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SHORT COMMUNICATION

Relationship Between Birth Weight of Newborns and Unsaturated Fatty Acid$_{(n-3)}$ Proportions in Their Blood Serum

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Summary

In a group of 26 preterm newborn infants (gestational age 24–37 weeks, birth weight 560–2800 g) we followed the possible relationship between the birth weight and the proportion of polyunsaturated fatty acids n=3 in the blood serum. The blood samples were taken usually within 24 hours after birth, exceptionally within 48 hours. The newborns as well as their mothers did not receive antibiotics, tocolytics or hormonal therapy. We found a positive correlation between the birth weight and the proportion (expressed in %) of polyenoic fatty acids$_{(n-3)}$ in the blood serum. This relation could be expressed by the regression line ($r=0.636$, $p<0.001$, % $FA_{n-3} = -1.166 + 0.00217$ x birth weight in g. The value of Kruskal-Wallis criterion H was 15.158. The importance of such a relationship is discussed.

Key words

Newborns – Birth-weight – Unsaturated fatty acids$_{n-3}$

The importance of unsaturated fatty acids, particularly those of the n-3 series, has recently been intensely studied with regard to findings suggesting that these fatty acids play a key role in the structure of such specialized membranes as those of nerve elements, retina or the germinal apparatus (Šmídová *et al.* 1984, Neuringer 1988, 1993, Innis *et al.* 1994, Makrides *et al.* 1994 and the others). These and other studies have documented either serious functional defects in the tissues involved caused by the absence of these unsaturated fatty acids (e.g. vision – Neuringer 1988, or behaviour – Hoffman *et al.* 1993, Crawford *et al.* 1993), or the fact that these acids are profoundly involved in the given tissues and structures.

There occurred a shift, both in theoretical and clinical observations, from the previous demand of the presence (availability) of two essential fatty acids (linoleic and linolenic) towards the conviction that even the presence of other unsaturated fatty acids (with 20 or 22 carbons) is absolutely essential. Furthermore, it is apparent that, even despite the presence of the two essential fatty acids, a deficiency or failure of enzymatic processes providing elongation and desaturation actions results in functional disorders or insufficiencies.

Our studies of preterm and/or hypotrophic infants as well as infants with extremely low birth weights (Mourek *et al.* 1993, Mydlilová *et al.* 1991, Šmídová *et al.* 1993, Mourek *et al.* 1995a, Mourek 1995b) revealed that the proportion of unsaturated fatty acids especially of the n-3 series in the blood serum was markedly decreased in all these risk newborns.

Using the gas chromatography method according to Baše (1978), a wide range of fatty acids was determined in the blood serum (from C 8 to C 26). A detailed description of the method was given in our previous studies (Šmídová *et al.* 1984, 1993, Mourek *et al.* 1987). Fatty acids are expressed by their percentage participation in total sum of fatty acids equalling 100 %. The described method shows, at participation values of individual fatty acids under 1 %, a greater error (up to 10 %). However, this error can be diminished by obtaining a sufficient number of results.

The present results are based on a group of newborns with a very low birth weight (n=9) and a group of preterm newborns (n=17). In the first group, the range of newborn weight was up to 1490 g, in the second group, the newborns weighed up to 2800 g. The gestational age in all the newborns (n=26) was from 24 to 37 weeks. The gestational age in newborns with extremely low birth weights ranged from 24 to 31 weeks (see Mourek *et al.* 1995a), in the second group, the gestational age was 30 to 37 weeks. Two newborns showing higher unsaturated fatty $acid_{(n-3)}$ proportion (about 9 %) had the gestational age of 35 weeks, in the other two with a higher proportion of the given fatty acids, about 4–5 %, the gestational age was 30 weeks.

The evaluation of dispersion analysis and significance of the regression line (Kruskal-Wallis test) was performed by the Department of Biocybernetics of our Institute.

Blood samples from the newborns (taken exclusively for diagnostic and therapeutic purposes) were usually available within 24 hours after delivery, sporadically within 48 hours. For safe analysis, 0.2 ml of serum were used as a maximum.

