

## Maternal & Infant Nutrition Briefs

---



**January/February 2000**

**Measuring the Risk of Caffeine during Pregnancy**

**A Comparison of Cup- and Bottle-feeding in Newborns**

**Costs of Formula-feeding**

**Maternal Cholesterol During Pregnancy**

*A research-based newsletter prepared by the University of California for professionals interested in maternal and infant nutrition*



### **Measuring the Risk of Caffeine during Pregnancy**

In 1981, the Food and Drug Administration (FDA) advised pregnant women to avoid caffeine-containing foods and drugs, if possible, or consume them only sparingly. However, more than 75% of all pregnant women in the U.S. still consume caffeinated beverages, possibly because adverse health effects due to caffeine have not been found consistently across studies. A number of study design issues may have contributed to this lack of consistency, including the need to rely on self-reported intakes of caffeinated beverages. The purpose of this study was to examine the risk of fetal loss due to caffeine, using a metabolite of caffeine, paraxanthine to estimate intake.

Serum paraxanthine level is actually more closely correlated with caffeine intake than serum caffeine, particularly in smokers. To examine the link between caffeine and spontaneous abortion, the authors measured serum paraxanthine in stored samples, collected from women who participated in the Collaborative Perinatal Project at 12 U.S. sites from 1959-1966. Data from women (n=591) who miscarried before 140 days of gestation were compared to data from matched controls (n=2558). The controls delivered live babies after 28 weeks and had serum samples drawn on the same day of gestation as the cases. The analysis examined the risk of spontaneous abortion, after accounting for the effects of mother's age, smoking, ethnicity, and vomiting during pregnancy. The latter variable was included because nausea is thought to be marker for a healthy pregnancy and may cause women to decrease their intake of caffeine. While mean serum paraxanthine levels were higher among those with spontaneous abortion compared to controls, the risk of spontaneous abortion was not increased until paraxanthine levels exceeded the 1846 ng per ml. That level would roughly correspond to 6 or more cups of coffee a day for a nonsmoker weighing 60 kg. Compared to women with no detectable or minimal levels of paraxanthine, heavy caffeine consumers were 1.9 times as likely to experience fetal loss (95% confidence interval, 1.2 to 2.8).

While this study examined a biochemical marker for caffeine intake, rather than rely on self-

reported intake, some limitations are important to consider before assuming moderate amounts of caffeine are safe. First, paraxanthine levels measured at one time during pregnancy may not reflect exposure during critical periods, given caffeine's short half-life of 5-10 hours. Little is known about the effects on fetal development of consuming more concentrated caffeinated beverages, i.e., espresso drinks, compared to regular coffee. Second, other outcomes, including neurological and cardiovascular effects on the baby, were not measured and may be more significant than effects on fetal loss. A meta-analysis concluded that risk of low birth weight is higher among women consuming more than 150 mg/day, which is equivalent to 1-2 cups of coffee. Thus, in the meantime, health providers should continue to advise pregnant women to limit their intake of caffeine from all sources. Food labeling would be an important first step to help women watch their intake of caffeine.

**Sources:** Klebanoff MA, Levine RJ, DerSimonian R, Clemens JD, and Wilkins DG. 1999. Maternal serum paraxanthine, a caffeine metabolite, and the risk of spontaneous abortion. *N Engl. J. Med.* 341: 1639-44.  
Eskenazi, B. 1999. Caffeine--filtering the facts. *N Engl. J. Med.* 341: 1688-1689.  
Fernandes O, Sabharwal M, Smiley T, Pastuszak, Koren G, and Einarson T. Moderate to heavy caffeine consumption during pregnancy and relationship to spontaneous abortion and abnormal fetal growth: a meta-analysis. *Reproductive Toxicology* 12 (4): 435-444.

### **A Comparison of Cup- and Bottle-feeding in Newborns**

In breastfed babies, early introduction to bottles is thought to lead to nipple confusion and breastfeeding problems. Consequently, cup-feeding has been recommended where breastfed infants need supplements for medical reasons. However, the safety and physiologic effects of cup-feeding on newborns have never been evaluated in a clinical trial. Therefore, the purpose of this study was to compare responses of newborns who were cup-, bottle-, or breastfed during the first few days of life.

Healthy, term formula-fed infants were randomly assigned to be fed by a nurse with either a small medicine cup (n=51) or a bottle (n=47). Twenty-five breastfed infants were also included for comparison. Heart rate, respiratory rate, oxygen saturation were monitored before and after the feeding and at 30 second intervals during the feeding. Feeding times and amount of milk consumed were also measured. Cup- and bottle-fed infants did not differ in feeding times, amounts consumed, or any of the physiologic variables measured. Breastfed infants fed for significantly longer periods. They also had lower heart rates and higher oxygen saturation levels than either of the formula-fed groups. The study cannot rule out that some of the differences observed between breast- and formula-fed groups were due to effects of being fed by the mother (breastfed) vs. a nurse.

Nevertheless, in healthy, term newborns, cup-feeding appears to be as time-efficient and effective as bottle-feeding. Whether cup-feeding can prevent nipple confusion remains to be determined by future studies. In the meantime, health providers can recommend cup-feeding as an alternative to bottle-feeding for healthy, term breastfed infants who need supplements for medical reasons.

