

CONCENTRATION OF NON-ESTERIFIED FATTY ACIDS IN THE BLOOD  
OF NEWLY BORN INFANTS AND ITS RELATIONSHIP TO THE BEGINNING  
OF BREAST FEEDING

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The researches of Dole [8] and of Gordon and Cherkes [9], published in 1956, showed that non-esterified fatty acids (NEFA) play an important role in lipid transportation and energy metabolism. Despite the fact that the plasma NEFA concentration fluctuates only within the range 10-40 mg %, and that these acids constitute only 5% of the total plasma lipids, they may yield twice as many calories as glucose [10]. This results from the fact that the NEFA are metabolized very rapidly. Their concentration in the serum of fasting adults varies within limits of 0.40-0.70 meq per liter [8, 9, 11, 12], and in children between the ages of 4 months and 10 years after fasting for 14 h -  $0.699 \pm 0.199$  meq per liter [13]. Our observations have confirmed these figures. In 26 breast-fed infants aged between 2.5 and 7 months, the fasting NEFA concentration after the night interlude of 8-10 hr amounted on the average to  $0.74 \pm 0.17$  meq per liter.

The NEFA concentration in the blood varies considerably depending on the physiological conditions. Fasting raises their level, while administration of glucose causes a sharp fall in their level within 20 min [8, 10, 12]. I. A. Arshavskii and co-workers [1-7] consider that there are good physiological grounds for making an early start with breast feeding (within the first hour after birth).

We considered it would be interesting to compare the changes in the NEFA concentration in the blood of newborn infants put to the breast soon after birth during the first 24 hr of neonatal life.

#### EXPERIMENTAL METHOD

We determined the NEFA concentration in 0.06 ml of serum by Dole's method [8], as modified by Novak [17]. By using small volumes of blood, we were able to carry out repeated investigations without causing serious injury to the infants. We used heptane in the extraction mixture.

Four groups of infants were investigated: the first group consisted of 12 infants put to the breast for the first time 24 hr after birth, the second group of 14 infants breast fed for the first time within 3 hr after birth, the third group of 47 infants breast fed for the first time 12 or 16 hr after birth (this group was investigated over a period of 8-10 days), and the fourth group, investigated for a period of 3 days, consisted of 12 new-born infants fed for the first time during the 3 hr immediately after birth.†

Investigation of the last two groups of infants was conducted in standardized conditions: in the morning before feeding, after an interlude of 6 hr in feeding during the night. Blood was taken from the heel by puncture with a needle. All the new-born infants were delivered at full term, without any form of interference or complication,

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NEFA,  
meq/liter

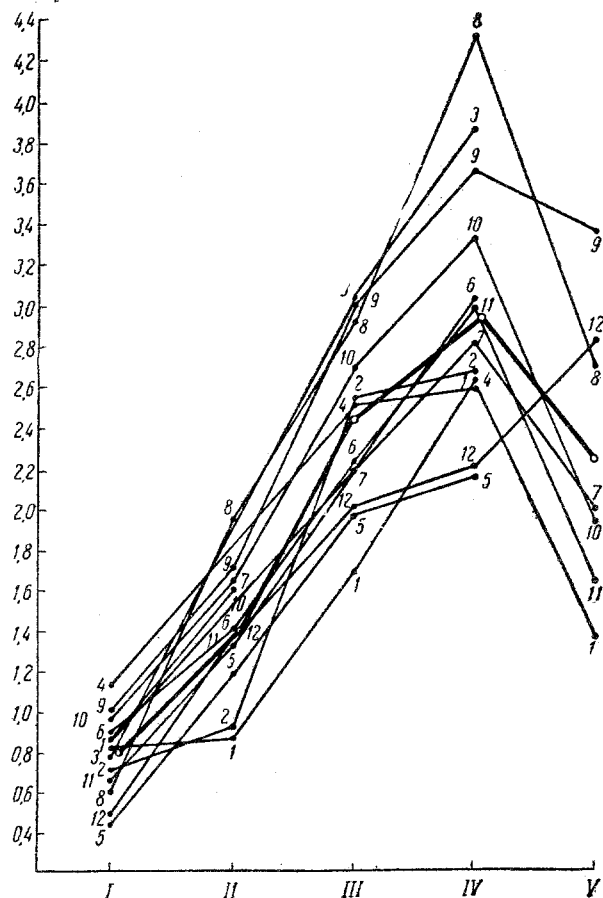


Fig. 1. NEFA concentration in 12 new-born infants (1-12) fed for the first time 24 hr after birth. I) Umbilical blood; II) child's blood 1-3 hr after birth; III) 5-6 hr after birth; IV) 12 hr after; V) 24 hr after birth.

most identical, and the average increase amounted to only 19%. It is interesting that in half the infants breast fed for the first time 12 hr after birth, the NEFA concentration at this time reached an extremely high level, namely from 3 to 4 meq/liter. After 24 hr their NEFA level fell spontaneously by 25%.

