Effect of skim milk supplementation of the maternal diet on lactational amenorrhea, maternal prolactin, and lactational behavior

Kamani H Tennekoon, Eric H Karunanayake, and Harsha R Seneviratne

ABSTRACT  Effect of skim milk supplementation of the maternal diet on lactational amenorrhea was studied in 30 pairs of healthy lactating women matched for parity, body mass index, and previous experience of lactational amenorrhea. Supplementation of the maternal diet had no significant effect on the time of resumption of regular menstruation or ovulation, maternal prolactin concentrations, breast-feeding pattern, maternal body mass index, or infant weight. However, the supplemented group breast-fed nearly exclusively (supplemental feeds were introduced but did not exceed 20% of total feeds) for a significantly longer duration ($P < 0.05$) than did the control group. Previous experience of lactational amenorrhea was significantly positively correlated with the time of resumption of menstruation in the supplemented ($P < 0.01$) and control ($P < 0.05$) groups when frequency of breast-feeding, maternal body mass index, and supplementary feeds to the infant were controlled for. Thus, maternal nutritional supplementation does not appear to affect the contraceptive benefit of lactation when the frequency of breast-feeding is not compromised but apparently lengthens the duration of nearly full breast-feeding.

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KEY WORDS  Lactational amenorrhea, maternal nutrition, prolactin, full breast-feeding, nearly full breast-feeding

INTRODUCTION

Lactational amenorrhea, which contributes considerably to fertility regulation in the developing world, has been shown to depend on the frequency and duration of suckling although the threshold required to suppress ovarian activity appears to differ among individuals and among populations (1–4). However, the effect of maternal nutritional status on the duration of lactational amenorrhea, milk production, and maternal prolactin concentrations remains controversial. The duration of lactational amenorrhea was found to be increased when food intake was less and to be reduced in women with higher body weights (5–8). In contrast, other studies found a very small (9) or no effect (2) of maternal nutritional status on lactational amenorrhea. Supplementation of the maternal diet has been shown to increase milk volume without altering milk composition, to have no effect on milk volume or composition, and to reduce prolactin concentrations (10–12). In another study, maternal nutritional status had no effect on prolactin concentrations in undernourished lactating women (13).

Thus, in view of the inconsistent findings of previously published studies and the lack of data on the effect of nutritional status on lactational amenorrhea for Sri Lankan women, we investigated the effect of supplementation of the maternal diet on the time of resumption of regular menstruation and ovulation, on plasma prolactin concentrations, and on lactational behavior. We hypothesized that the supplemented group would resume regular menstruation and ovulation earlier than the control group.

SUBJECTS AND METHODS

Subjects

Thirty pairs of normal, healthy lactating women matched for parity, body mass index (BMI, in kg/m$^2$; matched within ± 0.5), and previous experience of lactational amenorrhea were recruited for this study after institutional ethical approval was obtained for the study and the subjects provided their informed consent. All subjects were aged 20–35 y, were breast-feeding their second or third baby, and had a BMI between 18 and 27. Each subject had delivered a single normal, healthy full-term baby by spontaneous or assisted vaginal delivery at the end of an uncomplicated pregnancy. Subjects were all nonworking mothers, exclusively breast-feeding at the time of recruitment, giving six or more breast-feeds per 24 h, had breast-fed their previous baby or babies, were not planning to use any form of hormonal contraceptives, and were living with a 20-km radius of the institution. Further, they remained nonworking and breast-feeding throughout the study. They were recruited from the postpartum wards of the De Soysa Hospital for Women.

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within 24 h of delivery and admitted to the study at 4 wk postpartum. Subjects who had introduced other feeds to the infant and who planned to use hormonal contraceptives by this time were excluded.

Study design

Matched pairs of subjects were randomly allocated to supplement and control groups. Neither the investigators nor the subjects were blinded. The supplemented group received ~50 g powdered skim milk/d [composition of the powder was as follows: 49.8% carbohydrate, 37.6% protein, 0.8% fat, 7.8% mineral salts, and 3.8% moisture, and 100 g provided 1523 KJ (364 kcal), 600 μg (2000 IU) vitamin A, and 10 μg (400 IU) vitamin D] throughout the study period, which began 4 wk postpartum and ended after the subject had two to three regular menstrual periods. Because of practical difficulties in observing daily consumption of skim milk, this was not attempted. However, each subject was given a 400-g packet once a week and strongly advised against using it for children or any other family members. During weekly home visits contents of the skim milk packet given the week before were examined and found to be nearly empty. Both the supplemented and control groups were seen at a follow-up clinic at four weekly intervals, at which time blood samples for prolactin estimation were collected, maternal BMI and weight of the infant were recorded, and a general examination of the mother and the infant was carried out. Blood samples for prolactin estimation were collected between 1400 and 1600: basal samples were collected between 1400 and 1500, ≥ 120 min after the previous breastfeed, and the suckling-stimulated sample was collected 30 min after the start of a breast-feed given after collection of the basal sample.

