

Nutritional factors in milk from Brazilian mothers delivering small for gestational age neonates*

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GRUMACH, A.S. et al. Nutritional factors in milk from Brazilian mothers delivering small for gestational age neonates. *Rev. Saúde Pública*, 27: 455-62, 1993. The composition of breast milk from Brazilian mothers delivering low birthweight infants and its adequacy as a source of nutrients for this group has not yet been fully elucidated. A total of 209 milk samples from 66 women were analysed. The mothers were divided into three groups: G1, mothers delivering term babies of low birthweight (TSGA, n=16); G2, mothers delivering preterm babies of appropriate birthweight (PTAGA, n=20); G3, mothers delivering term babies of appropriate birthweight (TAGA, n=30). The following factors were analysed: osmolarity, total proteins and protein fractions, creatinocrit, sodium, potassium, calcium and magnesium. Milk samples were collected 48 h and 7, 15, 30 and 60 days after delivery. The groups did not differ significantly in terms of osmolarity, total proteins and fractions, creatinocrit, calcium, magnesium or potassium throughout the study period. Sodium levels were higher in all samples from mothers of TSGA infants and in samples from mothers of PTAGA infants on the 7th, 15th and 30th days than in milk from the TAGA group. The authors consider the needs of the low birthweight and TAGA infants and that these high sodium levels may be necessary for growth of low birthweight infants.

Keywords: Milk, human, physiology. Infant, low birth-weight. Infant nutrition.

Introduction

Few studies have been conducted to determine the minimum nutrient needs and the ability to tolerate food in small for gestational age term newborns (TSGA) (Boehm et al.⁶, 1988). In general, studies on the composition of breast milk from mothers of small for gestational age newborns have been devoted almost exclusively to preterm infants (American Acad Ped¹, 1985). However, considering that TSGA infants make up 5 to 8% of all newborns and approximately 25 to 30% of very low birthweight infants (Boehm et al.⁶, 1988), it is important to determine the nutritional composition and adequacy of breast milk for this group, specially in developing countries.

In view of the difficulty in fixing an ideal weight gain for this population, it is accepted that the growth rate applicable to premature infants is

identical to that of the weight-height gain occurring during gestation (American Acad Ped¹, 1985). However, no specific studies of this type are available for TSGA infants.

The American Academy of Pediatrics¹ (1985) recommends the same supply of macronutrients for low birthweight infants regardless of gestational age, with higher protein concentrations and similar fat and carbohydrate concentrations when compared to the diet for TAGA infants.

The composition of breast milk from mothers of TSGA infants has been investigated in only a few studies (Garza et al.¹³, 1981; Barros et al.⁴, 1984; Pamblanco et al.²², 1986; Grumach et al.¹⁶, 1993) and the present study was undertaken to evaluate the composition of breast milk from mothers of small for gestational age infants delivered at term and to compare it to that of milk from mothers of premature infants and adequate for gestational age term infants. These groups of samples were collected until the 60th day of lactation, so the nutritional factors in the same mother could be studied longitudinally.

Subjects and Methods

The nursing mothers included in the present study were divided into three groups according to the classification of newborn weight and gestational age: G1, mothers of small for gestational age

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term newborns (TSGA, n=16); G2, mothers of preterm appropriate for gestational age newborns (PTAGA, n=20) and G3, mothers of appropriate for gestational age term newborns (TAGA, n=30). This procedure was based on the data obtained by Ramos²⁵, 1986 in a study conducted at the same hospital and by Battaglia & Lubchenco⁵, 1967 (Fig. 1). Gestational age was determined taking into account the date of the last menstruation and the criteria of Dubowitz et al.¹¹, 1970 and/or Capurro et al.⁹, 1978. Mothers of newborns with gestational age of between 37 and 38 weeks were excluded from this study. The gestational age of the TSGA group was 38 to 41.3 weeks (mean 39.2 weeks) and infant birthweight was of from 1,900 to 2,510 g (mean 2,218 g). For the PTAGA group, gestational age ranged from 31.9 to 36.7 weeks (mean 34.6 weeks) and birthweight was of from 1,380 to 2,640 g (mean 2,065 g). For the TAGA group, gestational age was of from 38 to 41.2 weeks (mean 39.1 weeks) and birthweight was 2,570 to 3,650 g (mean 3,063 g)(Fig. 1).

