Human Milk as the First Source of Nutrients

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The nutrient requirements of young infants are higher per unit body weight than at any other time of life. Those who are exclusively breastfed (EBF) consume on average about 750 mL/day between 1 and 6 months. There are substantial differences in daily milk intake among infants; on average the range is about 570–900 mL, but in reality it is even wider than this. It is assumed that milk intake is predominantly influenced by infant demand. But whether those who habitually consume less milk also have proportionately lower intakes of all nutrients has not been systematically studied – perhaps nutrients are more concentrated in milk of mothers who produce smaller volumes.

In general, the amount of nutrients in the milk of a well-nourished woman is sufficient to support optimal growth and development of her infant. There are, however, some nutrients that may not be sufficient especially toward the end of the first 6 months. These include iron and zinc, the concentrations of which fall during the postpartum period such that they do not meet the requirements of the infant. Requirements for iron and zinc are estimated by the factorial approach that provides a basis for concluding that their intake becomes inadequate. Also the prevalence of low hemoglobin in infants increases with time postpartum. Other nutrients that may be inadequate in milk of well-nourished women include vitamin B12, a conclusion based on falling serum B12 and increasing serum methylmalonic acid concentrations by the middle of the first year of life, and vitamin D.

It is actually difficult to make conclusions about the nutritional adequacy of human milk because there are few normative data on the nutritional status of infants during the first year of life. Cut-points for adequacy and deficiency are usually nonexistent, so adult values are used. Even cut-points for hemoglobin are controversial. An additional problem is the very limited amount of information on the concentrations of nutrients, due to limitations in the number of participants, analytical uncertainties and constraints, and the variable nutritional status of the mothers.
Typically, the nutritional status of infants is not studied until after age 6 months and there are few supplementation trials at younger ages (IRIS was an exception). The few data that exist indicate that there may already be a high prevalence of deficiencies by age 6 months in poorer populations. This is usually ascribed to lack of true EBF or illness and infections. Unfortunately, there are almost no studies of the benefits of maternal supplementation on infant function (mention B12, other B vitamins, iodine, etc.).

The assumption that human milk no longer provides sufficient amounts of all nutrients after age 6 months drives the recommendation that complementary foods are required after this age (include studies of this). A recent study in a rural poor population in The Gambia revealed, however, that following WHO’s recommendation of exclusive breastfeeding to age 6 months versus nonexclusive breastfeeding did not affect growth between birth and 2 years.

In recent years, we have developed efficient methods for measuring multiple nutrients in milk. This has enabled us to illuminate the large differences in milk micronutrient concentrations across populations and to study the effects of maternal supplementation in pregnancy and/or lactation on secretion of the micronutrients in milk and the effect on infant’s status. Maternal deficiency or low intake has a major impact on milk concentrations of all the B vitamins except folate; on vitamin A and B-carotene; iodine and selenium; and, to a lesser extent, vitamin D. Vitamin A, vitamin B12, and iodine will be discussed in most detail. The effects of maternal supplementation during lactation vary among nutrients, with milk riboflavin increasing the most rapidly and in the largest amount, B12 increasing only slowly, and folate not at all. Since there is an acute increase in some milk micronutrients within hours, the timing of collection of milk samples in supplementation studies is difficult; collection prior to consuming a daily supplement will underestimate the daily amount secreted in milk, while collection within a few hours after a supplement is consumed will overestimate daily secretion.

The ongoing Mothers, Infants and Lactation Quality (MILQ) study proposes to answer some of the uncertainties raised above. Participants are 250 mother–infant dyads in 4 countries who are EBF for at least 3.5 months and still consuming some milk through 8.5 months. The mothers are healthy, and well-nourished, but do not take supplements (except for iron and folic acid) during pregnancy or lactation, and do not have high intakes of fortified foods. The range of nutrient concentrations in the milk of these women will provide “Reference Values” against which other studies and surveys can evaluate the quality of milk in their population and possibly target nutrients with especially low values for treatment with supplements or fortification. The MILQ study will also collect
longitudinal samples of mother’s and infant’s blood so that Reference Values for nutrients can be established during this period. The values for milk concentrations of nutrients will also be useful for improving nutrient intake recommendations for infants, young children, and lactating women.

The lecture will end with a summary of the many information gaps concerning nutrients in human milk.