Subjects were visited at their homes at weekly intervals so that data could be collected on suckling frequency, average duration of a breast-feed, and the frequency and types of other feeds through use of the 24-h recall method. During these visits, an early morning urine sample was also collected for the measurement of estrone glucuronide and pregnanediol glucuronide concentrations and data on menstrual status were obtained. In addition, 24-h home dietary records were obtained at four weekly intervals. These were used to compare food intake in each pair and to ascertain whether the supplemented subjects consumed skim milk in addition to their normal diet. No attempt was made to calculate energy intake because accurate information could not be obtained about the quantities of food consumed although the types were recalled accurately.

Plasma prolactin and urinary estrone and pregnanediol glucuronide concentrations were measured through use of a double-antibody radioimmunoassay with World Health Organization matched reagents (14, 15). For prolactin, estrone, and pregnanediol glucuronide, average batch CVs were 6.6%, 6.0%, and 6.2%, respectively, and interassay variations were 10.3%, 11.6%, and 9.1% for low-; 7.3%, 6.8%, and 7.9% for medium-; and 9.0%, 6.0%, and 8.1% for high-quality control pools, respectively. All samples from each subject were analyzed within one assay whenever the number of samples did not exceed the maximum number that could be analyzed per assay.

If the duration between two consecutive menstrual periods was > 3 and < 6 wk, the first of these two menstrual periods was regarded as the first regular menstrual period. A urinary pregnanediol glucuronide concentration ≥ 0.1 mmol/mol creatinine during the luteal phase was considered to be evidence of ovulation; the cutoff point was established after the study of daily urinary pregnanediol glucuronide concentrations during normal menstrual cycles in women of similar age (n = 10).

Breast-feeds given from 0600 to 2200 (both hours inclusive) were counted as daytime feeds whereas the remainder were considered to be nighttime feeds. Feeds of water were not counted as other feeds. Feeds of fruit juice made up < 15% of all feeds and also were not counted as other feeds. Liquid, semisolid, or solid feeds other than water or fruit juice were included in the other feeds category.

Statistical analyses

Stratified life table analyses and log rank tests were carried out to evaluate the effect of skim milk supplementation of the maternal diet on the time of resumption of regular menstruation and ovulation postpartum (STATVIEW; Abacus Concepts, Inc, Berkeley, CA). Stratification was done according to the total number of breast-feeds per 24 h (ie, ≤ 8, 9–11, 12–14, and ≥ 15) and maternal BMI (ie, < 21, 21–24, and > 24) at admission to the study. The proportions of subjects menstruating and ovulating at each postpartum interval were compared by using the t test for proportions. The characteristics of the first regular menstrual bleed (ovulatory or anovulatory) were compared between those who resumed regular menstruation before and after 24 wk postpartum in the control group as well as in the supplemented groups through use of a chi-square test to ascertain any difference at time postpartum. Further, the same analysis was performed between control and supplemented groups for the periods before and after 24 wk postpartum to ascertain any difference between the two groups. Odds ratios were used to compare a possible difference in the resumption of menstruation between 4–24 and 28–56 wk postpartum. Multiple-linear-regression tests were carried out to examine the effects of previous experience of lactational amenorrhea, frequency of breast-feeds per 24 h at admission to the study, time postpartum at introduction of other feeds to the infant, and maternal BMI at admission to the study.

Basal prolactin, sucking-stimulated prolactin, increment of prolactin (ie, the difference between suckling-stimulated and basal), frequency of all feeds, frequency of breast-feeds (total number per 24 h, daytime, nighttime, and total number per 24 h expressed as a percentage of all feeds), number of other feeds per 24 h and as a percentage of all feeds, maternal BMI, and infant weight were compared between control and supplemented groups at time postpartum. These variables were also compared at: −3, −2, −1, 0, 1, 2, and 3 mo of regular menstruation or ovulation, and also at −3, −2, −1, 0, 1, 2, and 3 mo of introduction of other feeds to the infant; month 0 was the month in which regular menstruation or ovulation resumed or the month in which other feeds were introduced to the infant.