The nursing mothers were in good nutritional condition and used no drugs that might interfere with lactation either during gestation or during the postpartum period. Gestation had been uneventful in all cases. Maternal age, parity, socio-economic level (Table) and previous experience with breast

Table. Socio-economic status of mother's delivering TSGA, PTAGA and TAGA neonates.

Groups	High	Low	Total
G1 (TSGA)	5	11	16
G2 (PTAGA)	3	17	20
G3 (TAGA)	11	19	30
Total	19	47	66

Goodman test (homogeneity)

$\chi^2 = 3.58$ (ns) $\chi_{crit} = 5.99$

TSGA = mothers of small for gestational age term newborns.

PTAGA = mothers of preterm appropriate for gestational age newborns.

TAGA = mothers of appropriate for gestational age term newborns.

feeding were similar in the three groups (Grumach et al.¹⁶, 1993). All the mothers gave their informed consent to participation in the study and the protocol was presented to an ethics committee of the Hospital.

Colostrum samples were collected during the first 48 hours after delivery and milk samples were collected on the 7th, 15th, 30th and 60th days of lactation. Collection was performed in the morning between breast feedings by manual expression or with the help of a manual breast pump. The

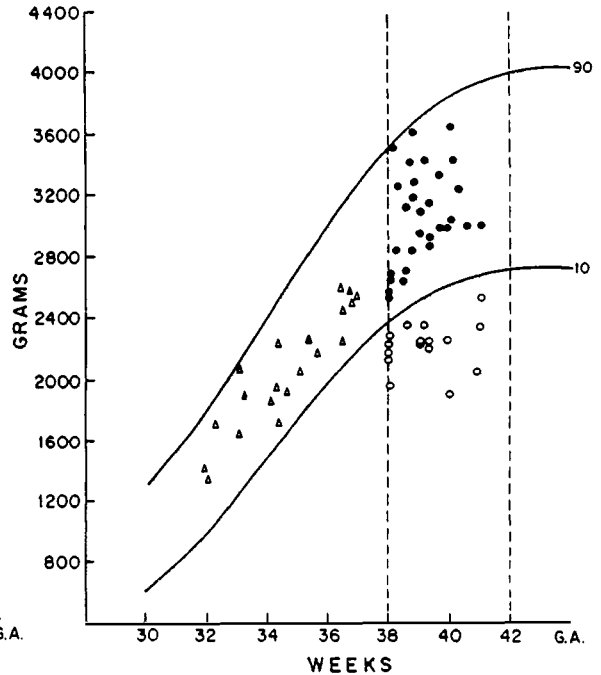
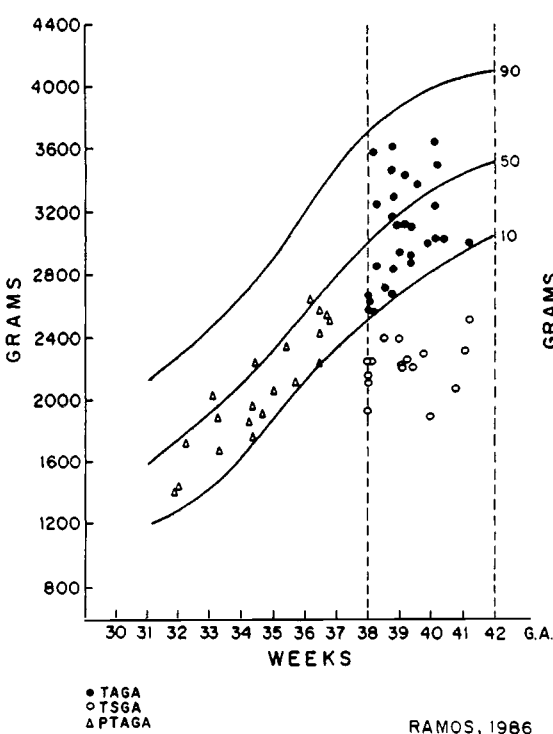


Figure 1. Weight distribution of neonates in relation to gestational age according to a) Ramos²⁵, 1986 b) Battaglia & Lubchenco⁵, 1967.

samples were divided into aliquots and stored frozen at -20°C for processing and analysis of the material as a whole.

