Gadjah Mada Journal of the Medical Sciences
Vol. VII, No. 1, March 1975

CORRELATION BETWEEN NUTRITIONAL STATUS OF LACTATING MOTHERS WITH THE COMPOSITION OF BREAST MILK AND THE GROWTH OF BABIES IN SELECTED SAMPLES[1)]

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It has been widely accepted that in areas with widespread undernutrition and malnutrition the growth and development of breast-fed infants are satisfactory in the first 3–4 months of age (W.H.O., 1965). Mothers in the low socio-economic group have the ability for secreting breast milk with normal protein concentration.

Shanti Gosh *et al.* (1971) showed that the growth rates of Delhi areas infants in the first 3–4 months compared well with the growth rates of those regarded as satisfactory. It was shown that the mean body weight at birth (2.87 kg $\pm$ 0.460) was doubled at the fourth month of life (5.85 kg $\pm$ 0.861).

Gopalan and Narasinga Rao (1971) pointed out the following facts:

1. From Gopalan's twenty-two-week longitudinal study (1956) on 14 infants of mothers belonging to the low socio-economic group, it was obvious that the growth performance of these infants were poor compared with the growth performance of infants studied by Fomon and May (1958). Those infants studied by Gopalan received about 2.0 g protein/kg body weight/day in the first week, and about 1.1 g protein/kg body weight/day in the 22nd week, whereas in Fomon and May studies, the infants received about 2.6 g protein/kg body weight/day in the first week, and 1.7 g protein/kg body weight/day at the end of 6 months.
2. Cross sectional studies by Someswara Rao *et al.* (1959) showed that the breast milk output among mothers in poor South Indian communities were lower than the breast milk required to meet the protein and calories needs of infants as recommended by F.A.O./W.H.O. Expert Group on Protein Requirements (1965).
3. Gopalan's study (1958) on the output of breast milk showed values that were even lower than those studies from Someswara Rao *et al.* (1959)

It is clear from the above studies, that mothers from poor areas can give relatively good infant growth up to 3–4 months when based on their infants birth weight. But compared with the infant growth on suggested protein and calories needs, poor growth performance is evident.

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1)Dibacakan pada: S.E.A. Addresses Its Health Problems, Current Research and Educational Activities, Bangkok, Thailand, October 28 – November 1, 1974.

Concerning breast milk and protein output, mothers in poor areas secrete less total milk and protein than mothers in well communities, although the concentration of protein in both milk are the same.

Our study was undertaken to establish the correlation between the nutritional status of mothers in selected samples, with the concentration of protein, fat and carbohydrate in their breast milk, and the growth or body weight of their babies.

Mothers with their babies attending the Child Health Clinics of the Department of Pediatrics Gadjah Mada University, Faculty of Medicine, Yogyakarta, Indonesia, were taken as samples. They were coming from various socio-economic classes, but it was difficult to discriminate them in low or high socio-economic group. Therefore we grouped them based on their body weight, expressed as the percentage of expected values. The standard used as reference was: General anthropometric standards of reference, Weight for Height, Adult Females (Jelliffe, 1966). These mothers differed in age and parity and also their children were of different age groups.

Eighty eight lactating mothers who were apparently normal, age from 19–42 years, parity up to 1–9, and 17 days up to 5 months after deliveries were examined anthropometrically.

The parity and age distributions of the mothers are presented in Table 1. More than 50% of the samples were in the parity of one and two, and their age were between 19 and 29 years.

TABLE 1. – Parity and age distribution of lactating mothers examined

Parity	Number	Age (Years)	Number
1	22	19 – 23	18
2	33	24 – 28	44
3	11	29 – 33	16
4	8	34 – 38	9
5	10	39 – 42	1
6 – 9	4		
Total	88	Total	88

After massage of the breast, in order to mix the breast content, breast milk was taken using a breast pump. The milk was directly pipetted out into separate flasks for the determination of protein, fat and carbohydrate.

Protein was determined by the Kjeldahl method, and the amount of protein was obtained by multiplying the total nitrogen content with 6.38.

Fat content was determined according to Gerber.

Carbohydrate content was determined according to the method of Benedict after the milk was deproteinized with phosphotungstic acid solution.

Anthropometric measurements of the mothers are presented in Table 2.

TABLE 2. – Anthropometric measurements (mean ± 1 SD) of mothers based on their weight[1])

Range	Number of Samples	Body Weight	Arm Circumference	Triceps Skinfold	Muscle Circumference
≤ 79	8	76.7 ± 3.69	71.0 ± 3.38	48.2 ± 9.19	76.5 ± 4.02
80 — 89	29	85.4 ± 3.09	78.7 ± 5.82	68.7 ± 14.83	81.4 ± 3.35
90 — 99	30	94.5 ± 4.26	83.4 ± 4.64	86.9 ± 18.10	82.6 ± 5.05
> 100	21	109.3 ± 10.01	92.8 ± 9.10	111.4 ± 30.70	88.8 ± 7.11

1) Values expressed as percentage of the expected values (Jelliffe, 1966).

