In American Journal of Obstetrics and Gynecology
Volume 135 - No. 3 October 1, 1979. pp. 303-307

Effect of maternal nutritional status and infant supplementation during lactation on postpartum amenorrhea

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This paper explores the effects of maternal nutritional status and food supplementation ingested by the infant on the duration of postpartum amenorrhea. A significant negative association was found between the nutritional status of the mother during the third trimester of pregnancy and the length of postpartum amenorrhea. A negative association was also found between infant supplementation and duration of postpartum amenorrhea. Each of these associations remained significant after controlling for the other, suggesting that both factors independently affect the length of postpartum amenorrhea. (AM. J. OBSTET. GYNECOL. 135:303, 1979.)

NUMEROUS CLINICAL and experimental observations suggest that, in addition to lactation,[1-4] socioeconomic factors are associated with the duration of postpartum amenorrhea. Several authors have postulated that nutrition could be one of these factors,[4-7] reasoning that the increased nutritional demands of pregnancy and lactation are easily coped with in high socioeconomic groups but not in lower class, malnourished women.[8]

Preliminary work in Guatemala[9] showed that supplementing the diets of pregnant and lactating women significantly reduced the duration of postpartum amenorrhea. However, in this study the infants also received diet supplements, and the consumption of the mother and the infant were highly associated. Thus, the observed effect of maternal supplementation during pregnancy on postpartum amenorrhea could be entirely due to the effect of supplementing the infant's diet, either by reducing the frequency of suckling or by reducing the nutritional drain on the mother during lactation.

This paper examines the effect of maternal nutrition and infant supplementation on the duration of postpartum amenorrhea, in the context of a prospective study of food supplementation carried out in a chronically malnourished population in rural Guatemala.

Material and methods

The subjects were inhabitants of four farming villages participating in a longitudinal study of the relationship between malnutrition and mental development.[10] The primary crops are corn and beans, most of which are consumed in the same villages. Within the study villages, nutritional status is generally deficient. Dietary surveys indicate that daily dietary intake throughout pregnancy is about 1,500 calories and 40 grams of protein per day. The women in the study population are at higher risk of calorie than of protein malnutrition.

Table I presents the significant features of the ex-

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Supported by Contract 1-R01-HD-12631-01 from the National Institute of Child Health and Human Development, National Institutes of Health, Bethesda, Maryland, and by Population Council Grant D 75, 49 C.

Received for publication June 20, 1978.

Accepted October 30, 1978.

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0002-9378/79/100303+05$00.50/0

Table I. Experimental design

	No. of communities	*Protein-calorie suppl.*	*Calorie suppl.*	*Vit. and minerals*	*Med. care*	*Nutrient content of suppl. per 180 ml**	
						Total calories (Kcal)	*Protein (gm)*
Atole	2	+	+	+	+	163	11
Fresco	2	–	+	+	+	59	—

*In addition, both preparations contain similar concentrations of vitamins and minerals.

Table II. Relationship between length of postpartum amenorrhea and maternal and infant indicators of nutritional status

Variable	*Correlation coefficient*	*No. of cases*
Nutrient intake:		
Maternal caloric supplementation		
During pregnancy	−0.07	398
During lactation	−0.04	398
Home caloric intake (pregnancy)	−0.10	339
Total caloric intake (pregnancy)	−0.12*	339
Infant food supplementation (0-9 mo.)	−0.14†	401
Anthropometry:		
Maternal height	−0.10	395
Head circumference	−0.09	298
Weight‡	−0.14	160
Arm circumference‡	−0.13	160
Infant's weight change (0-9 mo.)	−0.15*	301

*$p < 0.01$

†$p < 0.05$.

‡At 3 mo. after delivery.

perimental design. One of the two types of supplements—a protein-calorie supplement (Atole, a gruel commonly made with corn) or a calorie supplement (Fresco, Spanish for a refreshing, cool drink)—was provided in each of the four participating villages. Attendance at the food supplementation center was free and voluntary and this resulted in a wide range of supplement intake in the study population.

The entire population of the four communities was 3,359 in the 1975 census. The total sample for analysis was made up of all mothers in the four communities who were delivered between January 1, 1969, and February 28, 1973 (n = 671), and who had been followed up to January, 1975. However, because reliable information on menstruation and lactation was not collected prospectively until the end of 1970, we have prospective information for only 438 intervals.