Osmolarity was determined using a model 3MO Advanced Microosmometer (Advanced Instruments, Massachusetts). Fat concentration and calorie content were determined soon after sample collection by obtaining the creamtocrít by the technique of Lucas et al.²⁰, 1978. Total protein concentration was determined by the biuret method. The protein fractions were separated by electrophoresis after defatting the samples (Hibberd et al.¹⁷, 1982). Sodium and potassium levels were determined by flame spectrophotometry, calcium and magnesium levels were determined by atom absorption spectrophotometry (Nóbrega et al.²¹, 1985).

Data were analysed statistically using nonparametric tests:

- a) Mann-Whitney test to compare TAGA and TSGA groups and to compare preterm and term newborns within the AGA group (Dorca et al.¹⁰, 1982); b) Friedman analysis of variance to compare the values obtained for each group separately at each collection time (Dorca et al.¹⁰, 1982). Homogeneity test of Goodman (Thomas et al.²⁸, 1986) was used to

analyse the presence or not of differences between the three groups (socio-economic levels, parity, maternal age).

Results

Sample osmolarity up to the 60th day was equivalent for all three groups (approximately 290 mOsm/l), with stable values being detected throughout the collection period (Fig. 2). Mothers of TSGA newborns had a smaller percentage of fat in colostrum and higher percentage in the 30th day milk in relation to the control (p<0.05) (Fig. 3). Milk from mothers of premature newborns has creamtocrít similar to the control group. The values detected varied widely for all three groups, with a fall in creamtocrít from 48 hours up to the 30th day of collection for G1 (p<0.05).

Total protein concentrations were similar for all three groups, with significantly higher values during the first 48 hours in relation to the 60th day for G3 (p<0.05) (Fig.4). Through the study of protein fractions, there was a predominance of beta and gamma fractions in colostrum, with small variations throughout the collection period for all three groups. Albumin concentration and

