

Thesis Title Brain growth in rats fed essential fatty acid
 deficient diet since neonatal period

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ABSTRACT

The purpose of this study was designed to investigate the importance of essential fatty acid (EFA) on brain growth.

Infant Sprague-Dawley rats age 2-3 days were studied in pairs (male 15 pairs and female 14 pairs). Members of the same pair were of the same sex and litter and had similar body weights. They were randomly assigned an EFA-deficient diet or an EFA-sufficient diet. All the animals were pair fed throughout experiment. EFA-deficient and EFA-sufficient diets were identical in every respect except for the type of fat and content of essential fatty acids. The control EFA-enriched diet contained 5.1% of total calories as linoleic acid. The EFA-deficient diet contained zero amount of linoleic acid. At age 2 months, rats were decapitated. The brains were separated into cerebrum, cerebellum, hypothalamus-thalamus, pons-medulla and mid-brain. Each portion was weighed and analyzed for protein, DNA and RNA. Plasma was analyzed for fatty acid patterns.

The results are as follow:

1. Whole brains and almost all areas of brains weighed less in the EFA-deficient rats than in EFA-sufficient controls. The differences in wet weights in favor of the controls reached statistical significance only in the whole brain, cerebellum and cerebrum in the male rats and whole brain and cerebrum in the female rats.

2. Total DNA contents in whole brain and all brain areas except hypothalamus-thalamus of the EFA-deficient rats were significantly less than those of the respective controls of both sexes of rats. The differences reached statistical significance in whole brain and all brain areas except pons-medulla in the male rats, whole brain and all brain areas except midbrain, hypothalamus-thalamus and pons-medulla in the female rats.

3. Statistically less total RNA contents were observed in whole brain and all brain areas except hypothalamus-thalamus and pons-medulla of the EFA-deficient rats than in those of the controls of both sexes.

4. Protein contents were statistically less in whole brain and all brain areas except hypothalamus-thalamus and pons-medulla of the male EFA-deficient rats than in the the corresponding portions of the controls, and in the whole brain, cerebrum and midbrain of the female EFA-deficient rats than in the respective portions of the EFA-sufficient animals.

5. RNA/DNA ratios and Protein/DNA ratios of whole brain and different anatomical areas of both sexes of rats did not differ between the respective EFA-sufficient controls and EFA-deficient animals.

6. Fatty acid composition.

Plasma: Values of non-essential fatty acids were significantly higher and those of essential fatty acids (C18:2,n-6, C18:3,n-3 and C20:4,n-6) were significantly lower in the total plasma lipids of the EFA-deficient male or female rats than in those of the respective controls. Of importance was the finding of C20:3,n-9 fatty acid in the plasma lipids of the EFA-deficient animals. This fatty acid was undetectable in the control rats.

The triene/tetraene ratios of total lipids of plasma were zero in the control male and female rats. The values were 1.38 ± 0.08 and 1.33 ± 0.12 in the plasma of male and female EFA-deficient rats respectively.

Thus, the findings in the present study clearly show that EFA deficiency since neonatal period affects not only physical growth but also has detrimental effect on brain growth.