The duration of postpartum amenorrhea and lactation was obtained prospectively by monitoring menstruation and lactation every 14 days in all women in the study population. The duration of postpartum amenorrhea was defined as the interval (in months) between a birth date and the first incidence of two menses occurring within a 3 month period. The duration of lactation was defined as the interval (in months) between a birth date and weaning.

Maternal and infant anthropometry were obtained at regular intervals. This report presents information on maternal weight, height, head circumference, and arm circumference and on infant weight.

Supplement intake is expressed in terms of calories because the normal dietary intake appeared to be more limited in calories than in proteins. The food supplementation program has been found to increase variability in nutrient intake and to provide a true supplement to the habitual diets of pregnant mothers.[11] Information on home diet was obtained through a 24 hour recall survey done once each trimester of pregnancy. For the present analyses this information was summarized for the last two trimesters of pregnancy and is expressed as the mean home caloric intake. Home dietary intake and supplement consumption were summed to produce an estimate of total nutrient intake. A total nutrient intake measure is not available for infants and lactating women since home diet surveys were not conducted for these groups.

Thus, pregnant women are categorized by: (1) the number of supplemental calories ingested during pregnancy, (2) home diet caloric intake, and (3) total caloric intake. Lactating women are recorded by supplemental caloric ingestion.

Results

General analytic strategies. Two types of postpartum amenorrheic intervals are distinguished in prospective studies: the "entirely prospective" and the "truncated prospective" intervals.[12] An interval is called "entirely prospective" when the start and end of the interval fall within the prospective period of data gathering. The "truncated prospective" intervals start in the prospective period but are truncated by outmigration or termination of the study.

In order to examine in detail the effect of maternal

Table III. Effect of maternal caloric supplementation by trimester of pregnancy and home diet on the duration of postpartum amenorrhea

*Controlling for maternal characteristics**	*Calorie supplementation during pregnancy*			*Home diet slope‡*
	First trimester slope†	*Second trimester slope†*	*Third trimester slope†*	
Simple regression	−0.005	−0.000	−0.006	−0.003‖
Multiple regression§	−0.011	−0.011	−0.013¶	−0.003¶

*Other variables entered in the multiple regression in addition to caloric supplementation per trimester of pregnancy and home diet: maternal morbidity, socioeconomic status, height, head circumference and parity; sex, birth weight, and gestational age of the infant.

†Slope expressed in months per 100 calories.

‡Slope expressed in months per calorie.

§After all variables have entered in the multiple regression $R^2 = 17\%$. Other variables statistically significantly related to the length of postpartum amenorrhea were socioeconomic status and parity.

‖$p < 0.01$.

¶$p < 0.05$.

Table IV. Effects of maternal total nutrient intake during the third trimester of pregnancy, and maternal and infant supplementation during lactation on the duration of postpartum amenorrhea

*Controlling for maternal characteristics**	*Pregnancy: total nutrient intake (third trimester) slope†*	*Lactation (0-9 mo.)*	
		Maternal food supplementation slope‡	*Infant food supplementation slope‡*
Simple regression	−0.003‖	−0.000	−0.004¶
Multiple regression§	−0.002¶	0.002	−0.008‖

*Other variables entered in the multiple regression in addition to total nutrient intake and maternal and infant supplementation during lactation: maternal morbidity, socioeconomic status, height, head circumference, and parity; sex, birth weight, and gestational age of the infant.

†Slope expressed in months per calorie.

‡Slope expressed in months per 100 calories.

§After all variables have entered in the multiple regression $R^2 = 20\%$. Other variables statistically significantly related to the length of postpartum amenorrhea were socioeconomic status and parity.

‖$p < 0.01$.

¶$p < 0.05$.

nutrition, infant supplementation, lactation, and duration of postpartum amenorrhea, we will concentrate on the entirely prospective intervals. This can be done because of the low attrition rates (<10%) and the long follow-up of the study sample. Stillbirth and infant deaths were excluded from all analyses.

Entirely prospective information. The mean duration of lactation in the four communities is 18 months; the mean duration of postpartum amenorrhea is 14 months. The two variables are highly associated ($r = 0.60$, $df = 423$, $p < 0.01$).

As shown in Table II, a negative association was found between the duration of postpartum amenorrhea and measures of nutritional intake (home diet and food supplementation) of the mother during pregnancy and lactation and of the infant during the first year of life. The magnitude of these associations was similar for both the protein-calorie supplement (Atole) and the calorie supplement (Fresco). Hereafter, the results of the Atole and Fresco population are combined for presentation. Negative associations were also found between the anthropometric measurements of the mother and the duration of postpartum amenorrhea, and a positive association was found between weight gain of the infant and duration of postpartum amenorrhea. In this population there are nonsignificant negative associations between weight gain of the infant and supplementation of the infant from 0 to 9 months ($r = -0.05$, $N = 353$, $p > 0.05$), and between infant supplementation and duration of lactation ($r = -0.02$, $N = 479$, $p > 0.05$).

