

GROWTH OF EXCLUSIVELY BREASTFED INFANTS

Arun Pathak
Nita Shah
Anil Tataria

ABSTRACT

The weights and lengths of 120 boys and 81 girls were followed from birth to 12 months at Shree Maharani Shantadevi Hospital (SMSH), Baroda. The sample was selected by the following criteria: (i) birth weight 2.5 kg or more, (ii) no serious defect or serious/chronic illness, (iii) upper and middle socio-economic level, (iv) normal motor-mental development, (v) regular follow-up every month (by appointment within two days of birth date) for at least nine months, (vi) exclusive breastfeeding for at least four months.

Mean and SDs and percentile values of weight, length and weight for length were computed separately for boys and girls. These were compared with those of National Centre for Health Statistics (NCHS) and of the Davis Area Research on Lactation, Infant Nutrition and Growth (DARLING) study in the USA. The breastfed babies were observed to be leaner by the currently accepted "standards" which have been established mostly on formula-fed babies. The growth pattern of the breastfed babies cannot be interpreted as 'faltering' since their motor-mental development was normal and they were thriving well. The study focusses attention on the need to have new growth charts on the basis of exclusively breastfed children.

Key words: Breastfeeding, Growth Charts.

Breastfeeding was included in the basic low-cost strategies for child survival by the UNICEF in 1985(1). During the year 1986, the SMS Hospital (SMSH) at Baroda adopted the policy of promoting exclusive breastfeeding for at least four months. In the follow-up clinic, it was observed that the weights of the children when plotted on the standard reference curves recommended by the Indian Academy of Pediatrics (IAP)(2) appeared to deviate downwards. The lengths, however, appeared to go parallel to the Harvard curves(3). A detailed study of the growth of weight and length of exclusively breastfed babies was, therefore, undertaken.

Material and Methods

The Sample

The SMSH offers routine health care service to infants and children born in that hospital. The first-month check is free but thereafter only those who enroll (at a subsidized rate) at the child health clinic (CHC) are seen by appointment every month in the first year and at 3 monthly intervals thereafter. The appointments are given within two days of the birth date. Many, however, drop out after 6-7 months after immunization with BCG, DPT and OPV is over and after weaning has started.

At birth and at each visit at the CHC, the weight, the length and the head circumference of the child are measured and the motor-mental development screened. These are recorded in the hospital register and plotted on the parent-carried booklet. Apart

*From the Shree Maharani Shantadevi Hospital,
Jawaharlal Nehru Marg, Baroda 390 001.*

*Reprint requests: Dr. Arun Phatak, 102, Ambica
Apartments, Shankar Tekri, Dandia Bazar,
Baroda 390 001.*

*Received for publication: March 18, 1993;
Accepted: July 26, 1993*

form catering to their felt-needs, the parents are given routine age appropriate advice such as: (i) no pre-lacteal feeds and bedding/rooming-in; (ii) exclusive breastfeeding for at least four months; (iii) iron supplements started in the fourth month; (iv) other foods and milk started in fifth or sixth month (no tinned products); (v) immunization schedule; and (vi) traditional practices harmful to the child.

The present study is based on longitudinal observations on infants attending the CHC for 9-12 months during the period 1988-90.

The sample was selected by the following criteria: (i) Birth weight 2.5 kg. or more; (ii) No serious congenital defect or serious/chronic illness; (iii) Upper and middle socio-economic level I-II-III on Kuppuswami scale(4); (iv) Normal motor-mental development on Baroda Development Screening Test(5); (v) Exclusive breastfeeding for at least four months; and (vi) Regular attendance at the CHC for at least nine months.

After the age of nine months there was gradually increasing dropout from the selected sample. Whereas there were 120 boys and 81 girls at each month from birth to nine months, at 10, 11 and 12 months, there were, respectively 105, 84 and 50 boys and 68, 58 and 37 girls.

Data Collection

All the infants in the sample were seen by the same pediatrician (AP) who carried out clinical examination including development screening, plotting the growth and development curves and counselling. The measurements were taken by the same assistant (dietician - NS) who also maintained the records-register. The weight was measured on a beam scale accurate to 20 g. The length was measured on an infantometer table accurate to 1 mm.

Data Analysis

The longitudinal data was treated cross-sectionally and standard statistical methods were employed for computing the age-wise means and standard deviations of the weight, length and weight for length separately for boys and girls. The means and standard deviations were used for computing the percentile values(6).

