Effect of a Formulation of Supplementary Food for Pregnant Women on Birth Weight of Newborns

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Summary The effect of a supplementary food mix prepared from roasted mungbean, groundnuts, and sugars on maternal nutrition and birth weight of newborns was studied. The results indicated that supplementary food provided to the pregnant women had a significantly positive effect on the birth weight of newborns. In addition, a significantly higher weight gain by the mothers was observed as compared to the control group.

Key Words supplementation, pregnant women, birth weight

The nutrition of the mother and child is an interrelating phenomenon. The fetus draws its nutritional requirements from mother during pregnancy and the baby’s birth weight is related to the food intake and body weight of the mother (1, 2). Maternal malnutrition is a major factor contributing to low birth weight, which is associated with high prenatal mortality. Chances are that a malnourished mother will produce a malnourished child who might show both physical and mental retardation and decreased capacity for adaptation to the environment (3–7).

Weight gain of healthy European women during pregnancy has been estimated to be 12.5 kg at term, while studies carried out in some developing countries in Asia and Africa have shown weight gain of only 5–6 kg during pregnancy. There seems to be strong correlation between weight gain during pregnancy and birth weight (8). Infants born to a taller and heavier mother weight at least 1 kg more than those born to shorter and lighter women (9), and mothers with low total protein and albumin on serum frequently deliver low birth weight babies (10). Similarly a high frequency of low birth weight infants is reported in anemic women (11). It has been reported that if the mother receives insufficient protein and energy during the last period of pregnancy, the newborn baby will have an unusually low birth weight (LBW) (12). In Pakistan, 35–40% of the babies born in low socioeconomic households are below 2–3 kg, while in developed countries it is 3.5 kg with only 10%
below 2.5 kg. The government is making serious efforts in trying to reduce the incidence of LBW to 25% of the present level during the current five-year plan (13).

The WHO has recommended an additional allowance of 300 kcal per day for pregnant women to allow for increasing growth and development of the fetus.

Many workers have advocated the use of supplementary food for pregnant women in the third trimester, which reportedly increases the mother’s weight and significantly increases the baby’s birth weight (14, 15).

It was therefore considered to be of great interest to formulate a supplementary food from low-cost cereal, legumes, and oilseed for feeding pregnant women.

The present study was undertaken to formulate protein- and energy-rich supplementary food from plant sources for the pregnant women of the low socioeconomic group and to see the effect of supplementary food on maternal health and birth weight of infant.

MATERIALS AND METHODS

Sample collection. Wheat flour (Triticum vulgare), mungbean (Phaseolus mungo), groundnut (Arachis hypogaea), and sugar were purchased from the local market. Four mixes were formulated and prepared.

Preparation of food mixes. Mungbean and groundnuts were roasted and ground in an electric grinder. Wheat flour was roasted on an iron pan. Sugar was ground. The ingredients were mixed in a specified proportion. The formulation of the mixes is given in Table 1.

Proximate composition. The protein and fat contents of the mixes were determined by the standard methods of A.O.A.C. (16). Energy content was estimated by Paar adiabetic bomb calorimeter. The results of these analyses are presented in Table 2.

Organoleptic evaluation. The prepared mixes were tested for their acceptability by distributing them among 50 randomly selected staff and students of the Institute of Nutrition, Ramathibodi Hospital, Bangkok, Thailand. The results showed that all the mixes were equally acceptable, but mix-4 prepared from mungbean, groundnut, and sugar in the ratio of 35, 35, and 30% was evaluated to be the best for taste and acceptability. Mix-4 also had the highest protein (16.5 g),
fat (14.6 g), and energy (488 kcal) per 100 g mix. Its shelf life was found to be one month. Therefore mix-4 was selected as the supplementary food to be given to the pregnant women.