Data were synchronized according to the time of resumption of menstruation and ovulation because of the well-known effect of suckling and the questionable role of prolactin in hindering the function of the hypothalamic-pituitary-ovarian axis (16, 17). Similarly, data were synchronized according to the time of introduction of other feeds to the infant because of previously reported changes in plasma prolactin concentrations in relation to the time of introduction of other feeds (1). If certain characteristics are similar within a group or different
between two groups in relation to a particular event, synchronization of data according to the time of such an event will uncover those characteristics in a matched-pairs analysis. In the analysis according to time postpartum, the effect of such characteristics will be masked because the event occurs at variable times postpartum. Time postpartum at which other feeds were introduced to the infants was also compared between the supplemented and control groups. Comparisons were made by using the paired Student's one-tail t test. Log-transformed data were used for comparing prolactin values. Further, the number of subjects giving other feeds at each postpartum interval was compared between supplemented and control groups by using a chi-square test.

RESULTS

Baseline characteristics of the subjects at admission to the study are shown in Table 1. There were no significant differences in any of these characteristics between supplemented and control groups. The cumulative percentages of supplemented and control subjects who had resumed regular menstruation and ovulation by time postpartum are shown in Figure 1. There was no significant difference in the number resuming regular menstruation or ovulation between the two groups when the data were analyzed with or without stratification according to the number of breast-feeds per 24 h or maternal BMI, although the control subjects appeared to lag behind the supplemented subjects. The greater delay seen in resumption of ovulation in the control group in Figure 1 compared with the delay in resumption of menstruation was due to five control subjects being censored because they left the study without ovulating. The cumulative percentage menstruating or ovulating was not significantly different at any postpartum interval between the two groups.

Characteristics of the first postpartum menstrual bleeding in the two groups are given in Table 2. There was no significant difference in the number of first regular menstrual bleeds that were ovulatory either within the control group or within the supplemented group between the periods before and after 24 wk postpartum. Similarly, there was no significant difference in the number of first regular menstrual bleeds that were ovulatory between the control and supplemented groups for the periods before and after 24 wk postpartum. Odds ratios for resuming menstruation were 1.307 for 4–24 wk postpartum and 1.212 for 28–56 wk postpartum. These were not significant and were not significantly different between the two periods. Odds ratios for resuming ovulation were not used for comparison because some control subjects were censored because they

![Figure 1](https://academic.oup.com/ajcn/article-abstract/64/3/283/4651529/1)

**FIGURE 1.** Cumulative percentages of women resuming regular menstruation (A) and ovulation (B), by time postpartum, in a group of healthy lactating women after skim milk supplementation of the maternal diet (n = 30, □) and in a nonsupplemented control group (n = 30, ○) matched for parity, BMI, and previous experience of lactational amenorrhea.

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>Characteristics at baseline in 30 matched pairs of lactating women at 4 wk postpartum</th>
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<tbody>
<tr>
<td></td>
<td>Supplemented group</td>
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<tr>
<td></td>
<td>[28.83 ± 0.66]</td>
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<td></td>
<td>[21.74 ± 0.60]</td>
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<td></td>
<td>[2860 ± 87]</td>
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<td></td>
<td>[12.07 ± 0.66]</td>
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<td></td>
<td>[9.32 ± 0.58]</td>
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<td></td>
<td>[2.75 ± 0.17]</td>
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<tr>
<td></td>
<td>[1227 (300, 5023)]</td>
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<tr>
<td></td>
<td>[2296 (596, 8851)]</td>
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<td>[843 (114, 6223)]</td>
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1 n = 18 male infants and 12 female infants in this group.
2 n = 17 male infants and 13 female infants in this group.
3 x ± SEM.
4 Geometric ±; 95% CIs in parentheses.
completed the study without having ovulatory menstrual bleeds.

A significant correlation was observed between previous experience of lactational amenorrhea and the duration of present lactational amenorrhea in the control group (β coefficient = 0.488, P < 0.05) and between the duration of previous lactational amenorrhea and the duration of present lactational amenorrhea (β coefficient = 0.508, P < 0.01) and anovulation (β coefficient = 0.524, P < 0.01) in the supplemented group. Number of breast-feeds per 24 h and maternal BMI at admission to the study as well as time postpartum at which other feeds were introduced to the infant were not correlated with duration of lactational amenorrhea or anovulation in either group.