Results

The percentiles and SDs of weight, length and weight for length are given in *Tables I, II & III*, respectively. The 50th centile values for the three measures as reported by the SMSH, NCHS(7) and DARLING(8) studies for selected ages are compiled for comparison in *Table IV-A, B and C*. *Figures. 1, 2 & 3* show the growth curves of the 50th centile values of weight, length and weight for length against the 95, 50 and 5 centile curves of NCHS(7) and of the breastfed group of the DARLING study(8). It is observed that the weight curves of the SMSH and of the breastfed DARLING babies are parallel to each other. Both, however, when compared with the NCHS weight curve appear to slow down after going parallel for the first four or five months (*Fig. 1*). The growth curves of length of the breastfed babies (SMSH and DARLING) were parallel to each other and also to the NCHS curves although the length of SMSH babies appeared to grow parallel to the 5th centile curve of NCHS. The weight for length of the SMSH infants corresponds to the NCHS curves for the first four or five months (length of 64 cm). Then the SMSH curve deviates downwards (*Fig. 3*). It may be observed that there are very few observations for the weight for boys 44-46 cm in length and for girls 76-78 cm in length (4 and 7, respectively). They, therefore, should be interpreted with caution.

TABLE I—Percentile Weight (g)* by Age (mo)

Age (mo)	Percentiles							SD
	3rd	10th	25th	50th	75th	90th	97th	
Boys								
0	2362	2584	2808	3058	3308	3532	3754	370
1	3011	3288	3569	3882	4194	4476	4753	463
2	3729	4101	4478	4897	5316	5693	6065	621
3	4368	4796	5229	5711	6193	6626	7054	714
4	4908	5364	5825	6338	6851	7312	7768	760
5	5314	5818	6328	6896	7464	7974	8478	841
6	5660	6192	6731	7330	7929	8468	9000	888
7	5973	6519	7074	7690	8306	8860	9407	913
8	6199	6774	7356	8003	8650	9232	9807	959
9	6540	7094	7656	8280	8904	9466	10020	925
10	6781	7334	7895	8519	9143	9704	10257	924
11	6857	7464	8080	8764	9448	10064	10671	1014
12	7054	7707	8370	9106	9842	10505	11158	1091
Girls								
0	2270	2497	2727	2983	3239	3469	3696	379
1	3040	3286	3536	3813	4090	4340	4586	411
2	3754	4031	4312	4625	4938	5219	5496	463
3	4229	4584	4945	5346	5747	6107	6463	594
4	4639	5045	5456	5914	6372	6783	7189	678
5	5090	5510	5936	6410	6884	7310	7730	702
6	5479	5915	6358	6850	7342	7785	8221	729
7	5654	6145	6642	7195	7748	8249	8736	819
8	5899	6410	6927	7502	8077	8594	9105	852
9	6118	6646	7180	7775	8370	8904	9432	881
10	6454	6985	7523	8122	8721	9259	9790	887
11	6681	7226	7779	8393	9007	9560	10105	910
12	6817	7433	8057	8751	9445	10069	10685	1028

(* Rounded to one gram).

The results of our study substantiate the initial impression that the pattern of weight gain by breastfed infants differs from the currently accepted standards.

Discussion

Unlike the DARLING study which had a well-matched control group of formula-fed babies (24-39 at each month in the two

TABLE II—Percentile Length (cm)* by Age (mo)