These results were in agreement with those reported in the literature [19], according to which the NEFA concentration began to rise sharply at the second hour after birth, and reached a value of 1.8 meq/liter by the seventh hour.\*

In the third group of infants, aged 1-10 days, the NEFA level was raised throughout the first week of life and became normal only on the 6th-10th day. Here, too, an appreciable difference was observed in the NEFA level in infants put to the breast early. In the first group the mean level was clearly lower, and in some cases normal values were established during the second day.

There was an important difference between the trends of the NEFA concentration in individual infants of the last two groups. Besides other factors, it is clear that the quality of the milk given to the infants has some part to play here.

Analysis of the individual curves and mean values of the NEFA concentration during the first days of the infant's life shows that the most significant changes in concentration took place in infants starting to breast feed late,

and all were viable after delivery. Their birth weight varied from 2700 to 4200 g and their length from 48 to 53 cm. All the infants were breast fed and given supplementary feeding with breast milk when necessary, i.e., the normal routine practice of the maternity department was not modified.

The values given are the mean of two, or usually three, parallel analyses. The possible error of the laboratory analyses was  $\pm 6\%$ . All the blood samples were kept in the refrigerator and were analyzed not later than 3 hr after taking the blood.

#### EXPERIMENTAL RESULTS

The results obtained after repeated investigation of the new-born infants during the first 24 hr of life are shown in Fig. 1.

The NEFA level in the umbilical blood of some children was slightly raised. In these cases birth was prolonged. We found no relationship between the levels of NEFA in the umbilical blood and in the first sample of child's blood.

The NEFA concentration began to rise soon after birth, and by the 2nd-3rd hour it reached a mean value of 1.2-1.3 meq/liter. The difference between the NEFA concentrations in the individual infants must be considered in association with differences in the times of taking blood during the first 3 hr after birth. In the fasting infants the NEFA level 6 hr after birth rose on the average by 176%, and 12 hr after birth by 217%, compared with the level of the first sample from the infant, taken as 100% (Fig. 1).

It is clear from Fig. 2 that in children put to the breast early, no significant increase in the NEFA concentration was observed. In seven infants the level was al-

\*When we had completed the present investigation, the researches of M. Novak and co-workers were published. These workers found that in new-born infants 8 hr after birth the NEFA concentration is significantly elevated (Physiol. bohemoslov. 10, 488, 1961).

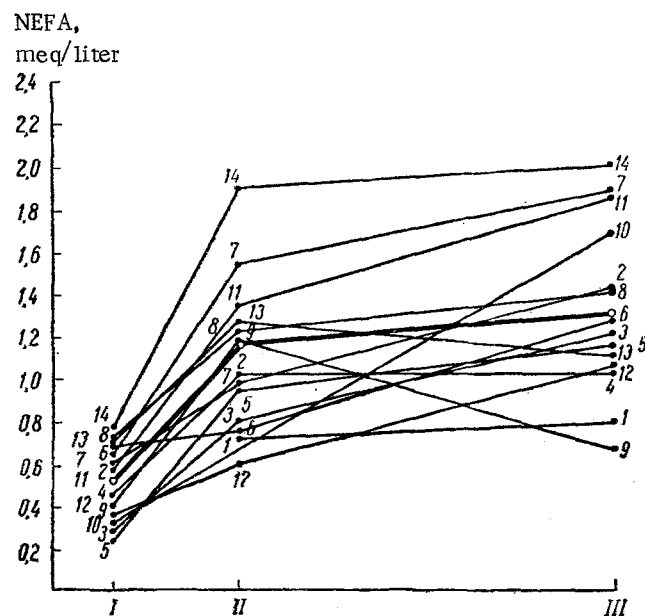


Fig. 2. NEFA concentration in 14 new-born infants (1-14) fed for the first time not later than 3 hr after birth. I) Umbilical blood; II) child's blood 1-3 hr after birth; III) 12 hr after birth.