All measurements here are expressed as percentage of the expected values, and grouped according to their body weights. We can see that, higher mean body weights agree with higher mean of other anthropometric measurements.

The differences in mean triceps skin fold between consecutive groups are very pronounced. The differences in mean muscle circumferences, calculated from arm circumference and triceps skinfold are less obvious, but still significant, except the difference between groups with body weight 80–89% and 90–99%.

In Table 3, we can see the concentrations of protein, fat and carbohydrate in the breast milk, according to body weight of the mothers.

TABLE 3. – Concentration of protein, fat and carbohydrate (mean ± 1 SD) in 100 ml breast milk, according to body weight of the mothers

Body Weight[1]) of the Mothers	Protein[2]) g	Fat g	Carbohydrate g	Calories[3])
> 79%	1.63 ± 0.25 (8)[4])	2.99 ± 1.10 (6)	7.13 ± 0.20 (7)	60.8 ± 10.40 (6)
80% — 89%	1.64 ± 0.26 (29)	3.43 ± 1.30 (27)	7.11 ± 0,23 (28)	63.9 ± 11.29 (26)
90% — 99%	1.61 ± 0.26 (30)	3.38 ± 1.17 (28)	7.13 ± 0.24 (30)	64.1 ± 10.80 (28)
< 100%	1.73 ± 0.28 (21)	3.00 ± 0.69 (17)	7.05 ± 0.20 (21)	61.2 ± 11.10 (17)

1) Body weight expressed as percentage of expected values.
2) Protein: calculated from total nitrogen obtained, multiplied by 6.38.
3) Calories: calculated from protein, fat and carbohydrate contents.
4) Numbers in parentheses are sample size.

The mean protein contents in milk in all groups of the mothers is not significantly different. This is in accordance with many other studies, which showed that the concentrations of protein in milk from well nourished mothers and undernourished mothers are similar. Our figure here is higher than that of many other studies in different countries, as cited by Jelliffe (1968), *e.g.* protein contents in milk of:

Indian women	:	1.06 g/100 ml
American women	:	1.06 g/100 ml
Australian women	:	1.41 g/100 ml
Bantu women	:	1.35 g/100 ml

But our result is in good agreement with other studies which showed protein contents of 1.63 g% (as cited by Jacobs, 1962), and 1.60 g% (as cited by Jelliffe, 1968).

The mean fat contents of the groups shows more variation than the mean protein contents, while the mean carbohydrate contents shows less variation. Calories calculated from protein, fat and carbohydrate contents show more less similar values for all groups.

Table 4 shows the mean body weight and length of infants according to the body weight of their mothers. Here again the values are expressed as the percentage of the expected values.

TABLE 4. – Body weight and length (mean ± 1 SD) of infants according to body weight of the mothers.[1])

Body Weight of the Mothers	Number of Samples	Body Weight of Infants	Length of Infants
< 79%	8	84.5 ± 8.15 [2])	96.3 ± 2.50
80% — 89%	29	94.7 ± 13.36 [2])	97.9 ± 4.05
90% — 99%	30	100.0 ± 13.40	99.3 ± 3.43
> 100%	21	106.6 ± 12.30	100.9 ± 3.54

1) Values expressed as percentage of expected values.
2) The difference is significant ($P < 0.02$).
Note: Reference standard for body weight of the mothers, see: Jelliffe (1966).
Reference standard for body weight and length of infants, see: Nelson (1954).

The reference standard used was the 50th percentile in Percentiles for Weight and Length Birth to 5 years (Nelson, 1954).

Seventeen from 36 infants above 2 months of life had received a small amount of fine, scrapped banana or orange juice, and 8 from 13 infants above 3 and a half months had received another semi-solid food. Infants of mothers with the lowest mean body weight have the lowest mean percentage of body weight. Mothers with body weights between 80–90% have babies with a mean percentage body weight of more than 90%. Length of the infant is not much influenced by the mother's body weight. Though undernourished mothers will give children with mean body weight higher than their mean body weight, low-body-weight mothers tend to give smaller babies. This is apparent from Table 5.

TABLE 5. – Correlation between body weight of mothers and body weight of their infants[1])

Body Weight of Mothers	Number of Infants with Body Weight <79%	80 — 90%	90%	Number of Samples
< 79%	2 [2]) (25%)	3 (37.5%)	3 (37.5%)	8
80% — 89%	3 (10.3%)	8 (27.6%)	18 (62.0%)	29
90% — 99%	1 (3.3%)	6 (20.0%)	23 (76.6%)	30
>100%	—	2 (9.5%)	19 (90.5%)	21

1) Body weight of mother and their infants are expressed as percentage of expected values.
2) Numbers in parentheses = % of number of infants.

This table shows the number of infants from different body weights of mothers grouped according to the percentage of infants body weight. We can see that mothers with body weight less than 80% show higher tendency for having children with body weight less than 90% (25% of the infants have body weight less than 80%; and 37.5% of the infants have body weights between 80–90%). The less the body weight of the mothers, the more the number of infants with low body weight. This is in accordance with Gopalan's longitudinal study (1956), as mentioned earlier, and also from the study of Shanti Gosh *et al.* (1971) if we consider the actual body weight either at birth or at four months of age, which were less than the weight of American infants.