Age (mo)	Percentiles							SD
	3rd	10th	25th	50th	75th	90th	97th	
Boys								
0	46.1	47.3	48.5	49.9	51.2	52.4	53.6	1.99
1	49.9	51.0	52.2	53.5	54.7	55.9	57.0	1.89
2	53.2	54.4	55.7	57.0	58.4	59.7	60.9	2.05
3	56.0	57.3	58.6	60.0	61.5	62.7	64.0	2.12
4	58.9	60.0	61.2	62.5	63.9	65.0	66.2	1.95
5	60.8	62.0	63.1	64.4	65.7	66.9	68.0	1.90
6	62.1	63.3	64.6	66.0	67.4	68.6	69.8	2.06
7	63.7	64.9	66.2	67.6	68.9	70.2	71.4	2.06
8	64.6	66.0	67.5	69.0	70.6	72.0	73.4	2.34
9	65.6	67.1	68.7	70.4	72.1	73.6	75.1	2.53
10	66.9	68.4	69.9	71.5	73.2	74.7	75.2	2.49
11	68.0	69.5	71.0	72.7	74.3	75.8	77.3	2.48
12	69.5	71.0	72.5	74.2	75.8	77.4	78.9	2.49
Girls								
0	46.0	47.2	48.3	49.5	50.8	51.9	53.0	1.84
1	49.8	50.8	51.9	53.1	54.2	55.3	56.4	1.75
2	52.8	54.8	55.1	56.4	57.7	58.8	60.0	1.90
3	55.7	56.8	57.9	59.2	60.5	61.6	62.7	1.87
4	57.8	59.0	60.2	61.5	62.8	64.0	65.1	1.94
5	59.5	60.7	62.0	63.4	64.8	66.1	67.4	2.09
6	60.9	62.2	63.5	65.0	66.5	67.9	69.2	2.22
7	62.2	63.5	64.9	66.4	67.9	69.3	70.6	2.24
8	63.0	64.6	66.1	67.8	69.5	71.0	72.5	2.50
9	64.9	66.2	67.6	69.2	70.7	72.1	73.5	2.30
10	66.6	68.1	69.5	71.1	72.8	74.2	75.7	2.40
11	67.3	68.8	70.3	72.0	73.7	75.2	76.7	2.48
12	68.9	70.3	71.7	73.2	74.8	76.2	77.5	2.30

(* Rounded to one decimal point).

groups), the mothers at SMSH were not given any choice. They were all advised, encouraged and helped to breastfeed their babies. A total of 98% of the mothers were

exclusively breastfeeding their babies at the time of discharge and 95% of those who attended the first month check (about 60% mothers reported at one month). The idea

TABLE III—Percentiles of Weight (g)/Length (cm)

Number of observations	Length (cm)	Weight percentiles							SD
		3rd	10th	25th	50th	75th	90th	97th	
Boys									
4	44-46	2217	2347	2479	2625	2772	2903	3033	217
29	46-48	2313	2493	2676	2879	3082	3265	3445	301
74	48-50	2388	2885	2784	3005	3226	3426	3622	328
97	50-52	2476	2724	2974	3253	3532	3782	4030	413
103	52-54	2959	3226	3497	3798	4099	4370	4640	446
116	54-56	3285	3595	3909	4259	4609	4923	5233	518
110	56-58	3893	4222	4555	4926	5297	5630	5959	549
135	58-60	4377	4714	5056	5436	5816	6158	6495	563
152	60-62	4815	5184	5558	5974	6390	6764	7133	616
195	62-64	5352	5752	6108	6531	6954	7335	7710	627
228	64-66	5823	6213	6607	7046	7485	7879	8269	650
236	66-68	6262	6679	7101	7571	8041	8463	8880	696
228	68-70	6736	7161	7592	8071	8550	8981	9407	710
204	70-72	7028	7465	7908	8401	8894	9337	9774	730
142	72-74	7548	7984	8427	8919	9411	9854	10290	729
68	74-76	8042	8551	9067	9641	10215	10731	11240	850
27	76-78	8170	8719	9275	9893	10511	11067	11615	916
Girls									
23	46-48	2333	2458	2585	2726	2867	2994	3119	209
55	48-50	2333	2540	2749	2982	3215	3424	3631	345
67	50-52	2657	2887	3121	3381	3641	3875	4105	385
76	52-54	2964	3235	3509	3814	4119	4393	4664	452
84	54-56	3466	3735	4008	4312	4616	4889	5158	450
82	56-58	3813	4128	4448	4804	5160	5480	5795	527
97	58-60	4360	4694	5032	5408	5784	6122	6456	557
114	60-62	4751	5113	5479	5887	6295	6661	7023	604
148	62-64	5247	5644	5989	6372	6755	7100	7497	568
148	64-66	5600	5985	6375	6809	7243	7633	8018	643
154	66-68	6070	6479	6894	7355	7816	8321	8640	683
148	68-70	6402	6830	7264	7747	8230	8664	9092	715
115	70-72	6816	7261	7713	8215	8717	9169	9414	744
80	72-74	7288	7724	8167	8659	9151	9594	10030	729
29	74-76	7418	7963	8514	9128	9742	10293	10838	909
07	76-78	9357	9562	9769	10000	10231	10438	10643	342