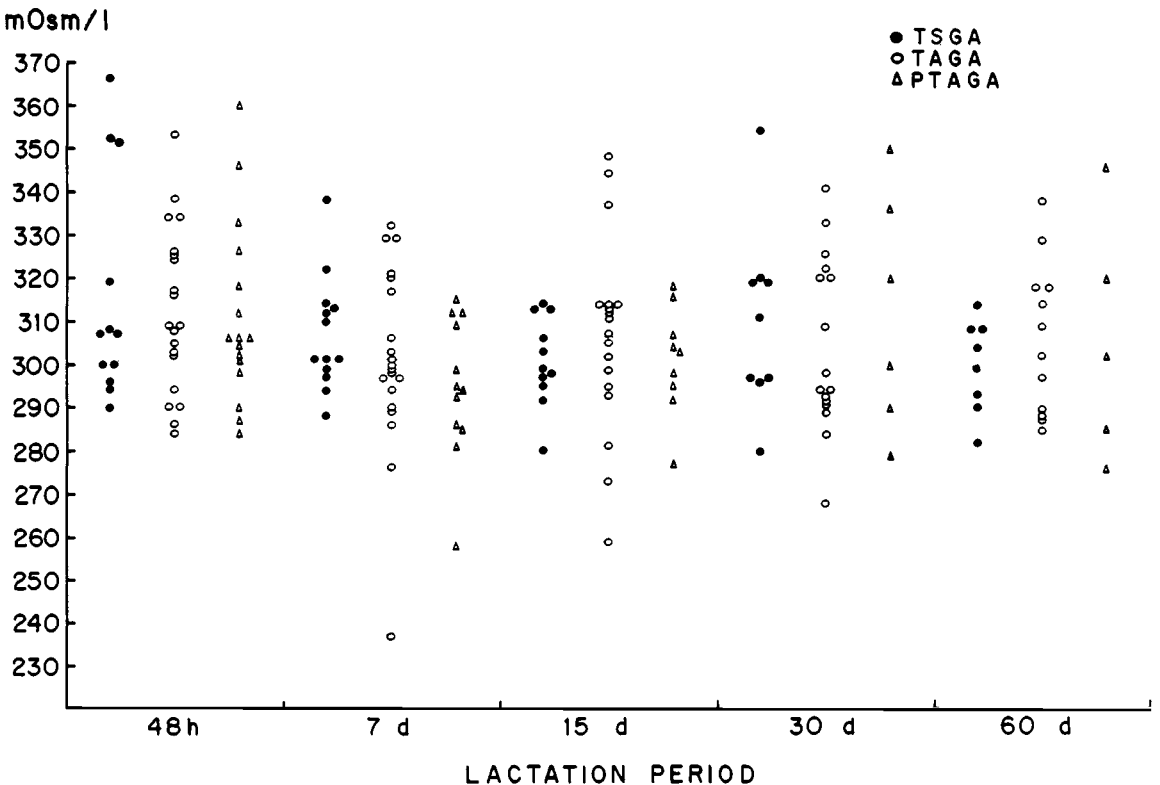


Figure 2. Osmolarity of colostrum and milk (up to the 60th day of lactation) from mothers of TSGA infants, of PTAGA infants and of TAGA infants (mOsm/l).

