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A Call for Clarity in Infant Breast and Bottle-Feeding Definitions for Research

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ABSTRACT

Unclear and inconsistent infant-feeding definitions have plagued much of breastfeeding research. To determine accurate health outcomes associated with infant feeding, it is imperative that different types of feedings be explicitly described. Definitions must be based on content, not mode of milk delivery. Five new definitions for infant feeding are provided. These definitions are operationally useful for breastfeeding researchers, allowing for the inclusion of almost every infant into an appropriate sample group.

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In 2004, the Centers for Disease Control and Prevention (CDC) reported that the breastfeeding initiation rate among U.S. infants was 77%. This met the goal of the Healthy People 2010 initiative for a 75% breastfeeding initiation rate. The national objective also called for 50% of infants to be breastfed for at least 6 months and 25% to be breastfeeding for 1 year. Unfortunately, the goals for breastfeeding duration are far from realized. As of 2004, the CDC reported that only 11% of infants were exclusively breastfed for 6 months of age and at 12 months, any breastfeeding among U.S. infants was 20%. These data clearly demonstrate that many mothers begin but do not continue to breastfeed their infants. The culture of infant feeding in the United States remains firmly grounded in the use of artificial milk.

Artificial milk is defined as any liquid milk product such as infant formula, cow, or other animal milk. Artificial milk feeding predominates in the United States despite evidence that infants fed breast milk are healthier than infants fed artificial milk. Although most people will acknowledge that "breast is best," breastfeeding and the use of artificial milk are widely considered adequate means of providing infant nutrition. Although the benefits of breast milk may be understood, the risks of artificial feeding are not well known or appreciated by the general population. Scientific evidence that demonstrates not only the benefits of breast milk but also the potential risks associated with artificial milk needs to be stronger. Close examination of past and present research has indicated that data generated from many infant feeding studies could indeed be stronger. Unfortunately, breastfeeding research has been plagued with inconsistent definitions and lack of clear distinctions between feeding groups. Authors have described how the protective effects of breastfeeding could be more dramatic if researchers coherently defined their feeding groups (Armstrong, 1991; Auerbach, Renfrew, & Minchin, 1991; Labbok & Krasovec, 1990).

Admittedly, the amount of breast milk an infant receives is inherently difficult to measure. Considerable variation exists regarding how and what infants are fed. Indeed, most infants do receive a combination of breast milk, artificial milk, and solid food during the first year of life. To assess intake, researchers must rely on the mother's report of her infant's diet, which can be complicated by poor recall and the wish to provide researchers with socially desirable responses (Chapman & Perez-Escamilla, 2009). In a review of the variables associated with breastfeeding duration, Thulier and Mercer (2009) concluded that breastfeeding is a complex phenomenon influenced by many demographic, biological, social, and psychological variables. At times, women have experienced guilt

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if they were unable to meet their breastfeeding goals (Lakshman, Ogilvie, & Ong, 2009). Attempts by researchers to help women feel good about any breast milk provided and to prevent them from feeling guilty may cause potential bias in studies.

Despite these challenges, researchers must strive to use clear definitions and appropriate feeding categories. In many feeding studies, infants have routinely been categorized as breastfed when they have consumed artificial milk. Conversely, infants categorized as artificially fed have consumed breast milk. When infants are categorized in this manner, researchers are unable to clearly demonstrate that associated health outcomes are related to infant feedings. Inconsistencies among definitions and categories call into question data generated from studies, comparisons across studies, and the value of current evidence as a guide to practice.

Significant health differences exist between infants who consume only breast milk compared to infants who consume breast milk supplemented with artificial milk, and infants who consume only artificial milk. For example, the type of milk fed to an infant may influence the development of allergy and disease. In 2002, Mountzouris, McCartney, and Gibson described how breastfed and artificially fed infants have different gut flora. Breastfed infants have a lower gut pH (5.1-5.4) throughout the first 6 weeks of life with reduced disease causing microbes such as *E. coli*, bacteroides, clostridia, and streptococci. Artificially fed infants have a high gut pH (5.9-7.3) characterized by a variety of anaerobic bacterial species. For infants fed breast milk in addition to artificial milk, gut pH is approximately 5.7 to 6.0, falling to 5.45 by the sixth week. The gut flora of breastfed infants who receive supplements is more similar to infants fed artificial milk. Specific deviations of the gut flora can predispose infants to allergic disease, inflammatory gut disease, and rotavirus diarrhea (Lee & Puong, 2002; Salminen, Gueimonde, & Isolauri, 2005).

It is well known that infants fed breast milk have fewer cases of acute illnesses, such as respiratory (Chantry, Howard, & Auinger, 2006; Roth, Caulfield, Ezzati, & Black, 2008), gastrointestinal (Duijts, Jaddoe, Hofman, & Moll, 2010), and ear infection (Hetzner, Razza, Malone, & Brooks-Gunn, 2009). Increasing numbers of studies have demonstrated that breastfed infants have lower risks for chronic conditions, such as childhood-onset diabetes mellitus (Rosenbauer, Herzig, & Giani, 2008) and obesity (Chivers et al., 2010; Feig, Lipscombe, Tomlinson, & Blumer, 2010; Twells & Newhook, 2010). Many of these differences are thought to be related to the specific components of breast milk including the amount of water, lipids, proteins, carbohydrates, vitamins, minerals, trace elements, and microminerals that it contains. Human milk also contains bioactive components including immunoglobulin sIgA, peptide and nonpeptide hormones, enzymes, and growth factors (Mountzouris, McCartney, & Gibson, 2002).

More than 200 components have been identified in breast milk, with some of their roles still unknown (Walker, 2006). Many of these substances have not been manufactured and are not contained in artificial milk. The differences in health outcomes may also be related to components included in artificial milk. Therefore, the amount of breast or artificial milk received by an infant is an important measure. For example, if an infant's diet is 100% breast milk, that infant is likely to have different health outcomes compared to the infant whose diet is 50% breast milk and 50% artificial milk. Certainly different outcomes are more likely compared to the infant whose diet is 100% artificial milk. To clearly demonstrate these differences, feeding definitions must explicitly describe the kind and amount of milk infants ingest. Definitions must describe feedings when only breast milk is offered, when breast and artificial milk are given in varying amounts, and when only artificial milk is given. To ensure reliable placement of infants into appropriate sample groups, feeding categories must be created based on these definitions.

When defining infant feeding, it is important to distinguish the subtle differences between breastfeeding and feeding infants with breast milk. There are advantages for the infant who breastfeeds directly, particularly from the biological mother. Some of these advantages include improved oral and visual development (Birch et al., 1993; Palmer, 1998), specific maternal antibody protection against pathogens in the infants immediate environment (Catassi, Bonucci, Coppa, Carlucci, & Giorgi, 1995), and changes in milk composition that meet the needs of the growing infant (Walker, 2006). As with artificial milk feeding, the risks associated with the consumption of expressed breast milk (EBM) include the possibility of contamination and overfeeding. Yet, though breastfeeding is clearly the goal for optimal health, "it is recognized that