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Infant Feeding Patterns A Mini Review on Evaluation of Infant Feeding in Several Aspects

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Abstract: Infant feeding pattern has long-term effects on health, growth and development. There are many factors affecting infant feeding patterns. These can be broadly categorized as social factors, nutritional and health statuses of mothers and infants, bioavailability of nutrients and composition of foods and government policies. In this mini-review, current information on infant feeding practices and their advantages and disadvantage was presented.

Key words: Infant, Feeding, Breast-feeding, Cow milk, Human milk, Formula

Introduction

Even though feeding infants commercial formula and cow milk has been very common during the last two decades, current infant feeding practices are highly variable. Nowadays, feeding infant human milk tends to increase and be strongly recommended. There are many factors associated with determining how to feed infant. These can be broadly categorized as:

Social factors that cover education levels, social and cultural statuses and economical conditions of parents,
Nutritional and health status of mother and health concern and development for infant,
Bioavailability and composition of nutrients in food and
Government policies.

The objectives of this mini-review were to discuss factors affecting current infant feeding decisions and evaluate their advantages and disadvantages.

Social Factors: Education levels, social and cultural statuses and economical conditions of parents are interrelated and greatly influence selecting and applying feeding type and feeding duration for infants (Ashraf *et al*., 1993; Lawson and Tulloch, 1995; Perez-Escamilla *et al*., 1995; Savino *et al*., 1994; Wijekoon *et al*., 1995). Maternal attitudes influence infant feeding decision (Dungy *et al*., 1994). Interestingly, paternal attitudes also influence infant feeding choice; paternal attitudes were shown to favor maternal attitudes towards breast-feeding (Freed and Fraley, 1993). In spite of a common knowledge that human milk is the most useful food source for infant feeding and development (Donovan and Odle, 1994; Freed and Fraley, 1993; Skinner *et al*., 1997), there is a great variation in application and consideration of infant feeding practices among families that are in different cultures and socioeconomic conditions (Ashraf *et al*., 1993; Tuttle and Dewey, 1996). It was reported that breast-feeding was negatively associated with the number of children (Tuttle and Dewey, 1996). Especially, belief that being formula-feeding is healthier than breast-feeding is very common among Asian immigrant mothers living in California and women in Laos and Vietnam (Tuttle and Dewey, 1996).

Nutritional and Health Concerns of Mother and Infant: Good nutrition is of great importance for all living individuals, especially for the rapidly growing newborn infant in order to reduce incidence of morbidity (Hendricks and Badruddin, 1992; Janke, 1994 and Kacew, 1994). Well-balanced nutrition is needed not only for the maintenance of physiological functions but also for growth of infants (Donovan and Odle, 1994; Hendricks and Badruddin, 1992 and van Beek *et al*., 1995). Health (Black, 1996) and nutritional (Manz *et al*., 1993 and Specker, 1994) statuses of mothers are very important for type of practicing infant feeding because they have carry-over effects on nutritional and health statuses of infants. Thus, maternal nutritional and health statuses should be monitored for decision for practicing type of infant feeding.

Breast-feeding is beneficial for mother and has desirable effects on maternal anthropometrical measures. It was shown that breast-feeding mothers had larger reductions in hip circumference measures than those applying formula feeding (Kramer *et al*., 1993). Characteristics of stools were found to be related type of infant feeding. It was reported that breast-fed infants had as twice amounts of stool as formula-fed infants (Hyams *et al*., 1995; Quinlan *et al*., 1995). Color of stool was greener when infants were fed a formula containing higher level of iron than its counterparts (Hyams *et al*., 1995) and this was attributed to differences in fatty acid composition of food sources (Quinlan *et al*., 1995). Human milk contains high level of fat and cholesterol, but feeding human infant a formula containing low level

of fat and cholesterol and high level of unsaturated fat did not show a significant difference in apoprotein E that determines serum cholesterol level (Kallio *et al*., 1997). Similar observation was stated for infants with phenylketonuria. There were no differences blood phenylalanine concentrations between infants subjected to dietary therapy (Greve *et al*., 1994).

Differences in protein sources, composition and concentration in several food types are associated with utilization, partitioning and excretion of its metabolites. Excretion of bile acids in urine was higher among infants fed commercial formula based on soy protein and cow milk compared to those fed human milk. This was led to taurine deficiency among the former. Isomers of bile acid and chenodeoxycholic acid appeared in the urine of infants fed human milk and introduction of formula might have modified bile acid metabolism (Wahlen and Strandvik, 1994). Moreover, plasma concentration of vitamin B (Donovan, S. N. and J. Odle, 1994) related to plasma concentration of protein (Heiskanen *et al*., 1994). Vitamin B (Donovan, S. N. and J. Odle, 1994) is associated with some vital enzymes including erythrocyte pyridoxal 5'phosphate and erythrocyte aspartate aminotransferase. Levels of these enzymes were found to be lower among breast-fed infants than for formula-fed infants (Heiskanen *et al*., 1994) and infants of vegetarian mothers (Specker, 1994). Iodine deficiency was also observed among infants whose mothers are iodine-deficient (Manz *et al*., 1993). Thus, formula feeding may eliminate prevalence of iodine deficiency in infants. Additionally, drugs used by mothers can be transmitted to infant via breast-feeding. For instance, colic is very common among infants whose mothers use fluoxetine and norfluoxetine hydrochloride (Lester *et al*., 1993).