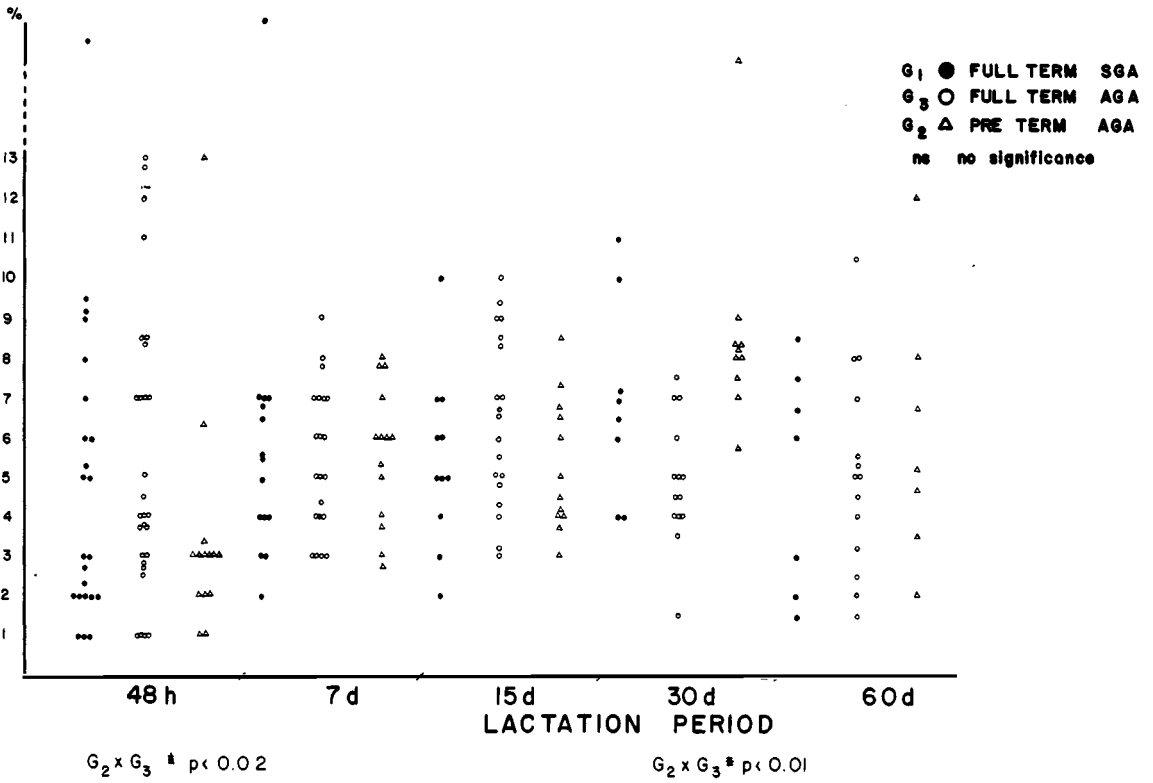


Figure 3. Creatatocrit in colostrum and milk (up to the 60th day of lactation) from mothers delivering TSGA, PTAGA and TAGA infants (%).

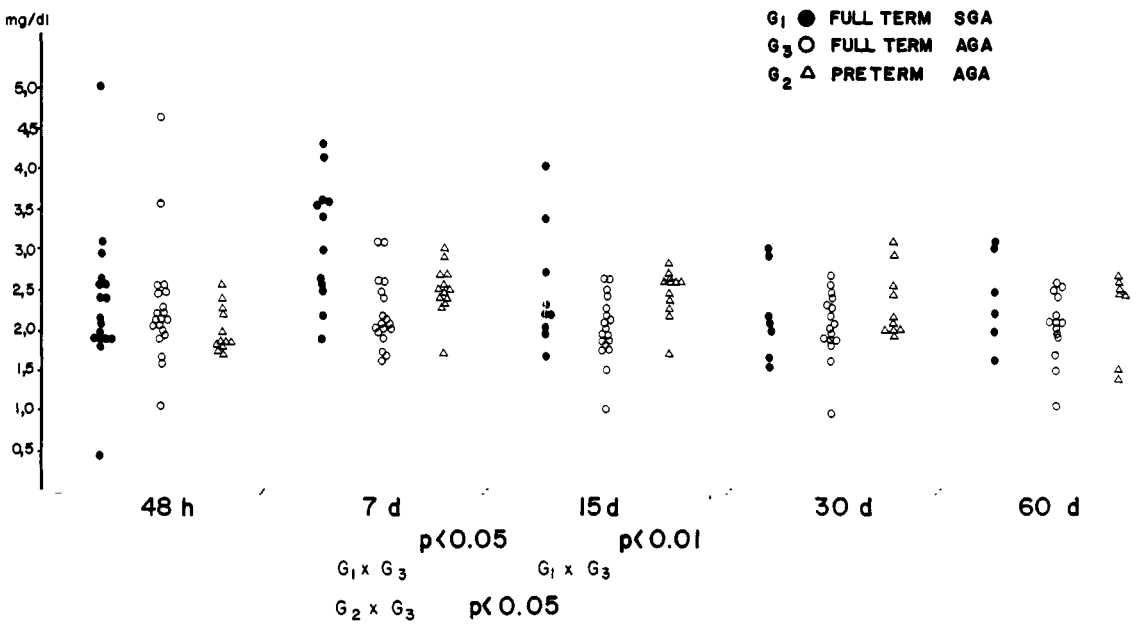


Figure 4. Total protein concentration in colostrum and milk (up to the 60th day of lactation) mothers delivering TSGA, PTAGA and TAGA infants (g/l).