Table 6 shows anthropometric measurements of the lactating mothers according to the age of their infants. Three groups of mothers up to 3 and a half months after deliveries had body weight which were almost of the same order.

But the other two groups were apparently different. One group had a higher mean body weight, and the other group had a lower mean body weight. The reason of these differences was not clear. It might be due to the small number of samples. From this cross-sectional study we cannot show whether lactation will influence the body weight of the nutritional status of the mother. Arm circumference, triceps skin fold and muscle circumference of the mothers had about the same pattern as their body weights.

Now let us look at the anthropometric measurements of the infants according to age in Table 7.

The mean body weight and length of the infants here are quite good compared to the expected values. From the age of about 4 months up to about $4^1/_2$–5 months the mean body weight did not increase, *i.e.* 6.29 kg and 6.30 kg and the percentage body weight were 101.5% and 95.2% respectively. Similar results were also obtained for arm circumference, triceps skinfold

TABLE 6. – Anthropometric measurements of lactating mothers (mean ± 1 SD) according to the age of their infants.

Age of Infants (Months)	No. of Samples	Body Weight kg	Body Weight %1)	Arm Circumference cm	Arm Circumference %1)	Triceps Skinfold mm	Triceps Skinfold %1)	Muscle Circumference cm	Muscle Circumference %1)
0,5 —	37	47.8 ± 7.08	93.3 ± 12.02	23.3 ± 2.52	81.7 ± 8.87	13.1 ± 4.20	78.6 ± 26.43	19.2 ± 1.58	82.5 ± 7.00
1,5 —	29	47.6 ± 4.93	93.7 ± 10.13	23.9 ± 2.19	83.8 ± 6.70	14.3 ± 3.58	86.5 ± 11.70	19.4 ± 1.43	83.4 ± 5.83
2,5 —	9	48.8 ± 7.88	93.8 ± 12.79	23.7 ± 1.76	83.1 ± 6.19	12.8 ± 3.53	77.5 ± 21.39	19.7 ± 1.28	84.6 ± 5.67
3,5 —	7	52.0 ± 12.01	99.1 ± 17.68	25.9 ± 4.21	90.8 ± 14.80	18.4 ± 7.39	111.4 ± 44.85	20.1 ± 2.42	86.7 ± 10.33
4,5 — 5	6	42.8 ± 6.69	85.3 ± 10.59	22.0 ± 1.99	77.3 ± 7.09	11.80 ± 5.67	70.1 ± 36.35	18.3 ± 0.57	79.0 ± 7.00

1) % = as percentage of expected values

TABLE 7. – Anthropometric mesurements of infants (mean ± 1 SD) according to age.

Age (Months)	No. of Samples	Body Weight 1) kg	Body Weight 1) %	Length1) cm	Length1) %	Arm Circumference cm	Triceps Skinfold mm	Muscle Circumference cm
0,5 —	37	4.0 ± 0.71	95 ± 13.6	55.6 ± 2.43	98 ± 3.5	11.6 ± 1.20	8.0 ± 1.73	9.0 ± 2.29
1,5 —	29	5.0 ± 0.95	102 ± 27.4	56.1 ± 2.78	99 ± 3.8	12.8 ± 1.66	9.7 ± 1.72	10.1 ± 0.87
2,5 —	9	5.6 ± 0.71	101 ± 12.3	59.9 ± 1.90	101 ± 3.4	13.5 ± 1.24	9.5 ± 0.98	10.6 ± 0.92
3,5 —	7	6.3 ± 0.62	101 ± 9.9	61.9 ± 1.66	100 ± 2.8	13.9 ± 0.81	10.6 ± 1.80	10.7 ± 0.73
4,5 — 5	6	6.3 ± 0.57	95 ± 8.6	62.8 ± 2.69	100 ± 4.3	13.9 ± 0.84	10.5 ± 1.01	10.6 ± 0.42

1) % body weight) Expressed as percentage of expected values.
% length)

and calculated muscle circumference. Though these anthropometric measurements showed no low values, it seemed that the growth rates of the infants in this period were relatively less. These agree with the well accepted fact that the growth rates of infants are good up to about 4 months of life, and then from this period it starts lacking behind. It might be due to the fact that the milk supply is not enough for their growth, and proper supplementation is needed (W.H.O., 1965).

We can conclude from this study that though the lactating mothers were underweight (undernourished), their breast milk had the same protein concentration as those who were well nourished. This is in accordance with earlier reports of many investigators. Considering the body weight of the infants, it is apparent that undernourished mothers show higher chance for having smaller babies. Though when we look at the growth of the infants in general, they grow very satisfactorily up to about 4 months of life. So the nutritional status of pregnant and lactating mothers needs more attention for obtaining good nutritional status of their babies, though after 4 months of life the infants need proper supplementation.

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