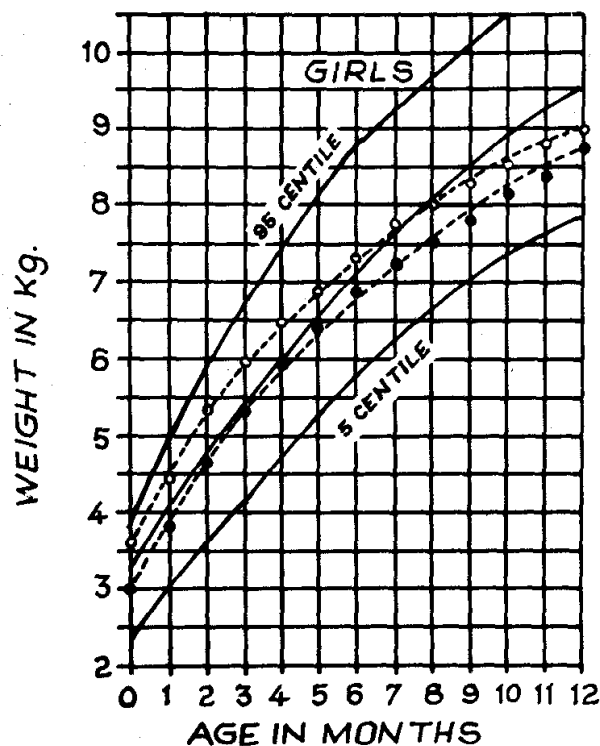
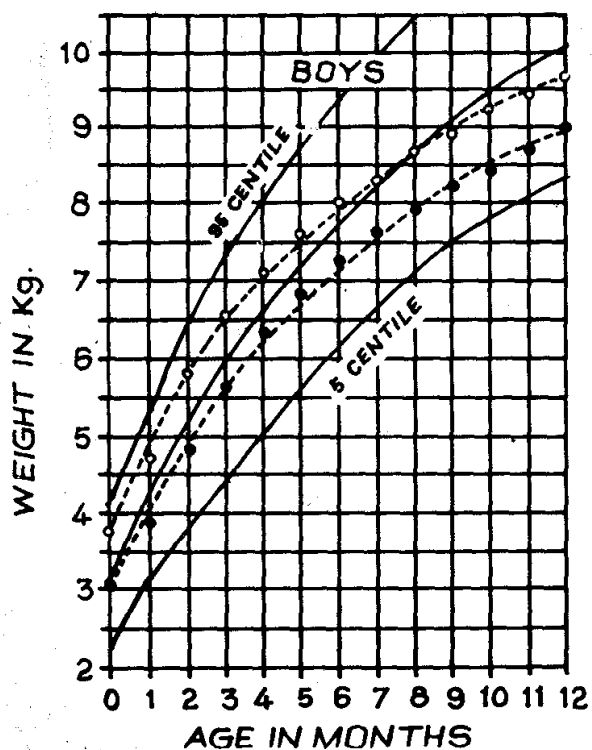


Fig. 1. Weight for Age

— NCHS (95, 50 and 5 centile); 0.....0 DARLING study - Breastfed Group - 50th centile
 •.....• SSMH study - 50th centile •

