or place	Ref. Year	Measure-ment*	AGE					
				0 (Birth)	1 months	3 months	6 months	9 months	12 months
India	Calcutta	1971—72	Weight	2.09	3.57	5.06	6.30	7.14	7.99
			Length	49.1	53.0	59.7	64.5	67.7	70.1
	(all income levels)		Chest	31.0	33.8	39.6	42.6	45.0	46.7
	Calcutta (well-off)	1971—72	W	2.98	3.72	5.36	6.75	7.81	8.89
			L	49.5	53.6	60.9	66.3	70.0	72.4
			C	31.4	34.6	40.4	43.6	46.5	48.5
	Calcutta (poor)	1971—72	W	2.81	3.55	4.61	5.71	6.34	6.98
			L	48.8	52.3	58.1	62.5	64.9	67.4
			C	30.4	32.9	38.1	41.2	43.2	44.7
	Delhi (well-off)	?	W	3.03	—	5.35	7.16	8.98	10.0
			L	50.0		60.2	66.0	70.8	74.1
	Delhi (poor)		W	2.80	—	4.83	6.20	8.02	8.52
			L	49.0	—	58.7	64.6	69.3	72.7
Jordan	(various)	1964	W	—	3.50	5.52	6.46	7.34	7.93
			L	—	50.5	60.8	64.7	68.3	70.7
Tunisia	Tunis (well-off)	1973	W	—	—	6.10	7.67	8.70	9.64
			L	—	—	59.2	65.6	70.0	72.6
	Tunis (poor)	?	W	—	—	5.83	7.38	8.20	8.97
			L	—	—	58.5	64.2	68.4	71.4
Japan	Tokyo	1965—66	W	—	4.22	6.25	7.94	8.86	9.43
			L	—	53.9	61.0	67.5	71.6	74.8
			C	—	36.5	41.9	44.6	46.1	47.0
Thailand	Bangkok	?	W	3.12	4.65	6.34	7.74	8.62	9.1
			L	—	56.1	62.0	67.8	71.9	73.5
			C	32.0	37.9	41.0	43.4	44.7	45.8
Taiwan	Taipei	1965	W	3.21	5.04	6.42	7.74	8.51	9.03
			L	—	57.2	63.1	68.4	72.0	75.0
			C	—	39.3	41.4	43.6	45.1	46.2
Poland	Lublin	1968	W	3.48	4.02	5.97	8.03	9.35	10.39
			L	50.8	54.3	61.4	68.0	72.6	76.5
			C	33.2	36.0	40.6	44.6	47.4	48.6
North-Germany	urban	1968	L	51.2	53.0	61.4	67.2	72.8	76.3
			C	31.6	32.8	38.7	42.9	43.9	46.4
London	urban	?	W	3.44	4.06	5.88	7.90	9.19	10.03
			L	—	53.9	60.0	66.6	71.2	74.9
Sofia	urban	1965	W	3.39	4.68	6.51	8.44	9.56	10.53
			L	51.4	56.1	63.0	69.2	73.3	77.2
			C	33.8	37.9	41.7	44.9	47.3	84.4
Paris	urban	1964	W	—	3.94	5.80	7.93	8.88	9.88
			L	50.0	53.2	59.8	66.5	70.7	74.5
			C	—	34.7	39.2	42.9	45.4	47.2

* W (Weight in kg); L (Length in cm); C (Chest Circumference in cm).
Source: Eveleth, P. B.—Tanner, J. M. (1976): *Worldwide Variation in Human Growth*, pp. 288—89, 372—73, and 398—99.

Table 6

Mean weight (W), length (L), and chest (C) of *girls* from birth to one year age in some selected developing and developed countries

