CLINICAL NUTRITION

MATERNAL DIETARY SUPPLEMENTATION AND INFANT BIRTH WEIGHT

A group of Guatemalan workers show that when all other important variables are controlled it can be proven in an undernourished population that maternal dietary supplementation critically affects infant birth weight.

KEY WORDS: maternal diet, birth weight, undernutrition, Latin America

It is clear that the amount of food ingested by the infant is a major factor in controlling his growth and development, but there is still considerable speculation as to whether and how maternal deprivation influences fetal growth. In conditions of maternal undernutrition, is it protein, calories, or vitamins which cause fetal underdevelopment? Are our methods of assessment in the case of humans adequate to answer such questions? There is no doubt about the animal studies, where carefully controlled experiments have shown that maternal malnutrition leads to low birth weight, reduced litter size, and congenital abnormalities. L. Bergner and M. W. Susser[1] in an extensive review could find only one study in man which was carefully enough controlled to permit the conclusion that maternal dietary supplementation affected infant birth weight. It was also concluded recently "that a well designed unbiased experimental approach to the problem could lead to important conclusions and consequences."[2]

This problem is being investigated intensively in Latin America. In a preliminary review, A. Lechtig, G. Arroyave, J.-P. Habicht, and M. Behar have looked at the current state of the knowledge about maternal malnutrition and fetal development.[3] To give an idea of the extent of the problem, they quote data to show that in Guatemala, Colombia, and Chile, mothers showed a mean weight increase in pregnancy of only 5 to 7 kg., and the ratio of essential and nonessential amino acids in plasma indicated a possible deficiency in protein intake. With pregnancy there was no evidence of increased maternal intake of food. They also claimed that in Latin America some 3.6 million children are born weighing less than 2.5 kg. The attendant fetal wastage is obvious and there is the possibility that these children are strong candidates for severe infantile protein-calorie malnutrition. From the review it was clear that in these countries there were no data to indicate which aspects of the maternal ecology were primarily responsible for the low infant birth weights.

In the next study the relationship between maternal diet as determined by dietary history and birth weights of the babies produced was examined.[4] The study involved 51 women in six Guatemalan villages. The intakes of calories, protein, riboflavin, iron, and vitamin A were calculated from 24- or 72-hour dietary recalls conducted at different times during the pregnancy. Most of the data were collected from 24-hour recalls repeated several times. Similar average results were obtained whether the 24-hour or 72-hour technique was used.

The mean caloric intake during the first trimester of pregnancy was about 1,400 calories and this increased to approximately 1,700 calories during the second and third trimesters. The mean protein intake increased from about 40 g. to nearly 50 g. Only the intakes during the latter two trimesters were considered in relating the data to the birth weights of the babies.

The frequency of intakes of the various nutrients is presented graphically relative to presumed standards of adequacy. The great majority were judged to be consuming

inadequate amounts of all five nutrients considered. Some 70 percent of the mothers were receiving less than 80 percent of the levels considered adequate for the nutrients studied. The intake of vitamin A appears to be particularly low and the intakes of iron and riboflavin somewhat less adequate than those of protein and calories.

The mean birth weight of the 51 babies was 2.99 ± 0.48 kg. The nine mothers with the highest calorie intakes, between 2,200 and 3,100 per day, had babies with a mean weight of 3,150 g. and 80 percent of the babies weighed 3 kg. or more. Of the 34 mothers with the lowest intakes, between 700 and 1,800 calories per day, the mean birth weight was about 2,850 g. and only 38 percent exceeded 3 kg. The eight mothers in the intermediate group produced babies of intermediate size also.

Comparable analyses for the intake of the other nutrients estimated are not presented. In all likelihood the intake of other nutrients would be correlated to a significant degree with the calorie intake and an analysis of the data would not be decisive in determining whether calories were indeed the primary nutritional deficit. However, some additional comparisons of birth weights with intakes of other nutrients would be of interest. The data imply that in spite of the apparent limitations in protein, iron, vitamin A, and riboflavin the outcome of pregnancy was reasonably satisfactory provided that the diet was eaten in sufficient amounts.

The authors comment that the data clearly suggest that mothers can survive and produce babies on levels of intake much below those considered to be required, or that the survey technique systematically underestimates the actual intake; also, that since it is not known what factors actually cause these very low intakes, one cannot necessarily conclude that there is a causal relationship between calorie intake and birth weight. A study in which food supplements were provided should be more decisive.