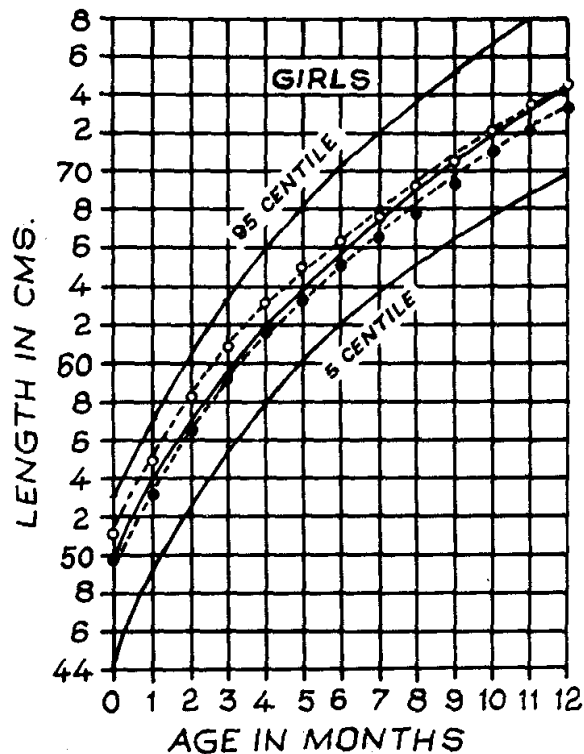
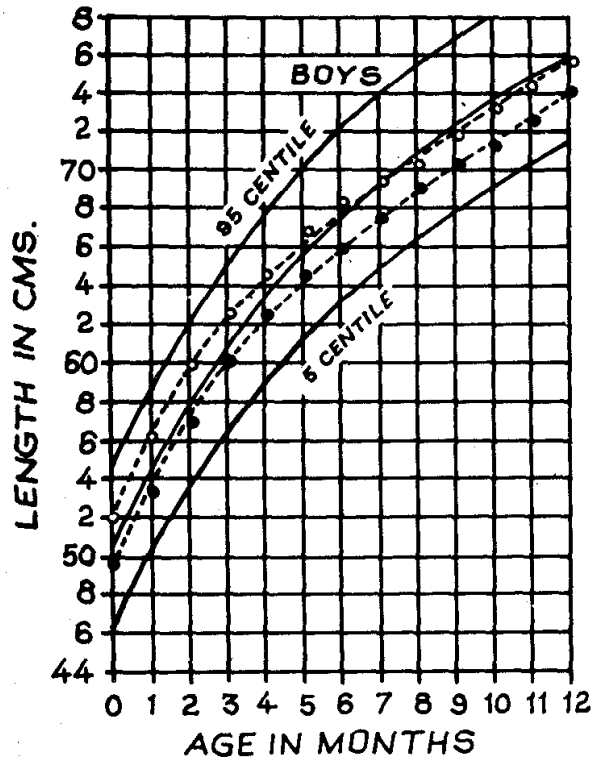


Fig. 2. Length for Age

— NCHS (95, 50 and 5 centile); 0.....0 DARLING study - Breastfed Group - 50th centile;
 •.....• SSMH study - 50th centile