The number of subjects giving other feeds at time postpartum in the supplemented and control groups is shown in Figure 2. The number was significantly lower in the supplemented group than in the control group at 8 (P < 0.02), 12 (P < 0.01), 16 (P < 0.05), and 20 (P < 0.02) wk postpartum. The supplemented group (x ± SEM: 19.28 ± 1.70 wk postpartum) introduced other feeds 5 wk later than did the control group (x ± SEM: 14.44 ± 2.10 wk postpartum), and this difference was significant (P < 0.05).

Numbers of total breast-feeds and of other feeds per 24 h at 4–60 wk postpartum are shown in Figure 3, A and B. There were no consistent differences in the numbers of all feeds, total breast-feeds per 24 h, total breast-feeds per 24 h as a percentage of all feeds, daytime breast-feeds, nighttime breast-feeds, other feeds per 24 h, and other feeds as a percentage of all feeds between the two groups. The only significant differences observed were a higher number of total breast-feeds at 48 wk postpartum (P < 0.05); a higher number of total breast-feeds when expressed as a percentage of all feeds at 12 (P < 0.01), 24 (P < 0.02), and 32 (P < 0.05) wk postpartum; and a lower number of other feeds at 12 (P < 0.01) and 24 (P < 0.02) wk postpartum in the supplemented group, and a higher number of nighttime breast-feeds at 52 wk postpartum (P < 0.02) in the control group. Although not significant, there was a lower number of other feeds at all other times from 4 to 56 wk postpartum in the supplemented group.

Basal, suckling-stimulated, and increment prolactin concentrations (geometric mean) in matched pairs at 4–60 wk postpartum are also shown in Figure 3, C and D. These were not significantly different between the two groups except for significantly higher stimulated prolactin concentrations at 28 and 32 wk postpartum in the control group (P < 0.05) and at 52 wk postpartum in the supplemented group (P < 0.01), and significantly higher prolactin increments in the control group (P < 0.05) at 20, 28, and 32 wk postpartum. Body weight of the infants expressed as a percentage of birth weight and maternal BMI expressed as a percentage of BMI at admission to the study were not significantly different between the two groups from 4 to 60 wk postpartum (data not shown).

Prolactin values, frequency of all feeds, frequency of breast-feeds (total per 24 h, daytime, and nighttime), maternal BMI, and infant weight were not consistently different between the supplemented and control groups when the data were synchronized according to the time of resumption of regular menstruation or ovulation (data not shown). However, the total number of breast-feeds expressed as a percentage of all feeds was significantly higher in the supplemented group at −3 (P < 0.02), −2 (P < 0.02), −1 (P < 0.01), 0 (P < 0.05), 1 (P < 0.05), and 2 (P < 0.02) mo of menstruation and at −1 (P < 0.05) and 1 (P < 0.05) month of ovulation (Figure 4, A and B). The number of other feeds per 24 h was significantly lower in the supplemented group at −3 (P < 0.02), −2 (P < 0.01), −1

**Figure 2.** Number of subjects giving breast-feeds only (open bars) or breast-feeds as well as other feeds (shaded bars) to their infants, by time postpartum, in a group of healthy lactating women after skim milk supplementation of the maternal diet (A; n = 30) and in a control group (B; n = 30) matched for parity, BMI, and previous experience of lactational amenorrhea.

**Table 2**

<table>
<thead>
<tr>
<th></th>
<th>Supplemented group</th>
<th>Control group</th>
<th>n (%)</th>
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<tbody>
<tr>
<td>Regular menstruation before 24 wk postpartum</td>
<td>17 (57)</td>
<td>15 (50)</td>
<td></td>
</tr>
<tr>
<td>Regular menstruation after 24 wk postpartum</td>
<td>13 (45)</td>
<td>15 (50)</td>
<td></td>
</tr>
<tr>
<td>Ovulatory first menstrual bleed</td>
<td>17 (57)</td>
<td>12 (40)</td>
<td></td>
</tr>
<tr>
<td>Ovulatory first menstrual bleed before 24 wk postpartum</td>
<td>9 (30)</td>
<td>5 (17)</td>
<td></td>
</tr>
<tr>
<td>Ovulatory first menstrual bleed after 24 wk postpartum</td>
<td>8 (27)</td>
<td>7 (23)</td>
<td></td>
</tr>
<tr>
<td>Not ovulated before completing the study</td>
<td>0</td>
<td>5 (17)</td>
<td></td>
</tr>
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</table>
(P < 0.01), and 1 (P < 0.01) mo of menstruation and at −1 (P < 0.05) and 1 (P < 0.05) mo of ovulation (Figure 4, C and D). The number of other feeds per 24 h when expressed as a percentage of total feeds was significantly lower in the supplemented group at −3 (P < 0.02), −2 (P < 0.02), −1 (P < 0.01), 0 (P < 0.05), 1 (P < 0.01), and 2 (P < 0.05) mo of menstruation and at −2 (P < 0.05), −1 (P < 0.01), and 1 (P < 0.05) mo of ovulation (Figure 4, D and E).