Country	People	Ref. Year	Measure-ment*	AGE					
				0 (Birth)	1 months	3 months	6 months	9 months	12 months
India	Calcutta	1971–72	Weight	2.08	3.46	4.91	6.11	6.92	7.70
			Length	48.5	52.5	59.1	63.7	66.9	69.3
	(all income level)		Chest	30.6	33.5	39.2	42.4	44.5	45.8
	Calcutta	1971–72	W	2.95	3.61	5.11	6.47	7.37	8.25
	(well-off)		L	49.3	53.4	59.9	65.3	68.6	71.1
			C	31.1	34.1	39.6	43.3	45.7	47.2
	Calcutta	1971–72	W	2.76	3.33	4.55	5.50	6.02	6.59
	(poor)		L	47.4	51.5	57.6	61.5	63.4	65.9
			C	30.4	33.4	38.2	40.0	41.9	42.7
	Delhi	?	W	3.10	—	5.15	7.05	8.34	9.45
	(Well-off)		L	50.0	—	59.1	64.9	70.1	73.1
	Delhi	?	W	2.75	—	4.58	6.04	7.07	8.12
	(poor)		L	48.1	—	57.8	62.9	68.0	71.3
	Jordan	1964	W	—	3.77	4.70	5.49	6.98	7.31
	(various)		L	—	50.9	58.3	62.1	66.4	70.0
Tunisia	Tunis	1973							
	(well-off)		W	—	—	5.50	6.93	8.00	9.02
			L	—	—	57.9	63.2	67.0	71.7
	Tunis (poor)	?	W	—	—	5.55	6.76	7.48	7.92
			L	—	—	57.6	61.4	65.2	68.1
Japan	Tokyo	1965–66	W	—	3.80	5.60	7.13	7.97	8.46
			L	—	52.3	58.9	65.2	69.1	72.7
			C	—	35.2	40.0	42.6	44.2	45.3
Thailand	Bangkok	?	W	3.10	4.46	5.61	7.33	7.97	8.50
			L	—	55.0	60.3	65.9	69.6	72.2
			C	31.9	37.5	40.1	42.7	43.5	44.1
Taiwan	Taipei	1966	W	3.10	4.94	6.01	7.31	7.99	8.42
			L	—	55.8	61.4	66.8	70.2	73.3
			C	—	37.4	40.5	42.6	43.9	45.1
Poland	Lublin	1968	W	3.36	3.77	5.42	6.96	8.65	9.54
			L	—	53.4	59.7	66.1	70.4	74.3
		*	C	32.8	35.3	39.3	43.3	45.9	47.1
North-Germany	urban	1968							
			L	51.2	53.0	61.4	67.2	72.8	76.3
			C	31.3	32.8	38.7	42.9	43.9	46.4
London	urban	?	W	3.44	4.06	5.88	7.90	9.19	10.03
			L	—	53.9	60.0	66.6	71.2	74.9
Sofia	urban	1965	W	3.39	4.68	6.51	8.44	9.56	10.53
			L	51.4	56.1	63.0	69.2	73.3	77.2
		*	C	33.8	37.9	41.7	44.9	47.3	48.4
Paris	urban	1964	W	—	3.94	5.80	7.93	8.88	9.88
			L	50.0	53.2	59.8	66.5	70.7	74.5
			C	—	34.7	39.2	42.9	45.4	47.2

* W (Weight in kg); L (Length in cm); C (Chest circumference in cm).

Source: Eveleth, P. B. – Tanner, J. M. (1976): *Worldwide Variation in Human Growth*, pp. 288–89, 372–73 and 398–99.

nutritional groups and two stages of weaning-time are also present. That differential feeding habits do effect physical growth of the Bengali infants in question is quite evident from the results obtained in the present study. It is pointed out here that the difference in growth as found with respect to weight and height of the Bengali infants can also be detected in the remaining four physical characters (Table 4).

It is significant to note that mean weight, mean length and mean chest girth from birth to first twelve months as obtained for the Calcutta infants (boys and girls) are definitely lower than their counterparts in European countries and/or cities like Poland, London, Paris, Sofia, North Germany. But the infants of the well-off families of Calcutta comes somewhat nearer to the European infants. In comparison to the well-off infants of Delhi their counterparts of Calcutta yield lower mean weight, length and chest circumference, at birth and also at other age intervals. It means that the Calcutta infants maintain, irrespective of breast feeding, subsequent rich or poor nutrient intake, and socioeconomic level, smaller body size by world standard (Tables 5 and 6).

As indices of nutrition and general well-being the present observations on growth of the Bengali infants of both sexes appear to indicate strongly that the babies belonging primarily to the fourth and the third nutritional groups (identified on the basis of two criteria, namely, (1) prolonged breast-feeding and (2) high starch-low protein foods after weaning) are relatively undernourished than their counterparts of other two nutritional groups to bear impairment of growth. It is admitted that many other causes may also contribute to produce the same effect. Now, the impairment of growth resulting from malnutrition, it has already been pointed out, appears to be more or less uniform throughout the body (MARSHALL 1976) and in this direction it is not unexpected to find that with respect to all the six characters the infants of the fourth and the third nutritional groups particularly have yielded relatively lower mean values at each age interval than the babies of the first and the second nutritional groups. During the first postnatal year, variations in feeding habits and weaning diets are thought to have played a vital role in bringing about these differences. Dietary factors, especially the low protein intake, are of obvious importance in the relatively slower growth pattern in the infants of the mothers concerned. This is especially true for the babies of those mothers who belonged to poor socioeconomic class (level I). This phenomenon has its parallel in human society at large (TANNER 1962, MALCOLM 1970). Therefore, it makes no unique disclosure; rather it only confirms that differential environmental factors like bad/good home conditions, poor/well-off socioeconomic level of the mothers, low/high strach, low/high protein foods after weaning (deficient/rich nutritional condition) are important determinants of growth in the Bengali infants.

The merits of the findings on growth pattern of the Bengali infants in their first year life have to be appreciated with a little caution. We have not considered for the present time the differences associated with infant's parity which is known to be an important source of variation in birth weight and subsequent weight gain, hence, no adjustments for size of parents have been made. But further analysis is in progress to accommodate these "refinements" (DAVID HEWITT—STEWART 1952, SELVIN—GARFINKEL 1972, MCCANCE 1976).

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Author's address:

DR. KANTI PAKRASI
Anthropometry and Human Genetics Unit,
Indian Statistical Institute
203 Barrackpore Trunck Road
Calcutta — 700035
India