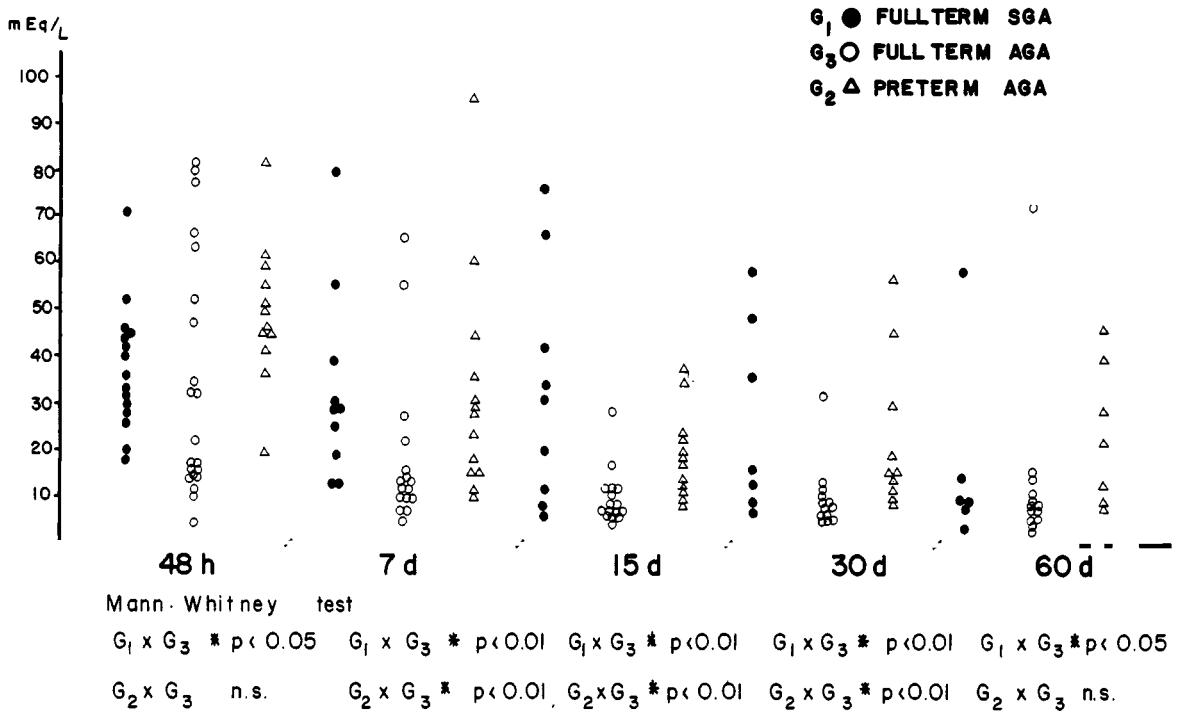


Figure 5. Sodium levels in colostrum and milk (up to the 60th day of lactation) from mothers delivering TSGA, PTAGA and TAGA infants (mEq/l).

alfa 2 fraction were significantly less in the TSGA group in relation to the TAGA group in the 60th day milk ($p < 0.05$). Alfa 2 fraction was also less in the TSGA in the 30th day milk ($p < 0.05$). There were no other significant differences between the groups in the protein fractions evaluation.

Sodium levels were elevated in milk from mothers of TSGA infants throughout the collection period and in milk from mothers of PTAGA infants on the 7th, 15th and 30th days of lactation when compared to the TAGA group ($p < 0.01$) (Fig.5). Potassium and calcium concentrations did not differ among groups or collection times. Magnesium levels were significantly higher in the 7th ($p < 0.05$) and 15th day ($p < 0.01$) of lactation in the G₁ group as observed on the 7th day for the G₂ group ($p < 0.05$).

Discussion

Doubts persist as to the adequacy of breast milk composition in terms of meeting metabolic and immunological needs of low birthweight infants. In addition to this lack of information on the composition of breast milk, breast-feeding of low birthweight infants tends to be discouraged because of the prolonged hospitalization of these ba-

bies, complications that prevent oral feeding and lack of physical contact with the mother. Although these factors are less frequent among TSGA newborns, the composition of their mothers' milk is still little known, a matter that motivated the present study.

In order to reduce the number of factors that might interfere with sample quality, nursing mothers with any type of chronic disease or who were using drugs were excluded, and good maternal nutritional status was a requirement for admission to the study. These are the reasons which led to a reduction in the total number of mothers and colostrum and milk samples in the groups studied, as pointed out earlier. Ramos²⁵ and Battaglia & Lubchenco's classification of newborn's weight and gestational age⁵ was also taken into consideration. This procedure was adopted in order to compare a local classification with an Internationally accepted pattern.