Only two variables (number of daytime feeds and increment of prolactin) were significantly different between the two groups when the data were synchronized according to the time of introduction of other feeds to the infant. These differences, however, were not consistent. The number of daytime feeds at −1 mo and the increment of prolactin at 1 and 3 mo were significantly higher in the control group (P < 0.05) than in the supplemented group (data not shown).

DISCUSSION

None of the previous studies that investigated the effect of nutritional supplementation of the mother on the duration of lactational amenorrhea (5, 18) or maternal prolactin concentrations (12) used matched pairs of subjects as in the present study. In the present investigation, matching of subjects for BMI ensured comparable nutritional status in supplemented and control groups at admission to the study. Matching for parity and previous experience of lactational amenorrhea removed two confounding variables whereas the other variables, such as frequency of breast-feeding, were controlled for in data analysis. We did not attempt to use the duration of a breastfeeding episode as a variable because for almost all women this was 5–10 min. Thus, when maternal nutritional status, previous experience of lactational amenorrhea, and frequency of breast-feeding per 24 h were accounted for, skim milk supplementation of the maternal diet had no significant effect on the time of resumption of regular menstruation or ovulation.

Most of the studies in which either maternal nutritional status or supplementation of the maternal diet was found to have a negative effect on the duration of lactational amenorrhea also included women who were undernourished or overweight (5, 7, 8). In some of these studies other possible confounding variables were not controlled for as well. Furthermore, in the Gambian study infants of mothers who were supplemented also received supplementary feeds (5). Popkin et al (6) found that low maternal BMIs, which represent maternal undernutrition, were related to an increase in the duration of lactational amenorrhea. In contrast, other investigators who did not include undernourished subjects in their samples failed to observe a significant effect of maternal nutritional status as assessed by body weight, ponderal index, BMI, or total water/% body wt on
the duration of lactational amenorrhea (2, 19). Kurz et al (9) found a small association between maternal nutritional status as assessed by triceps skinfold thickness and the duration of lactational amenorrhea but once infant suckling was controlled for this effect was inadequate to add even one additional child during a woman's reproductive years. Furthermore, these investigators failed to find any significant effect of supplementation of the maternal diet on the duration of lactational amenor-
AMENORRHEA. Recently, a maternal BMI > 26 was found to be positively associated with early cessation of breast-feeding, whereas a BMI within the normal range had no effect (20). Thus, although extremes of nutritional status may have an effect on the duration of lactational amenorrhea, this may not be a significant factor within the normal range.

Although net energy supplementation was not calculated in the present study, the improved lactation in the supplemented group, the examination of the skim milk packets during home visits, and the evidence of consumption of skim milk from dietary records strongly suggest that there would have been some degree of net supplementation. Consumption of milk was rare in the control subjects and none of them consumed skim milk. The sample size used in the present study was adequate to detect a prevalence of menstruation or ovulation 33.33% higher in the supplemented group than in the control group at \( \alpha = 0.05 \) and \( 1 - \beta = 0.80 \). However, a larger sample size would have been required to bring out a significant difference if the difference in the prevalence of menstruation or ovulation was \( < 33.33\% \).

Strong correlations have been observed between durations of postpartum amenorrhea in successive pregnancies (21). Recently, Ford (22) observed previous length of lactational amenorrhea to have a significant predictive value for subsequent length of amenorrhea when time of introduction of solids was taken into account. However, maternal nutritional status or the frequency of breast-feeds was not accounted for. It is evident from the present study that even when these two factors were accounted for, previous experience of lactational amenorrhea was significantly correlated with the duration of lactational amenorrhea.

