Maternal & Infant Nutrition Briefs

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Are High-Iron Formulas Needed to Prevent Anemia ?

After four to six months of age, infants depend on dietary sources of iron to prevent anemia. The American Academy of Pediatrics has recommended that formula-fed infants receive 12 mg/L of iron during the first year of life. Some have raised concerns that 12 mg/L may be higher than necessary and could interfere with absorption of other trace elements (especially zinc) and immune function. In fact, in many countries, use of unfortified formulas with 1.5 mg/L is common. Some studies suggest that these low-iron formulas may be meeting iron needs better than expected. One possible reason is that infants in those studies were receiving adequate iron from other dietary sources. The purpose of this study was to compare the effects of low- vs. high-iron formulas on infant iron status in a setting where the weaning diet is typically low in iron.

This study was carried out on the outskirts of Santiago, Chile, where almost all babies are breast-fed in the early months and 50% continue nursing for up to six months. At the time of the study (1991-94), no national program of iron supplementation was in place, and the weaning diet provided about 5 mg of iron per day, mostly from plant sources. Excluded from the study were exclusively breast-fed babies and all others with low birth weights, congenital defects, anemia, or other health problems or complications. At six months of age, 835 babies were randomly assigned, in double-blind fashion, to either a low-iron (aver. 2.3 mg/L) or high-iron (aver. 12.7 mg/L) modified cow=s milk formula. Weekly records of illness, breast-feeding frequency, and formula intake were kept between 6 and 12 months. At 12 months, iron status was assessed (hemoglobin, mean cell volume, serum ferritin, and erythrocyte protoporphyrin). Nonanemic children in the low-iron group were assessed again at 18 months. Iron-deficiency anemia was defined as hemoglobin (Hgb) < 110 gm/L and abnormal values for at least 2 of the 3 other measures.

The two groups were similar in growth, formula consumption, and most breast-feeding variables. The low-iron formula was surprisingly effective in preventing anemia at 12 months. Only 3.8% of the low-iron vs. 2.8% of the high-iron group were anemic (NS). However, compared to the high-iron group, a larger proportion of the low-iron group (35% vs. 17%, $p < 0.001$) had low values for 2 of the 3 other iron status measures. By 18 months, these infants had improved their iron status, even though they continued on the low-iron formula.

Although the low-iron formula met infant needs better than expected, only healthy, normal birth weight, nonanemic infants were recruited into the study. Most had been breast-fed and were weaned to diets high in vitamin C-rich fruits and vegetables. Nevertheless, given the concerns about high-iron formulas, the optimal level of iron in formula for normal birth weight infants may actually be somewhere between the current levels in high- and low-iron formulas.

Source: Walter T, Pino R, Pizarro F, Lozoff B. Prevention of iron-deficiency anemia: comparison of high- and low-iron formulas in term healthy infants after six months of life. J. Pediatr. 132: 635-40.

NCHS Charts: Growing Problems for Breast- and Formula-Fed Infants

Much has been written about the limitations of the 1975 National Center for Health Statistics (NCHS) growth reference. This growth reference is thought to be particularly inadequate for infants since the data were derived from a relatively homogeneous group of mostly formula-fed infants. Moreover, measurements were not taken often enough to yield a precisely fitting curve, and the techniques used for curve-fitting are outdated. A recent analysis of growth in 5304 Brazilian infants found that, regardless of how the children were fed, their growth deviated substantially from the NCHS reference charts. Both the breast-fed subset and all infants from Pelotas, Brazil grew faster in the first 3-6 months and then slowed down, compared to the NCHS reference. The Pelota breast-fed infants, in particular, showed a marked faltering in length after 3 months of age. The World Health Organization (WHO) has pooled data from seven developed countries in North America and Europe to study problems with the NCHS reference. When the authors compared growth of the Brazilian infants to that of the WHO breast-fed and formula-fed infants, as well as the U.S. Pediatric Nutrition Surveillance data (primarily formula-fed babies), they found that weight and height patterns from all samples deviated substantially from the NCHS reference.

Sometime this year, NCHS will release a revised version of its growth reference, largely based on national surveys including the NHANES III. Improved techniques will ease the transition between the 0-36 months and 2-18 years charts. However, the national surveys still do not include enough infants under 6 months. Therefore, the revised NCHS charts will continue to include the Fels Longitudinal Study and other datasets with relatively few breast-fed infants. A large multicountry study is underway to develop a new international growth reference for the first two years of life. This longitudinal dataset will be based on healthy, breast-fed infants who come from diverse racial/ethnic backgrounds and live in settings that do not limit their growth. The new chart will probably be available in the year 2001.

In the meantime, health providers may wish to refer to the WHO growth charts in cases of suspected growth faltering. The report with these charts may be ordered from: Dr. Mercedes de Onis, Nutrition Unit, World Health Organization, CH-1211 Geneva 27, Switzerland.

Sources: Victora CG, Morris SS, Barros FC, de Onis M, Yip R. The NCHS reference and the

growth of breast- and bottle-fed infants. J. Nutr. (1998) 128: 1134-1138.

Dewey KG. Growth patterns of breastfed infants and the current status of growth charts for infants. J Human Lact. (1998) 14 (2): 89-92.