Osmolarity was analysed up to the 60th day of breast-feeding and it was found to be stable and close to 290 mOsm/l in all three of the groups studied. No specific studies on the milk of mothers of TSGA infants are available, but similar values have been previously detected in the milk of mothers of premature infants (Hibberd et al.¹⁷, 1982).

The crematocrit technique was used to determine fat concentration in the samples, since this

is an easily executed, low cost method requiring small volumes, thus permitting a rapid evaluation of the calorie content of breast milk (Lucas et al.²⁰, 1978).

Despite the care taken during collection, creatocrit values varied widely as has been described before (Nóbrega et al.²¹, 1985). Except for the milk samples obtained during the first 48 hours from mothers of TSGA infants, no differences were detected between the low birthweight and the TAGA groups, as has also been observed by others (Barros & Carneiro-Sampaio⁴, 1984). Longitudinal creatocrit analysis showed higher levels in 30-day milk than in colostrum of mothers of the TSGA group. Human milk variation due to differences between the right and left breast at collection or to the presence of final residue of previous feeding, affecting fat concentration has been observed (Dorea et al.¹⁰, 1982; Thomas et al.²⁸, 1986). Lucas et al.²⁰ (1978) have proposed a formula for the conversion of creatocrit to fat concentration and caloric content of the samples. Both fat and total caloric concentrations obtained in the present study were similar to those reported in the literature for the milk of the mothers of premature infants and were sufficient to satisfy minimum requirements, in the light of the data previously published (Ferris et al.¹², 1988; Butte⁸, 1988). There are no reports on the ideal fat and caloric levels for TSGA infants.

The ideal protein concentration in breast milk for low birthweight infants is still a controversial subject (Reynolds²⁶, 1985; Ronnholm et al.²⁷, 1986). Weight gain has been the main parameter for the evaluation of protein supply, but this form of evaluation does not take into account protein quality (Räihä et al.²⁴, 1976).

The protein levels detected in the milk of premature and TSGA infants' mothers were similar to those in the milk of TAGA infants' mothers, with a drop in levels during lactation, as also reported by others (Anderson², 1983; Butte et al.⁷, 1984). However, there are reports that milk of mothers who delivered premature infants has a greater protein concentration that satisfies the infant's needs (Pamblanco et al.²², 1986; Lemons et al.¹⁹, 1986), though no conclusive data are available for TSGA infants.

When the weight and height gains of the newborns studied here were monitored up to the 60th day of collection, no impaired growth was observed in exclusively breast-fed premature or TSGA infants, both groups gaining 20-30 g per day on average.

Albumin concentration was constant in all samples throughout the collection period, with similar levels in the three groups except for the fall ob-

served on the 60th day in milk from mothers of TSGA infants. There was a predominance of beta and gamma fractions, certainly reflecting the high IgA concentrations, with a fall in their levels occurring as early as on the 7th day of lactation (Barros & Carneiro-Sampaio⁴, 1984; Pamblanco et al.²², 1986).

Sodium, chloride and potassium are the main electrolytes present in body fluids. Under basal conditions, urinary sodium excretion is higher in preterm than in term infants. An inverse relationship between urinary sodium excretion and gestational age has been reported (Aperia et al.³, 1985). Thus, premature infants require a greater sodium supply to avoid hyponatremia and small for gestational age term infants are supposed to have a more mature renal function than preterm infants (Aperia et al.³, 1985).

The milk from TSGA infants' mothers had elevated sodium levels throughout the collection period in the present study, presenting about twice the value found in milk from mothers of TAGA (G3) from the 7th up to the 60th day of lactation. Sodium was also elevated on the 7th, 15th and 30th days in milk from mothers of PTAGA (G2) but these high levels did not result in alteration of osmolarity in both low birthweight groups (G1, G2). These results are in agreement with values obtained by Barros & Carneiro-Sampaio⁴ (1984) in colostrum and in 7th day milk. The high sodium levels may be necessary to the premature infant as has been mentioned above, but this electrolyte was also found to be high in breast milk for TSGA infants, despite the longer period of gestation.