These results suggest that both the nutritional status of the mother and the food supplement ingested by the infant affect the duration of postpartum amenorrhea. However, food supplement ingested by the mother and by the infant are positively and significantly associated.

Thus, it may well be that the observed association between maternal nutritional status and the length of postpartum amenorrhea is spurious. We explored this possibility in two steps.

Multiple regressions analyses were performed to determine the relative impact of food supplementation ingested during the different trimesters of pregnancy. Table III presents the results of these analyses. There was a significant negative association between amount of caloric supplement consumed by the mother during the third trimester and the duration of postpartum amenorrhea, after controlling for the amount of supplement consumed during the first two trimesters of pregnancy.

Furthermore, as illustrated in Table III, home diet, family socioeconomic status, and parity are also significantly associated with the duration of postpartum amenorrhea. Based on the results in Table III, we combined calories from both home dietary intake and supplement consumption during the third trimester as an estimate of total nutrient intake for this period. This measure of total nutrient intake was negatively and significantly associated with the duration of postpartum amenorrhea ($r = -0.219$, $p < 0.01$). These results suggest that most of the association between total nutrient intake during pregnancy and length of postpartum amenorrhea can be attributed to the nutrient intake of the mother during the third trimester of pregnancy.

Next, we examined the relative contribution to length of amenorrhea of our measure of total nutrient intake during the third trimester of pregnancy as compared to food supplementation ingested by the mother during lactation and that ingested by the infant. The lack of information on home diet of the lactating mother and of the infant preclude construction of an estimate of total nutrient intake during this period. In this regression analysis the supplement consumed by the lactating mother, the infant, the estimate of total nutrient intake during the third trimester of pregnancy, and other maternal characteristics were used to predict the duration of postpartum amenorrhea.

As shown in Table IV, when all independent variables were entered into the multiple regression equation predicting duration of postpartum amenorrhea, the association between total caloric intake during the third trimester of pregnancy and length of postpartum amenorrhea remained statistically significant. Similarly, the amount of supplement ingested by the infant during the first 9 months of lactation continued to predict postpartum amenorrhea significantly. Thus, variables controlled for here, either alone or in combination, could not explain either of the original significant associations. Although the strength of the association between third trimester total nutrient intake and postpartum amenorrhea diminished after controlling for the other variables, suggesting that part of this association was due to the intercorrelation between total nutrient intake and the other variables, the association remains statistically significant.

Comment

The data presented here indicate that improved nutritional status of the mother during the third trimester of pregnancy is associated with a decreased duration of postpartum amenorrhea. Food supplementation ingested by the infant during the first 9 months of life is also negatively associated with the duration of amenorrhea. Each of these associations remained significant after controlling for the other. The results suggest that both factors independently affect the length of postpartum amenorrhea.

The fact that food supplementation ingested by the infant during lactation is negatively associated with the length of postpartum amenorrhea admits to three possible interpretations: (1) if a mother begins supplementing the breast-fed infant's diet the frequency of suckling will decrease, reducing the secretion of prolactin and, as has been postulated,[3] triggering the commencement of ovulation; (2) if a mother begins supplementing the breast-fed infant's diet the nutritional demand of lactation will decrease, improving the nutritional status of the mother; this alternative would support the hypothesis of an effect of nutrition on the duration of postpartum amenorrhea; (3) there may be an interaction between hormonal and nutritional mechanisms. Cases of secondary amenorrhea in young women resulting from uncontrolled weight reduction have been reported by Lev-Ran.[13] In these cases, extremely low levels of follicle-stimulating hormone were associated with the decrease in weight. Even though we do not know all the possible relationships between nutrition and the endocrine pattern of the hypothalmic pituitary ovarian axis, Lev-Ran's report suggests the probability of an interaction. It may well be that this is also the case in the interrelationship among nutrition, lactation, and postpartum amenorrhea.

In the analyses reported above, the amount of food supplement ingested by the infant during the 9 months after birth was used as proxy for frequency of suckling. This is consistent with the observed negative association between infant food supplement ingestion and the duration of postpartum amenorrhea. However, if ingestion is a poor proxy for reduced levels of suckling, it is impossible to select among the three possible mechanisms reviewed above.

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