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# Maternal Nutritional Status, Maternal Dietary Supplementation and the Growth of Suckling Infants

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**Summary**

**Ogundahunsi OA, Olanrewaju DM, Akesode FA, Olowu AO, Sule-Odu AO, Fakoya TA, Oluwole FA, Odunlami VB, Ketiku AO, Dada OA. Maternal Nutritional Status, Maternal Dietary Supplementation and the Growth of Suckling Infants.** *Nigerian Journal of Paediatrics* **1999; 26: 34.** The effects of maternal nutritional status and maternal dietary supplementation on the growth of infants were studied in 125 marginally malnourished mothers in the Sagamu Local Government area of Ogun State. Sixty-five of the mothers who received supplementation served as experimental subjects while 60 served as controls. The dietary supplementation provided energy at approximately eight percent, protein at 27 percent, iron at 35 percent, vitamin A at 53 percent, vitamin B1 at 122 percent and vitamin B2 at about 123 percent of their recommended daily allowances, respectively. No significant differences were observed (P>0.5) in the frequency, mean duration of breast-feeding episodes, milk output, Quetelet index, and skinfold measurements of supplemented mothers compared to control subjects throughout a six-month follow up period. Similar infant growth patterns were recorded in the two groups and no differences were observed in infant anthropometric measurements. Furthermore, the growth of infants of malnourished mothers was not significantly different from that of infants of well-nourished women.

## Introduction

ADEQUATE dietary intake is important for the promotion of reproductive health of women. The role of maternal nutritional status on the growth of breast-fed infants particularly during the first six months postpartum, remains unclear. Lactational performance appears to be preserved over a wide range of maternal nutritional states, except in advanced nutritional deficiency. Accounts from different parts of the world suggest that malnourished women often lactate adequately with little clinically obvious deterioration of their nutritional status.[1]

Limited studies have been carried out on the effect of supplementation of maternal diet on lactation and on the growth of suckling infants.[2] This present study was carried out to document the effect of supplementation of

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maternal diet on the mother's nutritional status and on the growth of their infants. It was part of a longitudinal study being conducted to assess the influence of maternal factors on infant nutrition, and growth, as well as duration of postpartum infertility.

## Subjects and Methods

The study was conducted in Sagamu, a peri-urban town in Ogun State. Recruitment of mother/infant pairs for the study was carried out within three to seven days of delivery, after informed consent was obtained. Body mass index (BMI or Quetelet Index) which has been approved by the Food and Agricultural Organization (FAO) and the WHO as an index of nutritional status,[8] was used to determine the nutritional status of the mothers. Mothers with BMI of 24 and above were considered well nourished and those with BMI of 18.5 and below as severely malnourished whereas those with BMI of 18.6 to 21.0 and ages between 20-39 were regarded as marginally malnourished. Based on this, 125 marginally malnourished mothers were randomly divided into two groups using a table of random numbers; the numbers were picked and put in sealed envelope prior to the study. Sixty-five mothers received nutritional supplementation while the remaining 60 served as controls. Only consenting mother/infant pairs fulfilling the following inclusion criteria were recruited:

(a) Intention to fully breast feed their infants and did breast feed.

(b) The babies had complete physical examination to exclude congenital abnormalities which might impair breast-feeding.

(c) The baby was singleton and healthy at the time of entry into the study.

(d) Mothers were parous (i.e. had had more than one child prior to the index child), were accessible for follow up, and did not intend to use hormonal contraception.

Records of frequency and duration of breast feeding episodes were kept by the two groups of mothers. The supplemented mothers were given 40 grams of high protein, high vitamin, Australian [4] biscuits daily (Table I). Weekly supplies were given to the mothers after a thorough explanation on the use of the biscuits. In addition, mothers were visited on at least, three occasions per week to ensure compliance with dietary supplements. The control group did not receive any nutritional supplements. All the mother-infant pairs were followed up monthly until after the sixth month postpartum. The following parameters were recorded at each visit:

### Infants

*(i)* ***Weight (kg):*** The infants were weighed nude with a 9-volt battery-operated digital electronic scale which provided readings to the nearest ten grams.