Potassium levels were constant throughout the collection period and equivalent in all groups giving support to the idea that the greater sodium concentration in the milk of TSGA infants' mothers is not due to a smaller potassium value, as proposed by other investigators (Barros & Carneiro-Sampaio⁴, 1984; Gross et al.¹⁵, 1980).

Calcium, magnesium and phosphorus are essential minerals for tissue structure and function (Koo & Tsang¹⁸, 1988). The supply of calcium and phosphorus in the milk from mothers of low birth-weight preterm infants has been considered to be insufficient (Pereira & Barbosa²³, 1986; Goshi¹⁴, 1989). Comparative analysis of the three groups did not show significant differences up to the 60th day of lactation, as also observed by others (Garza et al.¹³, 1981; Butte et al.⁸, 1984). The calcium levels detected during this study do not permit the conclusion that they are insufficient for low birthweight infants.

Significant higher magnesium levels were observed in low birthweight groups in the 7th

(G1&G2) and 15th (G1) day of lactation, as also reported by Garza et al.¹³ (1981).

On the basis of the nutritional factors evaluated in the present study, it was found that, in general, protein and fat levels are similar in milk of low birthweight infants when compared to appropriate for gestational age term newborns. With regard to sodium values, it might be supposed that a greater supply leads to greater fluid retention, which is needed for growth, while at the same time the replacement of urinary sodium loss is necessary for premature newborns (Aperia et al.³, 1985). Nutritional balance studies should be performed in order to support this hypothesis.

The possibility that concentration occurs in the breast milk from mothers of low birthweight infants as a consequence of a lesser volume can not be accepted on since the other parameters studied had not followed sodium values (Gross et al.¹⁵, 1980). Maintenance of high sodium levels during all period of collection for TSGA group (G1), even after their mothers produce more milk, have also been observed.

It should be emphasized that this study was the first conducted to evaluate nutritional factors in the milk of small for date term infants' mothers over a period of 60 days of lactation. The results show some differences in breast milk of low birthweight infants although some doubts still persist as to the adequacy of the calcium and magnesium content, which could only be fully clarified in prospective clinical studies, including nutritional balances.

Conclusions

The nutritional composition of breast milk from mothers delivering small for gestational age infants, taking into consideration total proteins and fractions, creatinocrit, calcium, magnesium, potassium and osmolarity, did not differ from that from mothers delivering term adequate for gestational age newborns. Sodium levels in colostrum and milk up to the 60th day after delivery were higher for mothers delivering small for gestational age term infants. Nutritional balances should be developed so that further conclusions regarding these findings might be arrived at.

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GRUMACH, A.S. et al. Fatores nutricionais no leite de mães brasileiras de recém-nascidos de baixo peso para idade gestacional. *Rev. Saúde Pública*, 27: 455-62, 1993. A composição do leite de mães brasileiras de lactentes de baixo peso e sua adequação como fonte de nutrientes para este grupo ainda não foi totalmente elucidada. Um total de 209 amostras de leite de 66 nutrízes foram analisadas. As mães foram divididas em três grupos: G1, mães de recém-nascidos(RN) a termo, com baixo peso (TSGA, n=16); G2, mães de RN pré-termo, com peso adequado (PTAGA, n=20); G3, mães de RN a termo e peso adequado (TAGA, n=30). Os seguintes fatores foram analisados: osmolaridade, proteínas totais e frações, creatinócrito, sódio, potássio, cálcio e magnésio. As amostras foram coletadas 48 h, no 7º, 15º, 30º e 60º dias após o parto. Os grupos não diferiram em termos de osmolaridade, proteínas totais e frações, creatinócrito, cálcio, magnésio ou potássio durante o estudo. Os níveis de sódio foram maiores em todas as amostras de mães de TSGA e em mães de PTAGA no 7º, 15º e 30º dias em relação a mães de TAGA. Foram consideradas as necessidades dos lactentes de baixo peso e TAGA, e estes níveis de sódio podem ser necessários para o crescimento dos RN de baixo peso.

Descritores: Leite humano, fisiologia. Baixo peso ao nascer. Nutrição infantil.

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