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STANDARD AND LOW BIRTH WEIGHT FORMULAS COMPARED FOR EFFECTS ON GROWTH OF PRETERM INFANTS*

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SUMMARY: Yeşilipek M.A. (Maternity and Children's Hospital, Samsun, Turkey). Standard and low birth weight formulas compared for effects on growth of preterm infants. Turk J Pediatr 34:31-36, 1992.

The study population consisted of 22 infants hospitalized for low birth weight or prematurity at the Maternity and Children's Hospital in Samsun. Eleven infants were fed the low birth weight formula and the rest were fed the standard formula. Weight gain, increases in length and occipitofrontal circumference were higher in the low birth weight formula group than in the standard formula group.

In cases which reguire it, a low birth weight formula should be given instead of the standard formula. *Key words: preterm infants, low birth weight formula, growth.*

It is a known fact that breast milk is the most suitable food for newborns. Its immunological properties may help prevent infection and reduce the incidence of necrotizing enterocolitis[1,2]. However, sometimes breast milk may be insufficient or undesirable, due to maternal conditions (illness, drug use, etc.), particularly in the early postpartum period.

Since brain growth occurs mainly between the second half of the third trimester of pregnancy and the second year of life, some authors stipulate that for normal neurological development, adequate growth of preterm and low birth weight infants is necessary[3].

Recently, there have been a few studies concerning newly modified formulas for preterm infants that are higher in protein, minerals and calories than standard formulas[1,4-7]. Preterm and low birth weight infant growth has been demonstrated to be better with these new formulas.

The present study was designed to compare the newly modified formula with the standard formula to determine if the former had any effect on the growth of preterm infants when used as a supplement to breast milk, and also to evaluate if it could be used as a replacement for breast milk.

Material and Methods

The study population consisted of 22 preterm infants who had been hospitalized at the Maternity and Children's Hospital in Samsun between January-March 1989.

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All infants with a birth weight under 2000 g were randomly divided into two groups. The infants were healthy at the time of the study and none had congenital malformations, infections or respiratory distress syndrome (RDS). The gestational age of the infants was determined from the obstetric history and from Dubowitz scoring[8]. Infants in group I were fed SMA-26 (Wyeth Lab) and the infants in group II SMA-Low Birth Weight Formula SMA-S-26 (Wyeth Lab) (Table I). All infants were fed 60 ml/kg of their respective formulas during the first day. This amount was gradually increased to 150 ml/kg/day over a period of five days. The study ended when each baby reached 2500 g.

TABLE I: Nutrient Content of Formulas
(per 100 ml)

	SMA-26	SMA-S-26 LBW***	Breast Milk
Energy (kcal)	66.66	81.00	64.00*
Fat (g)	3.60	4.32	3.50*
Protein (g)	1.50	1.92	1.46*
Carbohydrates (g)	7.20	8.40	7.30**
Sodium (mg)	15.00	32.00	29.00**
Calcium (mg)	42.00	80.00	28.00**
Phosphorus (mg)	28.00	40.00	12.00**

* Ref. 9
** Ref. 1
*** LBW: low birth weight.

Weight, length and occipitofrontal circumference (OFC) were measured weekly. The infants were weighed on a scale to the nearest 10 g, the crown-heel length and OFC were measured to the nearest mm using a disposable paper tape measure. All measurements were taken by the same observer.

The compositions of the two formulas were supplied by the respective companies. Serum electrolytes, urea, calcium, total protein and glucose were measured one week after the start of the study using a flame photometer (Lange M-7D) for electrolytes and a spectrophotometer (Shimadzu) for the other measurements. Osmolality was calculated by the following formula: Osmolality = $(Na^+ + K^+)$ 2+ (Glucose/18) + (Urea/3).

For statistical analysis, the groups were compared using *Student's t* test.

Results

Pertinent data regarding the infants are presented in Table II. No statistical differences were found between the two groups with regard to gestational age or birth weight (Table II).