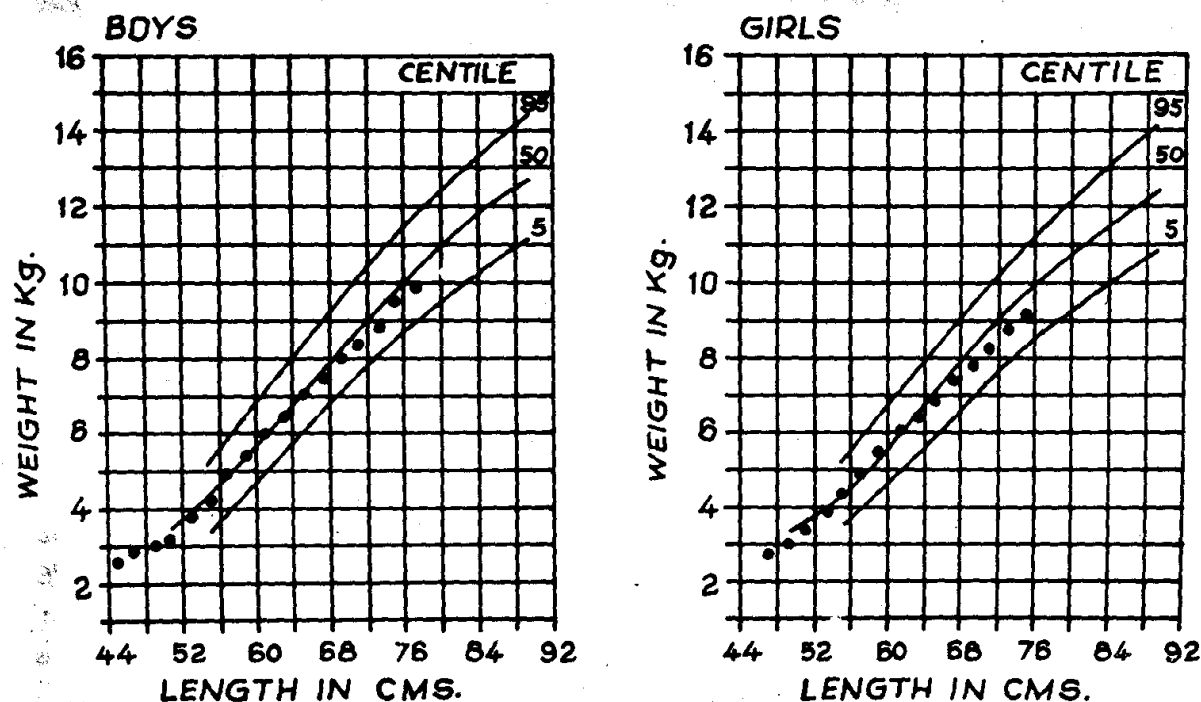


Fig. 3. Weight for Length

— NCHS (95, 50 and 5 centile); ••• SSMH study - 50th centile

of having a control group of babies fed on formula since birth was, in our situation, considered unethical. Instead, a comparison with the currently used 'standards' were considered proper.

The WHO(9) recommended the NCHS standards as best suited for international reference. The IAP(2) accepted the 50th centile of Harvard standard as the reference weight. There is very little difference between the two. Jelliffe(10) has opined that figures obtained from Europe and North America are too high, reflecting a too generous calorie supply. It has been shown that after the age of six months (when 'other foods' comprise an increasingly large proportion of the total intake), the energy intake of breastfed babies is low even when the quality and quantity of food offered is similar(11). The energy intakes of the breastfed infants are notably less than the

currently recommended dietary allowances which are based on voluntary intakes of formula-fed infants(12). Since the growth performance of the breastfed children was good, the relatively less calorie intake is interpreted as due to efficient energy utilization. It is also possible that artificially fed children get into the habit of 'over-eating' and a reconsideration of the dietary recommendations is necessary(13).

The formula-fed babies in the DARLING study followed the NCHS curves while the breastfed babies had a pattern similar to that observed in the SSMH study, although the curve of the former was at a higher level. This is probably a reflection of the shorter length of children in Baroda compared to those in USA. This is obvious even at birth and the mean adult height of University boys and girls above the age of 18 years is reported to be 166.01 cm and 153.67 cm,

TABLE IV—Comparison of the 50th Centile Values of Weight, Length and Weight for Length Reported by SMSH, NCHS and DARLING Studies

Age (mo)	Boys				Girls			
	SMSH	NCHS	DARLING		SMSH	NCHS	DARLING	
			Breast-fed	Formula fed			Breast-fed	Formula fed

TABLE IV-A—Weight in Grams

0	3058	3270	3800	3556	2983	3230	3584	3571
1	3882	4290	4754	4616	3813	3980	4434	4402
3	5711	5980	6605	6499	5346	5400	5941	5952
6	7330	7850	8095	8292	6850	7210	7303	7676
9	8280	9180	8990	9420	7775	8560	8277	8791
12	9106	10150	9745	10269	8751	9530	8946	9679

TABLE IV-B—Length in cm

0	49.9	50.5	51.9	51.3	49.5	49.9	50.8	50.3
1	53.5	54.6	56.2	55.6	53.1	53.5	54.9	54.9
3	60.6	61.1	62.6	62.2	59.2	59.5	60.9	61.1
6	66.0	67.8	68.3	68.4	65.0	65.9	66.2	66.9
9	70.4	72.3	71.9	72.9	69.2	70.4	70.3	70.9
12	72.4	76.1	75.8	76.8	73.2	74.3	74.5	74.6

respectively (personal communication from Demography Department, M.S. University of Baroda).

The babies of the SMSH study as well as the breastfed babies of the DARLING study were healthy, thriving and with normal motor-mental development. To interpret their deviation from the current "standards" as 'faltering' is not only wrong, but dangerous. Even a suggestion of faltering is likely to shake the confidence of the mother in her ability to breastfeed her baby and may encourage forced feeding with other milk and food—usually the much advertised tinned

products. It is important to realize this and to remember it while plotting the baby's weight on the 'standard' curves. Indeed for the last two years, we have been informing the parents that after the age of four or five months the baby's weight may not follow the printed curves and have at times drawn a free hand expected curve.