During fabricating, packaging, marketing, or storing, commercial formula may be exposed to contamination of health threatening compounds. In a study to evaluate the risk of exposure to aflatoxin among infants fed commercial formula, it was shown that commercial formula fed-infants had higher serum aflatoxin B_1 than breast-fed infants (Aksit *et al*., 1997). However, toxic contamination could be also observed among mothers who have silicon in their breasts (Kacew, 1994).

Even thought some diseases can be transferred to fetus via vertical contamination, there is no strong proven evidence that some infections of mother including HTLV-1 (Hino *et al*., 1996) and AIDS (Black, 1996) can be transferred to infant via breast-feeding. A serological study in Japan showed that the maternal transmission rate of HTLV-1 declined approximately from 20 to 3% when infants were switched from human milk to commercial formula, respectively (Hino *et al*., 1996). Because pasteurization cannot destroy virus in milk, HIV-1 positive mothers are not recommended to feed their infants via breast (Black, 1996).

Table 1: Nutrient compositions of human milk, cow milk and infant formula.

Nutrient	Human Milk	Cow Milk	CommercialFormula[1]
Water, %	87.6	87.2	89.91
Energy, kcal/100 m*L*	71	69	67.60
Protein, %[2]	1.1	3.3	1.39
Fat, %[3]	3.8	3.8	3.65
Carbohydrate, %[4]	7.0	4.8	7.30
Na, %	0.015	0.058	0.0162
Ca, %	0.034	0.126	0.053
Fe, mg/100 m*L*	0.21	0.15	1.216
Vitamin B_6, ig/100 mL	11.0	48.0	40.56
Vitamin C, mg/100 m*L*	4.3	1.8	6.084
Vitamin D, IU/100 m*L*	0.4-10	0.3-4.0	40.56

[1]Similac with Iron Fortified Infant Formula (Ro Pediatrics, Columbus, OH, USA) costs $1.9 per day with assumption of 946 m*L* daily

[2]The primary types of protein for human milk, cow milk and commercial formula are whey-casein, whey-casein and enzmatically hydrolyzed whey, respectively.

[3]The primary types of fat are triglyceride for human milk and cow milk and high-oleic acid, safflower oil, soy oil and coconut oil for commercial formula, respectively.

[4]The primary types of carbohydrate are lactose for human milk and cow milk and lactose and corn maltodextrin for commercial formula, respectively.

Bioavailability and Composition of Nutrients in Food: Bioavailability and composition of nutrients in human milk, cow milk and commercial formula are different (Table 1) and important for infant growth and development. Association of nutritient bioavailability and nutrient composition of food provided to human infant with occurrence of postnatal disorders in infants has been enthusiastically observed recently.

A histopatological study showed that docosahexaenoic acid levels in frontal lobe tissues were not different between

infants fed human milk and formula, who both had died of sudden infant death syndrome (Byard *et al*., 1995). However, there were significant differences in total fatty acids levels in that tissue. Human milk is superior in bioavailability of immunogenic proteins and mediators that are very important for health status and growth of infants (Donovan and Odle, 1994). Interestingly, a study conducted in Chine showed that there were no differences in the concentration of serum IgA in human milk and feces of infant fed either human milk or commercial formula (Wang and Shi, 1995). However, in this study, it was concluded that human milk provided a large amount of SIgA that protected the immune function of infant digestive tract. Moreover, one of disadvantages of formula feeding of infant is that it can cause an allergy along with toxic or fungal contamination. IgE level in feces is determined as an indicator of allergic response of infants to food. Breast-fed infant were observed to excrete less fecal IgE level than formula-fed infants (Sasai *et al*., 1994).

Quantitative and qualitative analyzes of carbohydrate utilization between breast-fed and formula-fed infants showed that lactic acid level for breast-fed infants was 5 times grater than for formula-fed infants (33 vs. 6 mmol/l), but fecal carbohydrate levels were within physiological range in both groups (< 5 g/l) (Filippskii and Tsaplin, 1994). Moreover, a novel clinical phenotype characterized by othostatic acrocyanosis, relapsin petechiae, chronic diarrhea, progressive pyramidal sings and mental retardation was postulated to be associated with the termination of breast-feeding and the initiation of feeding formula. Main concern here was the oxidation rates of isoleucine and partitioning cytochrome c oxidase activity in regarding to the elevation of short-and branched-chain plasma acylcarnitine levels in formula-fed infants (Burlina *et al*., 1994).

Government Policies: Government helps to improve nutritional and health statuses of mothers and infants. A government organization called women-infant-child (WIC) in the USA and Canada showed a great accomplishment in reducing mortality rate and improving nutritional and health statuses of infants (Levitt *et al*., 1996; Tuttle and Dewey, 1996). Moreover, recent financial reports have indicated that compared with formula-feeding, breast-feeding for each infant enrolled in WIC program saved approximately $500 for food distribution and $200 for medicaid expenditures (Montgomery and Splett, 1997). Economic benefit analyzes recommend to promote breast-feeding among low-income populations to achieve remarkable net benefit, more desirable benefit-cost ratios and health consideration for government and families. On a family basis however, it was shown that breast-feeding was not remarkable cost efficient in comparison with formula-feeding due to hidden costs associated with breast-feeding (Jarosz, 1993).

In summary, infant feeding patterns greatly vary among families who have different education level, social and economical statuses. The nutritional and health statuses of mothers and bioavailability of nutrients and composition of food also influence infant feeding practices. Based on epidemiological studies determining interrelationships among infant mortality, growth and development rates and maternal nutritional and health statues, government of developing countries should also take actions to reduce infant mortality rate and help low-income families to improve nutritional and health statuses.

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