TABLE II: Data Pertaining to the Infants

	Group I (SMA-26) (n = 11)	Group II (SMA-S-26) (n = 11)	
Gestation (wk)	31.73 ± 2.53*	31.45 ± 2.54	p>0.05
Birth weight (g)	1622.72 ± 368.35	1677.27 ± 378.39	p>0.05
M/F**	5/6	5/6	

* Mean ± SD
** M: male, F: female

Weight gain, increases in length and OFC gain were greater in Group II when compared to Group I. The differences between the two groups were statistically significant (Table III).

Mean serum sodium, potassium, total protein concentrations and serum osmolalities were similar in the two groups and no significant difference was observed statistically. However, there were significant statistical differences found with regard to the serum urea, calcium and glucose levels (Table IV).

TABLE III: Average Growth Rate of the Two Groups

	SMA-26 Group I	SMA-S-26 Group II	
Weight gain (g/day)	25.75 ± 1.46*	42.88 ± 2.41	p<0.001
Length increase (cm/wk)	1.09 ± 0.11	1.63 ± 0.16	p<0.05
OFC increase (cm/wk)	0.80 ± 0.09	1.19 ± 0.11	p<0.05

* Mean ± SD

Discussion

Nutrition is an important problem in premature and low birth weight infants. Although protein and energy requirements of low birth weight infants are still

TABLE IV: Blood Chemistry of the Groups

	SMA-26 Group I	SMA-S-26 Group II	
Sodium (mEq/L)	135.55 ± 2.58*	136.09 ± 1.81	p>0.05
Potassium (mEq/L)	3.39 ± 0.23	3.45 ± 0.38	p>0.05
Urea (mg/dl)	15.00 ± 3.60	11.64 ± 1.69	p<0.05
Total protein (g/dl)	6.86 ± 0.74	7.24 ± 0.46	p>0.05
Calcium (g/dl)	9.04 ± 0.35	9.42 ± 0.41	p<0.05
Glucose (mg/dl)	73.63 ± 8.05	64.54 ± 3.22	p<0.05
Osmolality (mosm/kg)	285.89 ± 4.53	286.72 ± 3.70	p>0.05

* Mean ± SD

controversial, some authors have recommended that intakes should be higher than in infants born at term to promote intrauterine growth performance and prevent hypoproteinemia[4]. In order to provide the energy requirements of most preterm and low birth weight infants, an intake of 110-165 kcl/kg/day is sufficient for a growth rate to be similar to that occurring in utero[10]. There have been several reports of differences in protein content between the milk of mothers who have delivered full term infants and those who have delivered preterm infants. This observation has been cited in support of preterm milk as an evolutionary adaptation to the greater protein requirements for growth of preterm infants[11-13].

Until now, breast feeding was accepted as the best method of nutrition for the premature infant[1]. Although the daily protein requirement of small preterm infants is not exactly known, breast milk is believed to be insufficent[1]. In recent years, newly modified milk formulas with higher protein, mineral and calorie content have been produced for the low birth weight infant[1,4-7]. When the new formulas were compared with breast milk and with standard milk formulas, the growth of preterm infants was found to be better with the new formula. Furthermore, low birth weight formulas have been shown to be metabolically safe for smallest infants[5]. Although optimum weight gain of the preterm infant has not been clearly defined, according to some authors, the optimal growth rate criteria should be taken as the intrauterine growth rate of the fetus in the third trimester of pregnancy. Thus a fetus of 32-36 week gestational age should grow at a rate of 30.7 g/day[1]. In this study, weight gain of infants fed the SMA-S-26 formula was above this value while those fed the standard formula (SMA) was below (Table III). There were statistically significant differences between the two groups ($p<0.001$).

Some authors suggest that the higher sodium content of preterm mother's milk may provide sufficient sodium for growth and reduce the incidence of late

hyponatremia. Therefore, they recommend the regular monitoring of plasma sodium concentrations and sodium supplements, if necessary[10]. However, in some reports, it is noted that higher sodium contents may have been responsible for the gain in weight. But these infants usually have higher serum sodium levels and their gain in weight is not accompained by increases in length or OFC[1]. In this study, sodium intakes were higher in group II infants than in group I infants. However, the sodium content of this formula is similar to that of breast milk. In addition, we found no cases evidencing hypernatremia, and although the differences in serum urea, calcium and glucose levels were found to be statistically significant, there were no significant differences between serum osmolality values of the two groups (Table IV). In addition the gain in weight was accompanied by increases in length and OFC in group II infants. There were statistically significant differences between the two groups regarding increases in length and in OFC ($p<0.05$).