The WHO/UNICEF Joint Statement on Protection, Promotion and Support of Breastfeeding(14) and the Baby Friendly Hospital Initiative(15) will certainly bring a change in the current maternity home practice. The pediatricians will be seeing

TABLE IV-C—Weight for Length

Length (cm)	Weight in grams			
	Boys		Girls	
	SMSH	NCHS	SMSH	NCHS
48-50	3005	3150	2982	3290
50-52	3253	3480	3381	3550
52-54	3798	3880	3814	3890
54-56	4259	4340	4312	4290
56-58	4926	4840	4804	4760
58-60	5436	5380	5408	5270
60-62	5974	5940	5887	5820
62-64	6531	6520	6372	6390
64-66	7046	7110	6809	6970
66-68	7571	7700	7355	7550
68-70	8071	8270	7747	8110
70-72	8401	8820	8215	8640
72-74	8919	9333	8659	9140
74-76	9641	9810	9128	9590
76-78	9893	10270	10000	10020

increasingly more number of exclusively breastfed infants. Since the pattern of weight gain is similar in the exclusively breastfed babies in Baroda (India) and Davis Area (USA), one may expect breastfed infants all over the world to have a similar pattern. Healthy breastfed infants from different developed countries in which adequate supplemental foods are available have shown similar weight gain over a period of thirty years. The stability of growth favours the hypothesis that this growth could constitute a standard for the evaluation of normal growth(13). The need to establish new growth charts based on breastfed babies is obvious. Multicentric national/international studies on the growth of breastfed babies should be undertaken to study the growth of breastfed babies.

Acknowledgement

The authors thank Dr. Dushyant Joshi, Superintendent, SMSH for permission to publish the data.

REFERENCES

1. UNICEF. The State of World's Children, 1985, New York, Oxford University Press, 1985.
2. Nutrition Sub-committee of Indian Academy of Pediatrics (1971-72): Report. Indian Pediatr, 1972, 15: 77-90.
3. Vaughan VC. Growth and development. In: Nelson Textbook of Pediatrics, 10th edn. Eds Vaughan VC, McKay RJ, Nelson WE. Philadelphia, WB Saunders Co., 1975, 40.

4. Kuppuswami B. Manual of Socio-Economic Status Scale, Revision New Delhi, Manasayan, 1962.
5. Phatak A, Khurana B, Baroda development screening test for infants. *Indian Pediatr* 1991, 28: 31-37.
6. Tanner JM, Whitehouse RN, Takaishi M. Standards from birth to maturity for height, weight, height velocity and weight velocity. British children 1965 Part I. *Arch Dis Child* 1966, 41: 454-471.
7. Vaughan VC, Litt IF. Growth and Development. In: Nelson Textbook of Pediatrics, 14th edn. Eds Behrman RE, Klieg RM, Nelson WE, Vaughan VC. Philadelphia, W.B. Saunders Co, 1992, p 22-25.
8. Dewey KG, Heinig MJ, Nommsen LA, Pearson JM, Lonnerdal B. Growth of breastfed and formula fed infants from 0-18 months: The DARLING study. *Pediatrics* 1992, 89: 1035-1041.
9. WHO Reference Data for the Weight and Height of Children. Nu 780. WHO, Geneva, 1978.
10. Jelliffe DB. The Assessment of the Nutritional Status of the Community. WHO Monograph Series, No 53. Geneva, WHO, 1966, p 66.
11. Dewey KG, Heinig MJ, Nommsen LA, Lonnerdal B. Adequacy of energy intake among breastfed infants of the DARLING study: Relationships to growth velocity, morbidity and activity levels. *J Pediatr* 1991, 119: 538-547.
12. Butte NF, Garza C, Smith EO, Nichols BL. Human milk intake and growth of exclusively breastfed infants. *J Pediatr* 1984, 104: 187-195.
13. Axelsson IEM, Raiha NCR. Protein and energy during weaning. In: *Advances in Pediatrics*, Vol 39. Chicago, Year Book Medical Publishers Inc. 1992, pp 405-440.
14. WHO/UNICEF. Protecting, Promoting and Supporting Breastfeeding: The Special Role of Maternity Services. Geneva, WHO, 1989, p IV.
15. UNICEF. The State of World's Children, 1992. New York, Oxford University Press, 1992, p 44.

NOTES AND NEWS

XXI ANNUAL STATE CONFERENCE OF IAP, WEST BENGAL BRANCH

The XXI Annual State Conference of IAP West Bengal Branch will be held on 16th January, 1994.

For further enquiries, please contact:

Dr. Tapan Kumar Ghosh,
Hony. Secretary, IAP West Bengal Branch,
IMA House,
53, Creek Row (2nd Floor),
Calcutta 700 014.