Does Vitamin / Mineral Use Reduce Risk of Fetal Death in Smokers?

Smoking during pregnancy has been linked to intrauterine growth retardation and fetal death in numerous studies. Exposure to free-radicals in cigarette smoke may cause oxidative damage to the fetus. Neutralizing toxic substances in tobacco may deplete the body of certain nutrients. In an analysis of data from the 1988 National Maternal and Infant Health Survey, Wu and colleagues have examined whether regular vitamin and mineral use before and during pregnancy could modify the risk of fetal death associated with smoking.

The sample included 12,465 singleton livebirths and 3,063 singleton fetal deaths. Regular vitamin users were defined as women who used multivitamin and/or minerals at least 3 days a week for 3 months. Maternal smoking was categorized as: 0, 1-9, 10-19, or 20 or more cigarettes per day. The analysis controlled for the potentially confounding effects of race, marital status, education, pre-pregnant weight, vomiting, alcohol use during pregnancy, previous history of miscarriage/stillbirth, family income, infant gender, and the extent to which the pregnancy was wanted.

In this study, 23.8% of the women continued to smoke after they became pregnant, 23.4% used multivitamins and minerals before pregnancy, and 74.8% used supplements after becoming pregnant. Among women who did not use supplements before pregnancy, fetal death rates (# per 100 pregnancies) were: 0.36 for nonsmokers; 0.41 for women who smoked 1-9 cigarettes per day; 0.42 for those who smoked 10-19 cigarettes; and 0.47 for those who smoked 20 or more per day. In examining the effects of supplements taken *before pregnancy,* the authors found a significant trend for increased fetal death with more smoking only in women *not using* supplements ($p < 0.05$). Supplement use before or after becoming pregnant had almost no effect on risk of fetal death in nonsmokers. Among women smoking more than 10 cigarettes a day during pregnancy, women who also took supplements tended to have a lower risk of fetal death, but the effect was not significant. However, in considering the effects of supplements use both before and after conception, protective effects of supplements were strongest *before pregnancy* in the heaviest smokers.

The study had a number of limitations: lack of dietary data, reliance on self-reported behaviors (i.e., supplement use and smoking), and lack of data on smoking before pregnancy. One of the most serious problems is that mothers who used vitamins were likely to be different from mothers who did not in ways that could not be fully considered in the analysis. However, the results are consistent with proposed mechanisms and the body of knowledge from other studies. Therefore, regular use of multivitamins and minerals, particularly among heavier smokers, *may* reduce the risk of fetal death associated with smoking.

Source: Wu T, Buck G, Mendola P. Maternal cigarette smoking, and regular use of multivitamin/minerla supplements, and risk of fetal death. Am J. Epidemiol. (1998) 148: 215-21.

Stressful Labor and Delivery Can Affect Early Lactation

Birth is certainly a stressful event for both infants and mothers. During an uncomplicated vaginal birth, levels of catecholamines (norepinephrine and epinephrine) are quite high in the infant and mother. This normal surge in catecholamines in the baby is thought to promote breathing, mobilize fuel, and increase blood flow and alertness. However, extremely high levels of catecholamine in cord blood are associated with fetal oxygen deprivation. On the other hand, infants born by elective cesarian deliveries do not experience the normal surge in catecholamines. More than forty years ago, some researchers reported an association between difficulties during labor and a lower incidence of breastfeeding in a sample of 600 women. Although several hormones play important roles in the initiation and maintenance of lactation, little is known how the extent of stress during labor and delivery affects these hormones and the beginning of lactation.

A recent study of 45 women involved direct observation of events occurring during labor and delivery and careful follow-up during the first 14 days postpartum. Cord blood samples were saved. Within 30 minutes of delivery, the observer asked the mother to rate her pain and exhaustion level during labor and delivery on a scale of 0-10. At that time, maternal blood samples were collected and again, at 4 days postpartum. The blood samples were later analyzed for catecholamines, insulin, prolactin, cortisol, and glucose. Other data collected included breast milk composition and volume, breastfeeding frequency, and the day and time the mother first noted breast fullness. Markers for early milk production included: 24-hour milk volume on day 5 postpartum; time when mother noted breast fullness; appearance of casein in the milk; and milk lactose levels on day 5 postpartum. Compared to multiparas, primaparas had a delay in breast fullness and lower milk volumes on the 5th day postpartum, which appeared mainly to be due to breastfeeding frequency. In vaginal deliveries, maternal and fetal stress (i.e., cord glucose and maternal exhaustion score) were significantly associated with a delay in breast fullness and later appearance of casein in the milk. A longer duration of labor was also related to a delay in casein appearance. Milk volumes on the 5th day postpartum were lower in women who experienced more exhaustion during labor and in multiparas who breastfed less often on day 2.

More research is needed to examine to relationships between infant plasma glucose and appetite, sucking ability and wakefulness. In the meanwhile, health providers should target primaparas and women who have experienced long and stressful labors for extra lactation support and guidance.

Source: Chen D, Nomsen-Rivers L, Dewey KG, and Lönnerdal B. Stress during labor and delivery and early lactation performance. Am. J. Clin. Nutr. (1998) 68: 335-44.

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