Maternal & Infant Nutrition Briefs

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Defining Iron Deficiency in Infants

Full-term, healthy infants are usually born with enough iron stores to prevent iron deficiency during the first 4 months of life. During that time, infants gradually switch from producing a fetal to an adult form of hemoglobin. In adults, iron deficiency increases absorption of iron, but in young infants, this process is immature. Therefore, the criteria for identifying iron deficiency, currently based on data from older children, may not be appropriate for infants. The purpose of this paper is to determine reference values for defining iron deficiency in healthy, exclusively breast-fed infants.

To determine appropriate cut-off values, the researchers used data on biochemical indicators of iron status in 197 full-term, healthy, exclusively breast-fed infants from Sweden and Honduras. The infants were participants in another study that randomly assigned the babies to an iron-supplemented or control group. Blood samples were collected at 4, 6, and 9 months and analyzed for serum ferritin, mean cell volume (MCV), hemoglobin, zinc protoporphyrin, and soluble transferrin receptors. As iron deficiency becomes more severe, the first three indicators are expected to decline, whereas the last two increase.

Using three different approaches, the authors looked at the range of values for these biochemical indicators in this sample of healthy breast-fed infants. In the paper, they recommend cutoffs for hemoglobin and serum ferritin (shown below) that are lower than those currently in use for infants:

Indicator	Current cut-off	4 months	6 months	9 months
Hemoglobin, g/L	< 110	< 105	< 105	< 100
Ferritin, mg/L	< 10-12	<20	< 9	< 5

They also found that, from 4 to 6 months of age, a hemoglobin response to iron supplements may not necessarily be a good indicator of iron deficiency, as it would be in older children. This study is the first to report cutoffs for indicators of iron status in exclusively breast-fed infants. Since the findings are based on a relatively small sample, these findings need to be replicated in a larger study.

Source: Domellöf M, Dewey KG, Lönnerdal B, Cohen RJ, Hernell O. 2002. The diagnostic criteria for iron deficiency in infants should be reevaluated. J Nutr 132: 3680-3686.

No Effect of Exercise on Immune Properties of Breast Milk

Breast milk has a number of factors that protect babies from infection. Immunoglobulin A (sIgA) prevents bacteria from sticking to the mucosa and neutralizes toxins from microorganisms. Lactoferrin, competing with bacteria for iron, prevents growth of microorganisms. Lysozyme is a protein that splits bacteria and works together with lactoferrin and sIgA in their antibacterial functions.

Although the benefits of breast milk are well known, maternal nutrition can affect immune properties of breast milk. A couple of studies found that breast milk of malnourished mothers has lower than normal amounts of sIgA, lysozyme, and other protective factors. Hormones released during stress can also suppress immunity. One study reported that strenuous exercise can temporarily reduce the level of these factors in breast milk, but the effects of more moderate exercise levels are unknown.

Therefore, the purpose of this study was to examine the effect of moderate exercise on immune properties of breast milk at 3 months postpartum. The subjects were healthy, exclusively breastfeeding mothers who reported either: exercising at least 30 minutes a day for a minimum of 3 days a week (exercise group, n=29) or exercising less than once a week (controls, n=24). Except for the level of cardiovascular fitness, the two groups did not differ in other characteristics. The mothers collected milk samples during the first morning feeding after 5 am. The samples were analyzed for sIgA, lactoferrin, and lysozyme. The researchers also looked at short-term effects of exercise by comparing breast milk samples from a small group of exercising mothers after either a rest period or an exercise session. The intensity of the exercise session was about 75% of the maximal heart rate. Breast milk concentrations of sIgA, lactoferrin, and lysozyme were similar among the exercising and control mothers. The concentrations were also similar after a rest or exercise session.

The authors conclude that moderate exercise does not appear to affect immune properties of breast milk. Other studies show that moderate exercise also does not result in a build-up of lactic acid in breast milk, which may occur after more strenuous exercise. Consequently, there may be no need to discard breast milk produced within an hour after moderate exercise. Although moderate exercise without dieting may not promote greater weight loss in nursing mothers, a regular exercise program can be encouraged to improve cardiovascular fitness levels and lower risk factors for chronic disease.

Sources:
Lovelady CA, Hunter CP, Geigerman C. Effect of exercise on immunologic factors in breast milk. Pediatrics 2003; 111;e148-e152.
http://www.pediatrics.org/cgi/content/full/111/2/e148.

Barriers to Control of Phenylketonuria in Pregnancy

Phenylketonuria (PKU) is a genetic trait that results in high blood levels of phenylalanine due to lack of the phenylalanine hydroxylase enzyme needed to convert phenylalanine to tyrosine. High blood levels of phenylalanine can cause mental retardation and may be avoided by following a special diet restricted in phenylalanine and protein. More than 90% of babies born to mothers with uncontrolled PKU are mentally retarded. Many also have congenital heart defects and low birth weight. At one time, experts believed that restrictions were only necessarily during childhood and pregnancy. However, researchers now think that discontinuing the PKU diet in adulthood may lead to neurologic or behavioral problems and learning disabilities.