**Source:** Howard CR, de Blicke EA, ten Hoopen CB, Howard FM, Lamphear BP, and Lawrence RA. 1999. Physiologic stability of newborns during cup- and bottle-feeding. *Pediatrics* 104 (5): 1204-1207.

## Costs of Formula-feeding

Breastfeeding is associated with lower rates of illness both in developing and developed countries. Attaching a cost-savings figure to breastfeeding may be important to encourage hospitals to establish policies promoting breastfeeding. A previous study estimated the cost of supporting a breastfeeding mother to be 55% of that needed to provide formula through the Women, Infants, and Child Nutrition (WIC) program. This study examines the added costs of formula-feeding due to otitis media (OM), lower respiratory tract infections (LRI), and gastrointestinal illnesses (GI).

The data came from two large community-based studies in Tucson and Dundee, Scotland. The Tucson data on infant feeding practices and illness was extracted from standard health forms, completed by physicians during the child's first year of life. The Dundee data came from files kept by home health visitors who recorded infant feeding practices and GI episodes at 1, 2, 3, 4, 5, 6, 9, and 12 months. Direct costs of office visits, hospitalizations, and prescriptions were based on data kept by a large clinic, hospital, and pharmacy in Tucson.

Exclusively breastfed infants had significantly fewer episodes of OM and GI compared to babies who never breastfed. The study reported 2033 excess office visits, 212 excess days of hospitalization, and 609 excess prescriptions per 1000 never breastfed babies for OM, GI, and LRI. The authors estimated that these services resulted in added costs to the Health Maintenance Organization (HMOs) of \$331 to \$475 per formula-fed infant during the first year of life.

These figures do not fully capture the true costs of formula-feeding, because parent absence from work and formula costs were not calculated. Since HMOs are striving to contain health care costs, these findings may be useful in encouraging hospitals to adopt baby friendly practices to promote breastfeeding.

**Source:** Ball TM, and Wright A. 1999. Health care costs of formula-feeding in the first year of life. *Pediatrics* 103 (4): 870-876.

## Maternal Cholesterol During Pregnancy

Fatty streaks are flat, lipid-containing areas in the lining of the arteries. In adults, fatty streaks seem to precede the formation of plaques, which, as atherosclerosis develops, eventually block the arteries and lead to stroke. Studies done on infants and children have also found fatty streaks but their significance is unclear, particularly since plaques are not seen until adolescence. The purpose of this study was to explore the influence of hypercholesterolemia during pregnancy on the development of fatty streaks in childhood.

The authors used computer-assisted imaging to measure fatty streaks in the aortic arch and abdominal aorta in children who had died from accidents, cancer, or other causes. From the medical records of the mothers, the authors extracted serum cholesterol levels, drawn at three to four times during pregnancy. This information, along with the mother's current cholesterol levels, was used to classify the mothers as having had elevated (n=59) or normal (n=97) cholesterol levels during pregnancy. Family history and other risk factors for atherosclerosis, as well as cholesterol levels of the deceased children, were also taken from the medical records. To determine whether early fatty streaks disappear, data from deceased children under three years were compared to previously collected data from fetuses.

All infants and children had some fatty streaks, but thickening of the arterial wall due to lipid build-up was not clearly visible in children under 10 years old. Fatty streaks in the aortic arch were proportionately smaller in young children, compared to fetuses, but the reverse was true for the abdominal aorta. These differences were especially pronounced in children born to hypercholesterolemic mothers. In both groups, the size of the fatty streaks increased linearly with age ( $r=0.89-.98$ ,  $p < 0.0001$ ). The rate of increase was stronger in children born to hypercholesterolemic mothers compared to those of normocholesterolemic women. Cholesterol levels in the children were not related to the rate of fatty streak development.

The cause of the child's death did not appear to influence the results but the number of children dying from cancer was small. We also cannot whether genetic factors and/or prenatal programming explain the link between maternal hypercholesterolemia and later development of fatty streaks in children. The authors conclude that more research is needed on the long-term benefits of lipid-lowering strategies during pregnancy, particularly using dietary interventions.

**Source:** Napoli C., Glass CK, Witzum JL, Deutsch R., D'Armiento FP, Palinski W. 1999. Influence of maternal hypercholesterolaemia during pregnancy on the progression of early atherosclerotic lesions in childhood: Fate of Early Lesions in Children (FELIC) study. *Lancet* 354: 1234-1241.

Maternal and Infant Nutrition Briefs is a research-based newsletter prepared by Dr. Lucia Kaiser ([lkaiser@ucdavis.edu](mailto:lkaiser@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.

The University of California, in compliance with the Civil Rights Act of 1964, Title IX of the Education Amendments of 1972, and the Rehabilitation Act of 1973, does not discriminate on the basis of race, creed, religion, color, national origin, sex, or mental or physical handicap in any of its programs or activities, or with respect to any of its employment policies, practices, or procedures. The University of California does not discriminate on the basis of age, ancestry, sexual orientation, marital status, citizenship, medical condition (as defined in section 12926 of the California Government Code), nor because individuals are disabled or Vietnam era veterans. Inquiries regarding this policy may be directed to the Director, Office of the Affirmative Action, Division of Agriculture and Natural Resources, 300 Lakeside Drive, Oakland, CA 94612-3550. (510) 987-0097.