*(ii)* ***Head circumference (cm):*** This was measured with a cloth tape placed on the lower forehead just above the supra-orbital ridges, passing round the head at the same level on each side and over the occiput posteriorly. The tape was then moved up and down to find the maximum reading, after having been pulled very firmly to compress the hair.

*(iii)* ***Supine length (cm):*** The infant was laid supine on a board with a fixed head-

**Table I**

***Nutrient Composition of Australian High Protein Biscuits***

| | *Nutrient Content of Four Biscuits (40gms)* | | | | | |
|---|---|---|---|---|---|---|
| | *Energy (Kj)* | *Protein (gm)* | *Iron (mg)* | *Vit. A (mg)* | *Vit. B1 (mg)* | *Vit. B2 (mg)* |
| | 750 | 8.0 | 10 | 400 | 1.1 | 1.6 |
| | Percentage of Recommended Daily Intake | | | | | |
| Adult (M) | 6.0 | 21.6 | 110 | 53 | 92 | 89 |
| Adult (F) | 8.2 | 27.6 | 35.7 | 53 | 122 | 123 |

**Table II**

***Daily Breastmilk Output* of Malnourished Breastfeeding Mothers***

| | *Months Postpartum* | | | | | |
|---|---|---|---|---|---|---|
| | *1* | *2* | *3* | *4* | *5* | *6* |
| Supplemented(n=28) | 680(410) | 750(480) | 1110(500) | 840(530) | 990(560) | 720(270) |
| Controls (n=21) | 850(515) | 870(620) | 820(480) | 960(640) | 1100(670) | 850(570) |
| Student t test | 0.23 | 0.70 | 0.98 | 0.64 | 0.47 | 0.66 |
| P values | >0.05 | >0.05 | >0.05 | >0.05 | >0.05 | >0.05 |

* Values are expressed as mean (± SD) of breast milk output (g/24hr).

piece at one end at right angles to it (infant measuring table). From this head-piece a meter rule ran down one side of the length of the board. The foot piece was a movable right-angled block. One person held the baby's head so that it touched the head board, with the baby's eyes and external auditory meatus in a straight line perpendicular to the board. Another person held the baby's ankles in one hand and the foot piece in the other, keeping the soles of the feet firmly pressed against the foot piece. The child was 'stretched' to get the maximum length which was read off the meter rule.

*(iv)* ***Chest circumference (cm):*** This was measured with a cloth tape passed round the chest with the tape overlying the xiphisternum anteriorly.

### Mothers

*(i)* ***Weight:*** The mothers were weighed with light clothing and without shoes.

*(ii)* ***Height*** was measured simultaneously with the weight using Avery's combined height-weight scale.

*(iii)* ***Body Mass Index*** was computed from the formula: BMI = Weight (kg)/Height $(cm)^2$

*(iv)* ***Milk volume*** was assessed by test weighing.[5] The weight of the baby before suckling commenced was subtracted from the weight obtained five minutes after suckling. The baby's daily intake was then estimated by extrapolation from the detailed infant feeding chart which was provided for the mothers to complete. Milk volume was not assessed in all the mothers because some of them could not keep the detailed infant feeding chart. Breast milk volume could not be studied over a period of 24-48 hours because it was not possible to stay with the mothers throughout the day.

*(v)* ***Energy expenditure*** of the mothers was calculated during the first three months of admission into the study, using the method described by James and Schofield.[6] The predicted basal energy needs of an adult woman is 7W + 829, where W is the weight in kilograms. Each activity of the mother as well as the time spent on such activity was recorded throughout the day. The energy cost of each activity in kcal was calculated by adding the energy expended on all the activities for the day.

*(vi)* ***Serum albumin*** levels were determined by the bromocresol green (BCG) method.[7]

A similar longitudinal study in well nourished breast-feeding mothers, was being conducted at the centre at the same time.[8] This provided the opportunity to compare our cohorts' anthropometric measurements with those of well nourished mother-infant pairs.