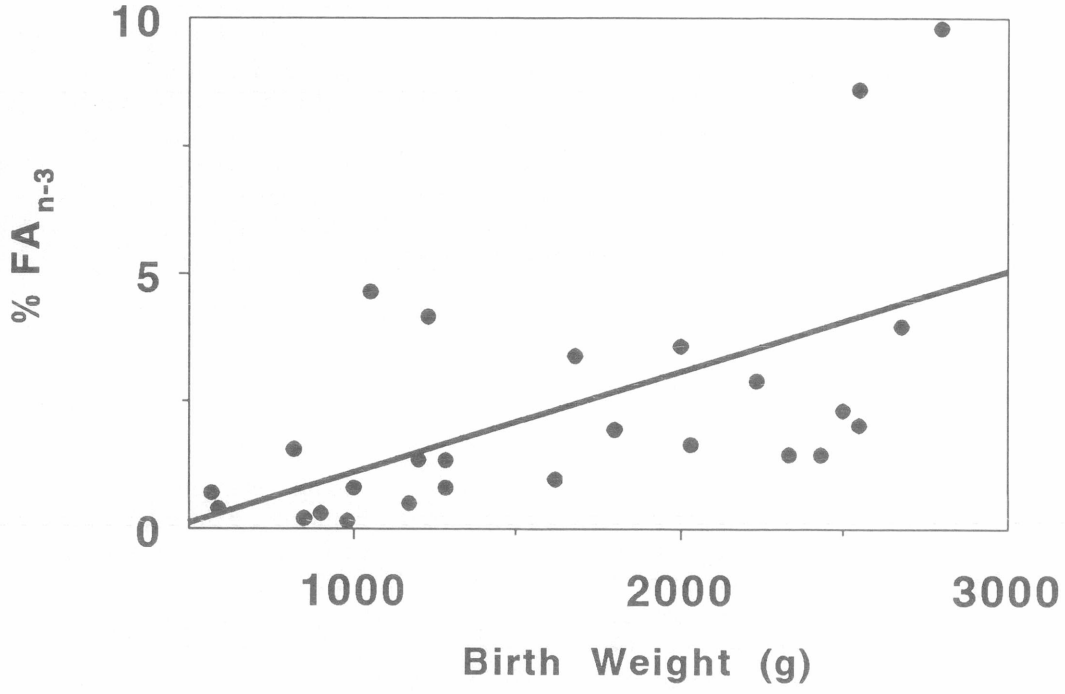

Fig. 1
Relationship of unsaturated fatty $acid_{n-3}$ proportion ($\%FA_{n-3}$) to birth weight. Abscissa – birth weight in grammes, ordinate – percentage of unsaturated fatty $acids_{(n-3)}$ in the total sum (100 %) of fatty acids detected. Black points = individual cases of the preterm newborn population. Relationship of birth weight and unsaturated fatty $acid_{(n-3)}$ proportion can be expressed by a regression line $\%\ FA_{n-3} = -1.166 + 0.00217$ x birth weight in g ($r=0.636$, $p<0.001$). The following fatty acids are included: 18:3, 18:4, 20:4, 20:5, 22:5 and 22:6.

The analysis shows (Fig. 1) that the proportion of unsaturated fatty $acids_{(n-3)}$ (% FA_{n-3}) depends on the birth weight in the population studied (560–2800 g). The regression analysis proved this relationship to be highly significant ($p<0.001$) with a correlation coefficient $r=0.636$. This relationship may therefore be expressed by a regression line $\%\ FA_{n-3} = -1.166 + 0.00217$ x birth weight in g. The value of Kruskal-Wallis criterion H was 15.158.

Our population of 26 newborns was not handicapped by administration of any antibiotics, tocolytics, sedation or hormone therapy, either direct or through their mothers. The study deals with a sample of spontaneous preterm deliveries. This fact is stressed here as, in a different context, the authors proved that e.g. the administration of adrenergic tocolytics or antibiotics markedly influenced the serum fatty acid spectrum both in the delivering mother and the foetus or newborn (Mydlilová *et al.* 1991, Mourek *et al.* 1993). It was even proved experimentally that administration of the above tocolytics resulted in an evident decrease of unsaturated fatty acid proportion in the cerebral cortex of foetuses (laboratory rat – Mourek *et al.* 1995b).

Leaf *et al.* (1992a) stated that the value $20:3_{n-3}$ + $20:4_{n-3}$ correlates with head circumflexion of the newborns as well as with their birth weight. In another study Leaf *et al.* (1992b) found a positive correlation between arachidonic acid and newborn weight (r=0.56) as well as a positive correlation between docosahexaenoic acid (DHA) and gestational age (r=0.64). Leaf's population differs from our group in several points:

a) the preterm infants weighed up to 1980 g (up to 2800 g in our population)
b) Leaf *et al.* detected fatty acids in newborn sera only in the phosphatidylcholine fraction whereas we measured all fatty acids in the serum, i.e. including the UFA fraction.
c) Leaf *et al.* concentrated their attention on docosahexaenoic acid (22:6 n-3). Our study related all unsaturated fatty acids $_{(n-3)}$ to the birth weight.
d) In Leaf's population the newborns were subjected to certain therapeutic interventions, and the time of sampling varied.

Despite all these facts and differences the detected relations (DHA/gestational age in Leaf's population, total unsaturated fatty acid proportions and birth weight in our study) are identical (r=0.64 and r=0.636 respectively). This close similarity probably reflects the biological connections between the maturation process (differentiation, structuralization) and the presence of realization elements of this process.

Leaf *et al.* (1992a,b) investigated a British population, undoubtedly with certain differences in nutritional habits etc. The finding that, in the above parameters, the described relations do not differ or express a very similar interdependence, is considered incentive by us.

We are convinced that the unsaturated fatty acid deficiency in preterm newborns represents a drawback from the point of view of their premature extrauterine existence and consequently profound differences in nutrition. It is well known that a healthy infant born in term receives in maternal milk – if only in small quantities – not only essential fatty acids but also other unsaturated fatty acids with 20 or 22 carbons (Mydlilová *et al.* 1993, Mourek *et al.* 1993, Mourek 1995). This fact is so far neglected in all formulas which may result in a gradually increasing deficiency of unsaturated fatty acids with subsequent negative sequelae in preterm newborns. Infants with such affections are known to display e.g. marked differences in erythrocyte membranes compared to the norm – a lower cholesterol content, different fluidity, different saturated/unsaturated fatty acid ratio (Lemery *et al.* 1993). It is hard not to suggest also the possible involvement of the membranes in neural elements.

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