**Experimental procedure.** The study was undertaken at the M.C.H. Centre, Rajpuri Province, about 150 km from Bangkok, Thailand. Twenty-nine pregnant women in their third trimester were chosen with the help of a gynecologist. The subjects were healthy, between 20–30 years of age, and from the same socioeconomic background. The dietary protein and energy intakes were calculated by 24-h recall method. The weight, height, and hematocrit of the subjects were measured at the beginning and end of the experiment. The duration of the experiment was about 12 weeks. The subjects were divided into two groups. One group acted as control and the other as experimental. The initial characteristics of the two groups is given in Table 3. The subjects were given a supplementary food containing 16.5 g protein and 488 kcal per 100 g of food per day. The food mixes were given once a week and the subjects consumed these foods daily from the beginning of the study until the last clinic visit for delivery. Most of the subjects entered the study when the fetus was at 25 weeks of gestational age. Two subjects in the control group and two in the supplemented group were enrolled at 26 weeks of gestation. The average age of the control group was 23.8 years against 22.3 years for the supplemented group. The gravidarum and height of control and test groups were in a similar range and not statistically different among the groups. The food mix was prepared in the metabolic kitchen of the Institute of Nutrition, Ramathibodi Hospital, Bangkok. One hundred gram of the food mix was packed in plastic bags, sealed, and 7 such

### Table 2. Proximate composition of the food mixes.

| Food mix | Protein (g/100 g) | Fat (g/100 g) | Energy (kcal) |
|----------|------------------|--------------|--------------|
| 1        | 12.1             | 12.6         | 432          |
| 2        | 13.6             | 14.0         | 447          |
| 3        | 13.9             | 12.7         | 461          |
| 4        | 16.5             | 14.6         | 488          |

### Table 3. Initial characteristics of pregnant women studied for evaluation of supplementary food mix.

| Group       | No. of subjects | Age (yr)       | Gravidarum | Height (cm) |
|-------------|-----------------|----------------|------------|-------------|
| Control     | 15              | 23.8 ± 2.52    | 1.46 ± 0.28 | 152.4 ± 2.34 |
| Supplemented| 14              | 22.3 ± 2.82    | 1.53 ± 0.31 | 149.9 ± 2.45 |

Mean ± SD. *No statistical difference between the two groups (p > 0.05).
bags were distributed weekly among each of the women in the experimental group at the M. C. H. Centre. Those who could not come weekly to the centre were given 14 bags for a 14-day period. The women were advised to consume 100 g of the food mix daily in addition to their usual diet. The women in the control group were given the incentive of free medical care for participation in the project. Informed consent was obtained from all the experimental subjects.

RESULTS AND DISCUSSION

The energy, protein, and carbohydrate intakes of control and supplemented groups are given in Table 4. The intakes of these nutrients were quite low. The habitual protein and energy intakes of the subjects were 50% below the FAO/WHO recommendation for pregnant women. The energy intake was inadequate even for non-pregnant women.

The effect of supplemental food during the three months of pregnancy on the maternal weight is given in Table 5. In this study the supplemented mothers gained significantly higher weight (0.42 kg/week) as compared to the control group (0.27 kg/week). This observation is in line with the finding of Lechtig et al. (14), who conducted a study in a low income rural population with intakes of 1,400–1,600 kcal energy and 40–50 g protein per day and found significant maternal weight gain with supplemented food.

Table 4. Energy intake and its distribution of pregnant women based on 24-h dietary recall (excluding supplementation).a

| Group        | No. of subjects | Energy (kcal) | Fat (g) | Protein (g) | Carbohydrate (g) |
|--------------|-----------------|---------------|---------|-------------|------------------|
| Control      | 15              | 1,440 ± 417   | 33.2    | 52.2        | 240              |
| Supplemented | 14              | 1,410 ± 382   | 31.8    | 53.1        | 234              |

Mean ± SD. a No significant difference between the two groups for all nutrients (p > 0.05).