### Statistical Analysis

The data was evaluated by the Analysis of Variance, using *Graph Pad Prizm* and *Microsoft Excel* software packages.

## Results

As shown in Table II, there were no significant differences in the daily quantity of breast milk produced by the two groups of malnourished mothers postpartum. The

frequency and duration of breast-feeding in the two groups of mothers were also similar. The number of breast-feeding episodes per day in the supplemented group ranged from 5-9, while its duration ranged from 9-12 minutes. The frequency of breast-feeding episodes in the controls was 5-10 times and for a duration of 8-16 minutes. Daily energy expenditure was similar in the supplemented subjects and controls (Table III).

The mean birth weight of infants of the supplemented subjects was 2.97 (0.4)kg, and this was not significantly different from the mean of 2.94 (0.4)kg in the controls (P>0.05) (Table IV). Similarly, there were no significant differences in the mean lengths, head circumferences, chest circumferences and Z scores of the two groups of infants at birth (P>0.05) (Table IV). Analysis of the anthropometric measurements of the two groups of babies throughout the follow-up period showed no significant differences. Furthermore, the anthropometric measurements of infants of well-nourished mothers were not significantly different from those of the malnourished mothers at birth and in the first six months of life.

The Quetelet Index rose from 20.2 in the third month to 21.0 at the end of the sixth month in the supplemented subjects, but fell from 20.5 to 20.2 in the controls (Table V); this difference was however, not significant.

**Table III**

***Nutritional Assessment of Malnourished Breastfeeding Mothers***

| | *Months Postpartum* | | | | | | |
|---|---|---|---|---|---|---|---|
| | *0* | *1* | *2* | *3* | *4* | *5* | *6* |
| No. of subjects | | | | | | | |
| Suppl. | 65 | 51 | | 43 | 37 | 34 | 27 |
| 26 | | | | | | | |
| Controls | 60 | 47 | | 40 | 36 | 30 | 23 |
| 20 | | | | | | | |
| Serum albumin (g/100ml) | | | | | | | |
| Suppl. | 3.3(0.9) | 3.5(0.9) | 3.7(0.6) | 4.0(0.6) | 3.9(0.6) | 4.1(0.7) | 3.8(0.8) |
| Controls | 3.4(0.7) | 3.9(0.7) | 3.8(0.9) | 4.1(0.6) | 4.4(0.5) | 4.0(0.5) | 4.2(0.5) |
| MAC (cm) | | | | | | | |
| Suppl. | 23.3(1.7) | 24.4(1.8) | 24.4(2.0) | 24.3(2.2) | 24.5(2.2) | 25.9(1.9) | 24.9(2.3) |
| Controls | 24.3(1.7) | 24.7(2.1) | 25.2(2.3) | 24.5(2.1) | 24.9(2.1) | 24.7(2.1) | 24.7(2.1) |
| Triceps skinfold (mm) | | | | | | | |
| Suppl. | 7.5(2.3) | 8.6(2.4) | 8.9(2.7) | 8.4(3.1) | 8.6(2.3) | 7.9(2.8) | 7.7(2.3) |
| Controls | 7.5(2.6) | 7.7(2.4) | 8.5(2.5) | 8.2(2.0) | 8.3(2.8) | 8.5(3.2) | 7.9(2.4) |
| Energy expenditure (Kcal) | | | | | | | |
| Suppl. | 2138(152) | 2193(178) | 2183(227) | | | | |
| Controls | 2137(219) | 2158(202) | 2218(156) | | | | |

Suppl. = Supplemented mothers
MAC = Mid arm circumference

*Note:* Breastfeeding mothers received daily dietary supplementation or served as controls.
Values are expressed as means (standard deviation).
There were no significant differences in the mean values of the two groups.

Serum albumin and triceps skin fold thickness were also similar in the two groups of malnourished mothers throughout the follow-up period (Table III).