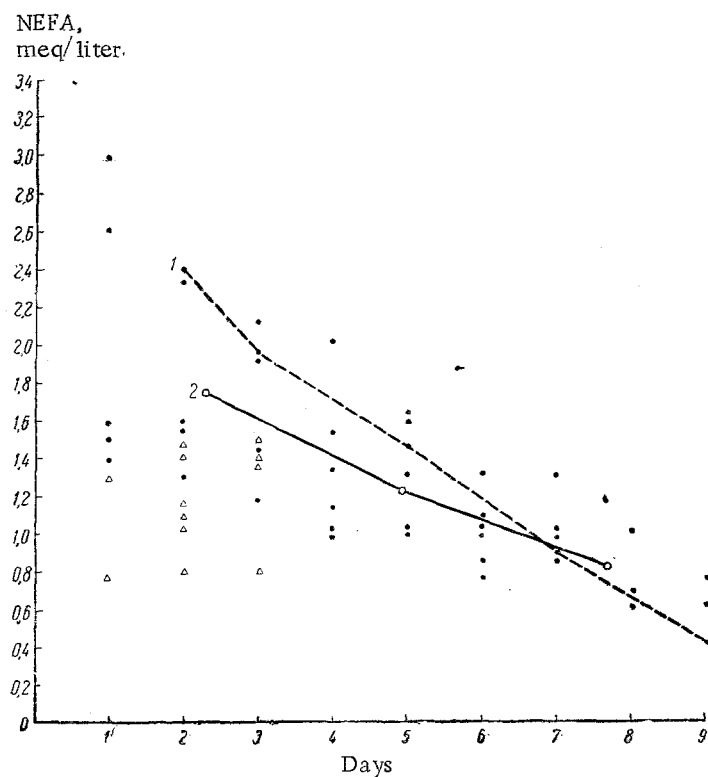


Fig. 3. NEFA concentration in 44 new-born infants at the age of 1-10 days, before the morning feeding after an interlude of 6 hr during the night. 1) Curve of the NEFA concentration in one infant; 2) mean NEFA concentration (of 3-day periods) in new-born infants starting to breast feed 12-16 hr after birth. The black dots denote infants starting to feed 16-24 hr after birth, the triangles those starting to feed not later than 3 hr after birth.

for their NEFA concentration rose steadily during the first 12 hr after birth. The results of the investigation in infants starting to breast feed early showed that this increase was associated with the feeding of the infants, for no appreciable differences were observed in the NEFA concentration 3 and 12 hr after birth. The rapid rise in the NEFA concentration 2-3 hr after birth before feeding started may be regarded as an expression of the intensive mobilization of the lipid reserves to supply the energy requirements of the organism. This conclusion is in agreement with the familiar facts regarding the energy metabolism after birth. The child is born with low reserves of glycogen, and after 3 hr the blood sugar falls to hypoglycemic values. The respiratory quotient, initially equal to 1, falls after 1-2 hr to 0.7. This shows that the source of energy at this period is lipids [19, 20, 21].

There is a close relationship between the NEFA concentration in the blood and the degree of carbohydrate utilization. Dole considers that the changes in the NEFA concentration after administration of carbohydrates may be used as an indicator of the utilization of these substances [18].

If it is remembered that in mammals, during the first 24 hr after birth, proteins can be used as a source of energy to only a very limited extent [15], it will be obvious that the principal, if not the only material supplying energy for the new-born infant is, in fact, NEFA and that their high concentration in the serum reflects the increasing energy requirements of the organism.

The results of the study of the NEFA concentration in infants between the ages of 1 and 10 days show that their level in the new-born infants starting to breast feed late was clearly raised throughout the first week of life (Fig. 3) by comparison with their level in new-born infants put to the breast early.

The NEFA concentration in the fourth group of children was lower, and during the first 3 days it was at the level reached in the group with a late start of breast feeding only after the 5th-7th day.

It follows from our investigations that the new-born infant, whatever the time at which it starts to breast feed, is at the limit of energy equilibrium during the first week of life, and consequently, an interlude of even 6 hr in feeding during the night (omission of one feeding) leads to the mobilization of the lipid reserves in order to meet the sharply increasing energy deficit.

#### SUMMARY

Four groups of neonates were examined: two groups included babies in which breast feeding began 24 hours after birth; the other two, 1-3 hours after birth. A comparative study was made of the changes occurring in the content of nonesterified fatty acid (NEFA) in the blood of neonates in relation to the time of the first breast feeding. With a late beginning of breast feeding the content of NEFA exhibited a marked rise 12 hours after birth, increasing by 217% as compared to the initial level. With an early start of feeding this high progressive rise of the NEFA concentration is absent.

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