

Distributions of Breast Milk Lipid Intake

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Introduction/Rationale

Breast milk lipid is an important source of infant exposure to environmental contaminants that are sequestered in adipose tissue and eliminated from the body primarily, or only, during lactation. PCBs and dioxins are examples of such contaminants. Breast-fed infants may receive a significant portion of maternal load over the breast-feeding period^{1,2} and their daily exposure may be much greater than formula-fed infants³. Exposure via breast milk is during a period of rapid growth and development when susceptibility to certain toxic effects of contaminants is likely to be high.

The American Academy of Pediatrics (AAP, 1997) recommends that infants receive breast milk as the sole source of nourishment through the first 6 months of age, then receive breast milk as the sole source of milk through 12 months. Physicians often encourage nursing mothers to follow the AAP's recommendations.

To assess infants' exposures via breast milk, we evaluated breast milk lipid intakes. For consistency with the AAP's recommendations, we characterized lipid intake for the 0-6 and 0-12 month age periods. Lipid intake was normalized to body weight using each infant's lipid intake and body weight (rather than an average infant body weight) to capture the full range of lipid intakes. Normalized lipid intakes were integrated over the 0-6 and 0-12 month periods to derive average daily lipid intake rates. To best characterize the spectrum and variability of lipid intake within the breast-feeding population, statistical distributions were derived.

Methods

Selection factors for the studies used in our analyses included: (1) data were available on individual infants at each measurement period (for the derivation of statistical distributions), (2) simultaneous measurements of infant body weight, milk volume intake, and milk lipid content levels were made (for normalization on an individual basis), (3) measurements were made periodically up to 12 months of age (consistent with AAP recommendations), and (4) sufficient sample size. The study of Dewey *et al.*⁴ was the only known study to meet all the selection factors and was thus chosen for use.

Milk lipid content (g lipid/100 ml milk) and milk intake rates (g milk/kg-day) measurements were available on 72 infants at 3 months of age, on 53 at 6 months, on 46 at 9 months, and on 39 at 12 months. A total of 211 lipid intake (LI) datapoints were calculated. The LI data were analyzed for curve fit and parameter estimation. Linear regression was used to evaluate age vs. lipid intake rate and derive percentiles of average daily milk intake over the 0-6 and 0-12 month age periods.

Results

LI data were found to fit the normal distribution fairly well. The distributions derived over the 0-6 and 0-12 month periods are shown in Table 1.

Table 1. Distributions of Average Daily Breast Milk Lipid Intake (g/kg-day) for Fully Breast-fed Infants Over the First Six and Twelve Months

Percentile	5	10	15	20	25	30	35	50	65	70	75	80	85	90	95
6 mos	2.79	3.18	3.45	3.66	3.84	4.00	4.15	4.57	4.99	5.14	5.30	5.48	5.69	5.96	6.35
12 mos	1.46	1.97	2.32	2.61	2.84	3.06	3.26	3.81	4.36	4.56	4.78	5.01	5.30	5.65	6.16

*derived from Dewey *et al.* (1991) data

Discussion

Milk intake on a body weight basis is quite low immediately after birth gradually increasing and leveling off at about 5-10 days of age⁶. Peak average daily lipid intakes occur during the next several weeks and gradually decrease over time. The period of peak intakes has been suggested to be the period of greatest susceptibility to certain toxic effects⁷. Decreased LI over time may be attributed to the introduction to solid food during later infancy.

The 50th percentile of our 0-6 month average daily lipid intake rate (4.57 g/kg-day) is consistent with the weighted mean lipid intake of infants 1-4 months age in the Butte *et al.* study (4.46 g/kg-day).

There have been significant increases in the incidence and prevalence of breastfeeding over the past 10 years (Ross, 2000). Nearly 20% of women still breastfeed at 12 months (Ross, 2000).

Limitations of our study:

- extrapolation of the 0-3 month period.
- lack of information on the exact age that individual infants were introduced to solid foods, weaned or became token breast-feeders.
- lack of data during the 3 month interval between measurements when many changes in lipid content and milk intake might occur influencing LI.
- lack of data at 2-3 weeks of age when there is a transition from colostrum to full-milk.
- LI at the 3 month measurement in the Dewey *et al.* dataset not normally distributed.

References

¹ Smith AH (1987). Infant exposure assessment for breast milk dioxins and furans derived from incineration emissions. *Risk Analysis* 7(3):347-353.

² Schechter A, Papke O, Lis A, Ball M, Ryan JJ, Olson JR, Li L, Kessler H. Decrease in milk and blood dioxin levels over two years in a mother nursing twins: estimates of decreased maternal and increased infant dioxin body burden from nursing. *Chemosphere*. 1996 Feb;32(3):543-9.

³ Abraham K, Knoll A, Ende M, Papke O, Helge H. Intake, fecal excretion, and body burden of polychlorinated dibenzo-p-dioxins and dibenzofurans in breast-fed and formula-fed infants. *Pediatr Res*. 1996 Nov;40(5):671-9.

⁴ Dewey KG; Heinig MJ; Nommsen LA, and Lonnerdal B (1991a). Adequacy of energy intake among breast-fed infants in the DARLING study: Relationships to growth velocity, morbidity, and activity levels. *J Pediatr* 119:538-547.

⁵ SAS Procedures: compare. SAS software version 8.0. SAS Institute, Cary, NC.

⁶ Neville MC; Keller R; Seacat J; Lutes V; Neifert M; Casey C; Allen J, and Archer P. Studies in human lactation: milk volumes in lactating women during the onset of lactation and full lactation. *Am. J. Clin. Nutr.* 1988; 48:1375-86.

⁷ National Research Council 1993. Pesticides in the Diets of Infants and Children. *National Academy Press*. Washington D.C.