The problem is that many teens and adults stop following PKU dietary restrictions and monitoring phenylalanine levels in their blood. As a result, while only 30% of young children with PKU have high blood levels of phenylalanine, 70-80% of youth with PKU (15 yrs. and up) may have high levels. A study among 24 postpartum women with PKU in three states found that only 33% resumed their PKU diet before pregnancy, and only 55% achieved control of phenylalanine levels before the 10th week of pregnancy. At the time of the postpartum interview, 71% were no longer using any modified foods or formula, largely due to the unpleasant taste and belief that diet was not important after pregnancy.

Current recommendations are to begin dietary restriction of phenylalanine through use of medical foods 7 months before conception and to monitor blood phenylalanine levels 1 to 2 times per week. Phenylalanine levels should be maintained between 2 and 6 mg/dL. Pregnant women should be referred to a metabolic clinic with staff that specialize in PKU. In the three-state study, all women who were referred to the metabolic clinics felt the staff were knowledgeable about PKU, whereas only 33% thought their usual obstetricians had enough expertise. Some barriers in following recommendations included adverse taste of the formula, a long commute to the metabolic clinics, and unwillingness of private insurers to pay for formula and low-protein foods. Women most at risk of poor control were younger (less than 25 years), less educated, and believed that costs of treatment complicated the diet. Nationwide, between 3000 to 4000 women of child-bearing age have PKU. Education regarding this condition needs to extend beyond the special metabolic clinics to the offices of obstetricians, family practitioners, and pediatricians. Community educational programs also needed to reach teens and women with PKU and help them improve metabolic control before, during, and after pregnancy.

Sources:

Brown AS, Fernhoff PM, Waisbren SE, Frazier DM, Singh R, Rohr F, et al. Barriers to successful dietary control among pregnant women with phenylketonuria. Genet Med 2002; 4: 84-89.

Walter JH, White FJ, Hall SK, MacDonald A, Rylance G, Boneh A, et. al. How practical are recommendations for dietary control in phenylketonuria. The Lancet 2002; 360: 55-57.

Breastfeeding and Increased Risk of Allergy and Asthma

Studies examining the relationship between breastfeeding and development of asthma or allergy have yielded mixed results. In younger children, breastfeeding has been associated with less eczema and wheezing, but the effects are not always apparent in older children. In addition to age of the children studied and length of follow-up, conflicting results may be due to varying definitions of breastfeeding, effects of family history of allergy, and many other differences (or flaws) in study design. Adding to the confusion, at least three different types

of wheezing may occur--a temporary infant wheeze, a virally-associated wheeze, and an allergy-related wheeze. Causes--and protective factors-- associated with these types may differ.

A recent longitudinal study from New Zealand sparked a flurry of criticism when the researchers reported that breastfeeding increases the risk of asthma and allergies. In a sample of 1037 subjects, the researchers collected data on infant feeding practices when the children were 3 years old and then conducted repeated interviews every 2 to 3 years until the subjects were 26 years old. Infants who breastfed for less than 4 weeks were grouped with those never breastfed. The breastfed group included both exclusively and partially breastfed infants. Most of the data on incidence of wheezing, asthma, and allergic response was obtained from the mothers' report in the early years, but skin testing with allergens and lung function tests were performed in youth and young adults. At 9 years of age, children who breastfed more than 4 weeks were 2.4 times more likely to have asthma, compared to nonbreastfed children ($p < 0.0027$). At 13 years, breastfeeding increased the risk of house dust mite allergy by 1.7 times ($p < -0.002$) and of any allergy by 1.9 times ($p < 0.001$). The authors concluded that, while there are many reasons to encourage breastfeeding, decreased risk of asthma and allergy may not be one of them.

Critics have raised a number of issues with this study. One point is whether a comparison of exclusively breastfed vs. never breastfed might have been a better comparison and yielded different results. The current study was not able to tease out an effect, but the number of exclusively breastfed infants may have been too small. The article is also somewhat unclear as to how socioeconomic factors were handled in the analysis. Breastfeeding was associated in this study with higher socioeconomic status which, in turn, may be linked to greater access to health care and possibly, greater use of antibiotics in childhood. Prescription of antibiotics also increases risk of asthma. In their rebuttal to the critics, the authors conceded that the relationship between breastfeeding and greater incidence of allergy and asthma was not likely to be a direct causal one, since they could not find any increased risk with greater duration of breastfeeding.

Source: Sears MR, Greene JM, Willan AR, Taylor DR, Flannery EM, Cowan JO, Harbison GP. Long-term relation between breastfeeding and development of atopy and asthma in children and young adults: a longitudinal study Lancet 2002; 360: 901-07.

Maternal and Infant Nutrition Briefs is a research-based newsletter prepared by Dr. Lucia Kaiser (*llkaiser@ucdavis.edu*), a Cooperative Extension Specialist in the Department of Nutrition, University of California at Davis. This newsletter is written for health professionals interested in nutrition of mothers and young children.