Improvement of maternal diet is known to increase milk production (10, 23). In the present study the longer duration of nearly full breast-feeding (feeds of water and fruit juice were permitted) seen in supplemented mothers may have resulted from such an effect. However, we have no direct evidence because we did not measure milk volume and there are other reports of a lack of an effect on milk volume when the maternal diet is supplemented (11). There was no significant difference in the frequency of breast-feeds or the frequency of other feeds between the two groups at time postpartum in the present study. However, when synchronized according to the time of resumption of menstruation and ovulation, the supplemented subjects had a significantly higher percentage of breast-feeds and a significantly lower percentage of other feeds than did the control subjects. The frequency of other feeds had no significant effect on the time of resumption of regular menstruation and ovulation in our subjects. Although introduction of other feeds to the infant is a strong determinant of resumption of menstruation in some communities (24), it is less so in others (4, 19). It is believed that abrupt introduction of high-energy supplements to infants, which leads to a significant reduction in the number of breast-feeds, has a dramatic effect on resumption of menstruation. On the other hand, the gradual introduction of supplementary feeds with low nutrient value, during which a high suckling frequency is retained, is thought to have a less dramatic effect.

The patterns of exclusive breast-feeding and 15–20% supplementation of breast-feeding with other feeds have been shown to share similar endocrine responses; the terms full breast-feeding and nearly full breast-feeding are now used to describe these patterns. Up to 15–20% supplementation is regarded as having no effect on resumption of menstruation and ovulation, which is one of the characteristics required for the lactational amenorrhea method of natural family planning (3, 25–27). In the present study, a certain amount of supplementation even above 15% (ie, over and above supplementation in the form of feeds of fruit juice) failed to exert a significant effect on the time of resumption of menstruation and ovulation. However, the mean percentage of supplementary feeds given (excluding feeds of fruit juice) did not exceed 30% of all feeds at any stage of the study in either group. The nutrient value of the supplementary feeds was much lower than the nutrient value of the supplementary feeds of formula. Most of the supplementary feeds given to infants in this study were clear soups, congee (water strained off after boiling rice with water), bread, biscuits, and small quantities of rice with vegetables and fish, eggs, or meat. These foods were introduced gradually. Thus, observations in the present study confirm that a certain degree of supplementation while a high suckling frequency is maintained has little or no effect on the return of fertility. Further, Campbell and Gray (27) observed that supplementary bottle feeds increased the risk of ovulation whereas supplementary nonbottle feeds had no effect on ovulation. The absence of a significant difference in weight gain of the infants was perhaps due to the receipt of adequate nutrition with more breast milk per feed in the supplemented group and the replacement of any deficit of breast milk with other feeds in the control group.

Although Lunn et al (12) observed a reduction in prolactin secretion when the maternal diet was supplemented, we failed to observe such an effect. Previously, Shatrugna et al (13) failed to observe an effect of body weight on prolactin in undernourished lactating mothers. The absence of a consistent significant difference in prolactin between the supplemented and control groups is explained by similar frequencies of breast-feeds in both groups because suckling is the most potent stimulus for prolactin secretion. Although protein meals have been shown to increase prolactin secretion (28), such an effect was not seen in the skim milk–supplemented group. It is possible that the amount of additional protein given in the present study was an inadequate stimulus. On the other hand, because prolactin secretion was maximal in response to suckling, the addition of protein to the diet may not have enhanced it any further.

In a cross-sectional study carried out in Sri Lanka, Fernando et al (29) observed that one-third of conceptions during the postpartum period occurred before menstruation returned. Campbell and Gray (27) observed two-thirds of subjects in their study to ovulate before their first vaginal bleeding but that 47% of these cycles had luteal phase defects. The lower prevalence of ovulation before the first postpartum menstrual bleed observed in the present study compared with previous studies may arise from the differences in subject selection; our subjects were those who were motivated to breast-feed, unlike those in the study by Fernando et al (29). On the other hand, weekly measurement of urinary estrone and pregnanediol glucuronide concentrations may have underestimated the prevalence of ovulation especially if there was luteal phase inadequacy.

The overall data in the present study indicate that in women who are in comparable nutritional status, supplementation of
the maternal diet has no adverse effect on the contraceptive benefit of lactation given that suckling frequency is not compromised and the infant is nearly fully breast-fed for a longer duration. Further, introduction of nonbottle feeds with low nutrient value as supplementary feeds to the infant does not appear to have a significant effect on the time of resumption of menstruation and ovulation when a high suckling frequency is maintained. Although one may argue that the amount of maternal supplementation used in the present study may not advance return of fertility in women who are not malnourished, the fact that it did not advance the return of fertility but prolonged the duration of breast-feeding is an important finding.

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REFERENCES