Preterm and very low birth weight infants fed human milk are at some risk of developing phosphate depletion syndrome and bone disease[10]. The European Society of Pediatric Gastroenterology and Nutrition has recommended that formulas for these infants should be high in calcium and phosphorus and that mineral supplements should be given in a proportionate amount to maintain the calcium/phosphorus ratio in the range of 1.4-2.0. The calcium/phosphorus ratio of the low birth weight formula given our subjects was in accordance with this recommendation.

As in many other reports, the results of this study proved that the low birth weight formula is suitable for feeding preterm infants. However, some pediatricians continue to advise mothers to breast feed their premature infants. Lewis and Smith[14] have shown that high volume breast milk achieved optimum growth in the preterm infant. In their retrospective survey, they found no evidence of complications secondary to the use of high volume feeding. Therefore, they suggested that high volume feeding is a satisfactory alternative to the low birth weight formula, particularly for infants above 30 weeks gestation and of a birth weight of 1000 g.

In conclusion, breast milk may be preferred particularly for the initial feeding of the ill preterm infant. However, the low birth weight formula should be used instead of the standard formula if breast milk is insufficient or undesirable for feeding preterm infants. In addition, pediatricians should pay special attention to the sodium and protein contents of these formulas.

REFERENCES

1. Bell A, Halliday H, McClure G, Reid M. Controlled trial of new formulae for feeding low birth weight infants. *Early Hum Dev* 13:97, 1986.
2. Hanson LA, Winberg J. Breast milk and defence against infection in the newborn. *Arch Dis Child* 47:845, 1972.
3. Mamunes P, Price PE, Thornton HH, et al. Intellectual deficits after transient tyrosinemia in the term neonate. *Pediatrics* 57:675, 1976.
4. Brooke OG, Wood C, Barley J. Energy balance, nitrogen balance, and growth in preterm infants fed expressed breast milk, a premature infant formula, and two low-solute adapted formulae. *Arch Dis Child* 57:898, 1982.
5. Brooke OG, Onubogu O, Heath R, Carter ND. Human milk and preterm formula compared for effects on growth and metabolism. *Arch Dis Child* 62:917, 1987.
6. Putet G, Senterre J, Rigo J, Salle B. Nutrient balance, energy utilization, and composition of weight gain in very-low-birth-weight infants fed pooled human milk or a preterm formula. *J Pediatr* 105:79, 1984.
7. Cooper PA, Rothberg AD, Davies VA, Argent AC. Comparative growth and biochemical response of very low birthweight infants fed own mother's milk, a premature infant formula, or one of two standard formulas. *J Pediatr Gastroenterol Nutr* 4:786, 1985.
8. Dubowitz LM, Dubowitz V, Goldberg C. Clinical assessment of gestational age in the newborn infant. *J Pediatr* 77:1, 1970.
9. Kayakırılmaz K, Köksal O. Emzikli kadınların beslenme durumları-II. Anne sütünün miktarı ve bileşimi ve bebeğin büyüme durumu. *Doğa TU Tıp ve Ecz. D.* 10:3, 1986.
10. European Society of Paeditric Gastroentrology and Nutrition, Nutrition and feeding of preterm infants. *Acta Paediatr Scand Suppl.* 336, 1987.
11. Atkinson SA, Bryan MH, Anderson GH. Human milk: difference in nitrogen concentration in milk from mothers of term and premature infants. *J Pediatr* 93:67, 1978.
12. Schanler RJ, Oh W. Composition of breast milk obtained from mothers of premature infants as compared to breast milk obtained from donors. *J Pediatr* 96:679, 1980.
13. Gross SJ, David RJ, Bauman L, Tomarelli RM. Nutritional composition of milk produced by mothers delivering preterm. *J Pediatr* 96:641, 1980.
14. Lewis MA, Smith BA. High volume milk feeds for preterm infants. *Arch Dis Child* 59:779, 1984.