A group of 120 pregnant women from four comparable Guatemalan villages was selected for study.[5] Seven were subsequently eliminated since they did not carry their infants to term. In two villages 71 women were provided with a nutritional supplement, composed of skimmed milk powder, vegetable protein mixture (Incaparina) and sugar, that contained 91 calories and 6.4 g. of protein per 100 ml. and was fortified with vitamins and minerals. Forty-two women in two other villages were provided with a low calorie refreshing drink which contained only sugar and 36 calories per 100 ml. The two groups were judged to be similar, based on dietary studies (mean intake of approximately 1,500 calories per day), days of illness during gestation, and maternal height. The group receiving the nutritional supplement had completed more pregnancies, average 4.7, than the other group, average 2.8. The women entered the trial after they had missed two menstrual periods.

The supplements were distributed twice daily to those women who attended specific distribution centers. There was a wide variation in the days of attendance, ranging from none to 200 days, and similar differences in the number of weeks of satisfactory attendance and total amount of the drink consumed. When the birth weights of the infants were analyzed, it was found that the mean birth weights were 3.089 ± 0.450 kg., compared with 3.069 ± 0.450 in the group without the fortified supplement. These average values are comparable to the average weights reported in the previous study.

Because there was such a wide range of attendance in each group the authors calculated the correlation between birth weights of the infants and the total days of attendance at the distribution center, the total number of satisfactory weeks of attendance (more than four days a week), and total consumption of the supplement during the trial. All of these were statistically significant in the group which received the nutritional supplement; none was significant in the group which received the sweetened drink. Also, 85 percent of the mothers who attended the supplementation center for 60 days or more delivered babies of 3.0 kg. or more compared with

only 50 percent of the mothers with unsatisfactory attendance of those in the control group.

The expected intake (assuming perfect attendance) is not presented. However, the intakes ranged up to 100 liters during the trial. It is of interest that of the 71 women assigned to the supplemented group, 31 consumed from zero to 10 liters and had babies with a mean weight of 2,940 g.; 26 had intakes between 11 and 30 liters and had babies of mean weight about 3,100 g.; and only 13 consumed over 30 liters. The babies of the latter group had a mean weight of 3,400 g. This value is comparable to the mean weight of babies in the technologically developed countries and in the upper social classes in Guatemala.

Although data are not given, the authors state that no significant changes in the amount of habitual diets consumed were observed during the study. Thus they believe that in the group with a high consumption of the supplement there was an actual increase in calorie intake between 200 and 500 calories per day, rather than a replacement of calories ordinarily consumed.

The figures on attendance given above are indicative of some of the difficulties of these kinds of studies and the general difficulties of programs for nutritional improvement. Of the 71 women offered the nutritional supplement only 13 took full advantage of the opportunity. Other means of distribution which would not require going to a distribution center might be more successful since this is certainly an inconvenience and no doubt discourages participation. However, it is very difficult to determine the degree of actual participation if food supplements are delivered to or consumed at home. It would be of interest to know what factors influenced attendance.

Although the numbers in the successful group are small, the fact that all measures of the degree of participation correlate positively with the weights of the babies argues strongly for the authors' conclusion that food supplementation during gestation resulted in an improvement in fetal growth. It probably cannot be argued that the mothers who were more highly motivated and attended regularly were also more concerned about other aspects of their pregnancy which might lead to improvement in the outcome, since there was no significant correlation between birth weight and measures of participation in the control group which received the low calorie drink.

No data are provided on the weights of the women or the gain in weight during pregnancy. It would be of interest to know whether there was an increase in maternal weight with the supplement and whether this also correlated with birth weight.

There is no doubt that if the maternal organism is severely malnourished the outcome of the pregnancy will be less than satisfactory. Thus the question is not whether maternal nutrition is important but rather how do we define nutritional requirements of pregnant women or identify those with inadequate intakes or special needs who will benefit from nutritional improvement. It is certain also that in better-fed populations there will be fewer individuals who are malnourished and the relationship between nutrition and the outcome of pregnancy more difficult to define. The opportunities in populations such as those being studied by Lechtig et al. are obvious and these well-designed studies are a clear contribution in a difficult field. □

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