DOES NUTRITION IN EARLY LIFE HAVE LONG TERM METABOLIC EFFECTS?

CAN ANIMAL MODELS BE USED TO PREDICT THESE EFFECTS IN THE HUMAN?

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INTRODUCTION

The mode of infant feeding is thought to affect the metabolism of the adult. It is the aim of my presentation to evaluate whether infant feeding practice affects lipid metabolism in later life. Specifically, I would like to address the following questions:

1. Does breast feeding alter adipose tissue development in a fashion that protects against obesity in later life?

2. Does early exposure to dietary cholesterol (present in human milk at much higher level than in formula) result in more efficient cholesterol catabolism in the adult and thus in lower incidence of hypercholesterolemia and atherosclerosis in later life?

3. Does the unique fatty acid composition of human milk, which provides adequate amounts of docosahexaenoic acid, affect brain composition and function, especially in premature infants?

4. Is membrane structure and function affected by the differences in composition of the fat in human milk and infant formula?

The following is a short review of the current status of information on the relationship between early feeding practices and health in later life. The literature review is by no means exhaustive, rather, the studies have been cited with the aim to illustrate trends and hypotheses. The part dealing with early nutrition, brain function and membrane composition is rather speculative summarizing mainly information on full term and preterm (i.e. produced by mothers of full term or premature infants) milk and the possible effect of different fatty acid composition on cell and organ function.

INFANT FEEDING PRACTICES, WEIGHT GAIN AND OBESITY

The widespread occurrence of obesity and atherosclerosis in developed societies and the difficulty to find efficient treatment modalities have increased the emphasis on prevention of these disorders. One question is whether breast feeding in infancy might be associated with lower incidence of obesity and atherosclerosis in adult life.

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Follow-up studies that compare the effect of breast feeding and of formula feeding on growth, weight, fat content, and incidence of obesity have been carried out during the last 20 years. While the earlier studies clearly showed that breast-fed babies had a tendency to be leaner than the bottle fed group, recent studies fail to show this effect. It seems thus, that in the late sixties and early seventies, bottle fed infants were often overfed, while more recently, with the greater awareness of good dietary habits, bottle fed infants receive volumes similar to those of infants fed human milk; furthermore, formula composition is also closer to that of human milk.

Follow-up studies on the effect of early nutrition on growth and obesity can be divided into 3 groups: short term studies (6 weeks to 6 months after birth), slightly longer term follow-up (1 year to 5 years after birth) and long term studies that evaluate the status of older children, adolescents and adults. The earlier studies have been reviewed by Weil (1) and Taitz (2) in 1977.

It is difficult to reach clear cut conclusions from the studies conducted in this field. The marked differences in experimental design, techniques of assessing weight gain and especially adiposity and furthermore, the poorly defined breast feeding variable (i.e., duration and exclusiveness of breast feeding) are major problems in the critical evaluation of this large number of studies.

Early Effects: Infants and Toddlers

In a study conducted in Sheffield in 1970 only 8% of 261 infants studied were breast fed (3). The author stresses the excessive weight gain during the first six weeks of life, which was much greater than in earlier decades, when most infants were breast fed. Taitz (3) also questions the wisdom of over-feeding formula and judging infant well-being solely by weight gain. Oakley (4) on the other hand found greater skinfold thickness at 6 weeks of age in breast fed than in bottle fed infants. Infants who were fed formula plus cereal supplements, had, however, the highest skinfold thickness.

More recently (5), when bottle fed infants were allowed to self-regulate food intake, they consumed almost identical amounts of kcal/kg/day and only slightly higher volumes than a group of breast fed infants, during the first 3 months after birth. The marked change in infant feeding habits during the period 1962-1982 is also evident in additional studies. Thus while Dubois (6), and Ferris (7) report similar weight gains in breast fed and formula fed infants in 1982 and 1980, respectively, Hooper, in studies published in 1965 (8) and 1971 (9) reports a much higher incidence of obesity ("Michelin tire baby" appearance) in bottle fed than in breast fed infants and higher morbidity in the former infants (8). The decrease in tendency to over-feed bottle fed infants (10) is evident also in recent reports of significantly later birth weight doubling (7,11) and tripling times (11), than reported in the mid seventies (12). The more rapid tripling times in formula fed infants, as compared to breast fed infants suggest however, that there still remains a risk of overfeeding the formula fed infant. Furthermore, Jung and Czajka-Narins show race and sex differences in infant growth and suggest that local standards may be more useful to monitor growth of certain populations (10). Indeed, two studies from Scandinavia report similar growth rate and adiposity in proprietary formula fed and breast fed infants in the mid and late seventies (13, 14). The Finnish study (14) shows differences in the type of artificial feeding: thus, while there was no difference between infants fed proprietary milk or breast milk, in infants fed cow's milk; weight for age and