## Discussion

This study has shown that marginal maternal malnutrition has no significant

**Table IV**

***Anthropometric Parameters of Infants of Well nourished, Marginally Malnourished Supplemented Mothers, and Control Mothers***

| | *Months Postpartum* | | | | | | |
|---|---|---|---|---|---|---|---|
| | *0* | *1* | *2* | *3* | *4* | *5* | *6* |
| No. of Subjects | | | | | | | |
| WN | 65 | 51 | 43 | 37 | 34 | 27 | 26 |
| Suppl. | 60 | 47 | 40 | 35 | 30 | 23 | 20 |
| Controls | 65 | 50 | 45 | 35 | 35 | 30 | 25 |
| Weight(kg) | | | | | | | |
| WN | 3.14(0.4) | 4.06(0.5) | 5.03(0.7) | 5.77(0.77) | 6.40(0.9) | 6.88(0.8) | 7.31(0.9) |
| Suppl. | 2.97(0.4) | 3.92(0.6) | 4.91(0.7) | 5.59(0.8) | 6.17(0.8) | 6.76(0.9) | 6.83(0.9) |
| Controls | 2.94(0.4) | 3.86(0.5) | 4.91(0.7) | 5.29(0.9) | 6.11(0.9) | 6.48(0.8) | 6.70(0.7) |
| Weight for age Z-score | | | | | | | |
| WN | -0.6(0.9) | -0.2(0.8) | 0.1(1.1) | 0.1(1.0) | 0.1(1.0) | -0.0(0.9) | -0.3(0.9) |
| Suppl. | -0.9(0.1) | -0.4(0.1) | -0.1(0.1) | -0.1(0.1) | -0.2(0.1) | -0.3(0.2) | -0.7(0.2) |
| Controls | -1.0(0.1) | -0.5(0.1) | -0.1(0.1) | -0.5(0.2) | -0.2(0.1) | -0.3(0.2) | -0.8(0.2) |
| Height for age Z-score | | | | | | | |
| WN | -0.2(1.3) | -0.3(1.1) | -0.2(1.1) | -0.6(0.9) | -0.3(1.1) | -0.02(1.5) | -0.1(1.0) |
| Suppl | -0.7(0.1) | -0.5(0.2) | -0.4(0.2) | -0.8(0.8) | -0.8(0.8) | -0.5(0.3) | -0.7(0.3) |
| Controls | -0.5(0.1) | -0.5(0.2) | 0.7(0.2) | -0.9(0.2) | -0.9(0.2) | -1.1(0.2) | -0.6(0.2) |
| Length (cm) | | | | | | | |
| WN | 50.2(4.0) | 53.6(2.7) | 57.1(2.9) | 60.3(2.6) | 62.0(3.1) | 64.5(2.6) | 66.6(2.4) |
| Suppl. | 49.7(2.6) | 53.5(2.5) | 57.6(3.1) | 59.5(3.8) | 62.5(2.9) | 64.8(2.6) | 65.5(2.7) |
| Controls | 49.3(1.9) | 53.0(3.4) | 57.5(3.4) | 60.7(4.5) | 61.5(3.8) | 63.2(3.7) | 65.0(2.6) |
| Head circumference (cm) | | | | | | | |
| WN | 35.2(1.5) | 37.4(1.5) | 39.1(1.4) | 40.6(1.4) | 41.7(1.5) | 42.6(1.5) | 43.5(1.5) |
| Suppl. | 33.9(0.6) | 36.9(0.3) | 39.3(0.3) | 40.8(0.2) | 41.6(0.4) | 42.9(0.4) | 43.0(0.4) |
| Controls | 34.3(0.2) | 37.2(0.4) | 39.5(0.4) | 41.0(0.4) | 41.4(0.3) | 42.3(0.2) | 42.9(0.2) |
| Chest circumference (cm) | | | | | | | |
| WN | 33.4(2.0) | 36.2(2.1) | 38.8(2.1) | 40.4(2.1) | 41.8(2.1) | 42.9(2.1) | 43.8(2.1) |
| Suppl. | 32.7(1.5) | 37.1(1.9) | 39.3(2.0) | 40.7(1.8) | 42.0(2.3) | 42.7(2.1) | 43.2(1.9) |
| Controls | 32.5(2.2) | 36.2(2.0) | 38.4(1.9) | 40.9(2.0) | 41.7(1.5) | 42.0(2.2) | 42.0(2.3) |