Table 5. Body weight and weight gain of pregnant women studied for evaluation of a supplementary food mix.

| Group        | No. of subject | Initialb Weight (kg) | Final Weight gain (kg) | Weight gainb (kg/week) |
|--------------|----------------|----------------------|------------------------|------------------------|
| Control      | 15             | 54.2 ± 7.25          | 57.5 ± 3.98            | 3.3 ± 1.11             | 0.27 ± 0.09          |
| Supplemented | 14             | 54.8 ± 5.80          | 59.9 ± 6.58            | 5.1 ± 1.70             | 0.42 ± 0.16          |

a At 25 weeks of gestation. b Significant (p < 0.05).
Table 6. Hematocrit value of pregnant women.

| Group          | No. of subject | Hematocrit (%)<sup>a</sup> | Before | After | Increase |
|----------------|---------------|----------------------------|--------|-------|----------|
| Control        | 15            | 36.2 ± 4.8                 | 36.4 ± 5.0 | 0.2 ± 3.2 |
| Supplemented   | 14            | 34.7 ± 2.8                 | 36.7 ± 4.2 | 2.0 ± 3.7 |

<sup>a</sup> Nonsignificant (<i>p</i> > 0.05).

Table 7. Birth weight, length, and head circumference of newborn, and placental weight studied for evaluation of maternal supplementation.

| Group          | No. of subjects | Gestational age (week) | Birth weight (g) | Length (cm) | Head circumference (cm) | Placental weight (g) |
|----------------|-----------------|------------------------|------------------|-------------|------------------------|----------------------|
| Control        | 15              | 39.5 ± 0.8             | 2,853 ± 137.03   | 50.4 ± 0.69 | 34.4 ± 1.3             | 532 ± 26             |
| Supplemented   | 14              | 39.5 ± 0.2             | 3,177 ± 364.46<sup>a</sup> | 51.6 ± 2.10 | 34.8 ± 1.42            | 637 ± 72<sup>a</sup> |

<sup>a</sup> Significant (<i>p</i> < 0.05).

Table 8. Birth weight of male and female newborn infants studied for evaluation of maternal supplementation.

| Group          | No. of subjects | Male | Female |
|----------------|-----------------|------|--------|
|                | No.             | Birth weight (g) | No. | Birth weight (g) |
| Control        | 15              | 5    | 2,798 ± 267 | 10  | 2,866 ± 242 |
| Supplemented   | 14              | 10   | 3,329 ± 388<sup>a</sup> | 4   | 2,884 ± 176<sup>b</sup> |

<sup>a</sup> Significant (<i>p</i> < 0.05). <sup>b</sup> Nonsignificant (<i>p</i> > 0.05).

The hematocrit value of the pregnant women in the control and supplemented groups is given in Table 6. The average increase in the hematocrit of supplemented group was 2.0% as compared to 0.2% for control group. Though there was an increase in the hematocrit of the supplemented group, this increase was not significantly different from the control group.

Table 7 shows the birth weight, length, and head circumference of the newborns and placental weight. The results indicated that the mean birth weight and placental weight of supplemented group were significantly higher (<i>p</i> < 0.05) than those in the control group, but the length and head circumference of the two
groups were not significantly different. This finding confirmed the previous observation that intrauterine malnutrition would affect weight first, then length and head size (11).

As presented in Table 8 the birth weight of male newborns was significantly higher than that of females in the supplemented group \((p<0.05)\). However, there was no significant difference in the birth weight of females in both groups. These findings agree with those of Mora et al. (15).

The result of this study shows that the supplementary food, which provides an additional 488 kcal of energy to the pregnant women, had a significant positive effect on the birth weight of newborns and could be of great use in developing countries where the incidence of low birth weight is quite high.

Since the supplementary food is made from locally available low-cost food ingredients and in its preparation no new technology is involved, this food supplement can be prepared at the village level to provide benefit for pregnant women and reduce incidence of low birth weight infants in Pakistan.

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