WN = Infants of well nourished mothers
Suppl. = Infants of mothers who received supplements
Controls = Infants of Controls
*Note:* Breastfeeding mothers received daily dietary supplementation or served as controls.
Values are expressed as means (standard deviation).
There were no significant differences in the mean values of the groups.

effect on the growth of infants in the first few months of life. This is evident from the fact that there was no significant difference in the mean weights and lengths of babies whose mothers had dietary supplementation and those whose mothers did not. This observation can be explained on the basis of earlier reports showing that a reduction in maternal caloric intake has very minimal effect on the composition, and therefore, the quality of breast milk.[7, 9-11] In one study, the energy, protein and fat contents at four, eight and 12 weeks after delivery were similar in normal and underweight women.[11]

Although some studies have shown diminished lactation in malnourished mothers, [7,12] the precise nutritional intake at which lactation is diminished is unknown. Van Steenbetrgen *et al* in 1983, showed a reduction of only 8gm/24 hours in the milk production of 46 rural Kenyan women who had low weight-for-height.[9] Protein and

**Table V**

***Quetelet Index of Well and Marginally Malnourished Mothers Months Postpartum***

| | *0* | *1* | *2* | *3* | *4* | *5* | *6* |
|---|---|---|---|---|---|---|---|
| No. of Subjects | | | | | | | |
| WN | 65 | 51 | 43 | 37 | 34 | 27 | 26 |
| Suppl. | 60 | 47 | 40 | 35 | 30 | 23 | 20 |
| Controls | 65 | 50 | 45 | 35 | 35 | 30 | 25 |
| Quetelet Index ($Kg/m^2$) | | | | | | | |
| WN | 25.2(2.6) | 24.3(3.1) | 24.1(3.0) | 24.5(3.2) | 24.8(3.1) | 25.1(2.8) | 25.6(3.2) |
| Suppl. | 20.3(1.9) | 20.3(3.7) | 20.7(2.4) | 20.2(2.0) | 20.6(2.0) | 20.9(2.2) | 21.0(2.5) |
| Controls | 20.5(1.5) | 20.5(2.0) | 20.8(2.5) | 20.3(2.0) | 21.0(2.1) | 20.5(2.2) | 20.2(2.4) |

WN = Well nourished mothers
Suppl. = Mothers who received supplements
Controls = Controls

*Note:* Values are expressed as means ( standard deviation).
There were no significant differences in the mean values of the groups.

lactose concentrations in the milk were comparable in these women with that of British mothers.

In the present study, there was no significant difference between the milk output of mothers who received nutritional supplementation and those who did not. A similar level of energy expenditure in the two groups of mothers is not unexpected since they live within the same environment and belong to similar socio-economic groups. Thus, the ambient temperature to which the mothers were exposed as well as the activities in which they were engaged, were similar in the two groups.

Maternal dietary supplementation was associated with some improvement in the Quetelet Index of mothers who received the supplement at five to six months postpartum. However, no significant differences were seen in the mean mid-arm circumferences, serum albumin, and triceps skinfold thickness of the two groups of mothers. Furthermore, there was no effect of the maternal nutritional intervention on the suckling infants. Thus, the mean weight-for-height, head circumference and length of infants of supplemented and control mothers at six months postpartum were not different. The general growth of infants of these marginally

malnourished mothers was similar to growth of infants of well nourished mothers in the same environment[8] as well as that reported in infants of well nourished mothers in a poor urban Chilean population.[14]

This study has thus shown that maternal dietary supplementation of marginally malnourished women had no significant influence on the growth of suckling infants although it may lead to some improvement in the general nutritional status of the mother. This observation suggests that breast milk production may not be sacrificed in the absence of good maternal nutrition and that supplementation of mother may likely help to build maternal stores in marginally nourished lactating mothers. Mothers utilize their stores and their non-storage body weight for foetal development and production of good quality breast milk. A similar observation has been made among Bangladeshi women.[13, 15]

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