Feeding practice for infants and toddlers

Importance of breast-milk

What is breast milk?

Breast milk is a complex biological fluid which contains all the nutrients that a baby needs, bot for nutrition and defense against infection. It has the optimal composition and supply which is sufficient for her child or infant. It provides sufficient energy ad essential macro and micro nutrients for rapid growth and development for at least the critical first four months.

Classification of breast-milk

The first breast milk is subdivided into two classes-

1. Colostrum = 1st secretion of mammary gland, 30 ml per day for upto 2 days after birth
2. Mature milk = the later secretion of mammary gland, about 700 ml per day, is produced from 10-15 days after birth
3. Transitional milk = produced between colostrum and mature milk
4. The nutrient composition of milk changes over time. The composition of human milk also changes during feeding so that most of the fat in human milk occurs in the latter part of feeding (change from foremilk to hind milk), probably saturating the infant and providing a signal for terminating feeding. It appears that the infant who is breastfed has more control over the amount consumed at a feeding than does the formula-fed infant

Colostrum

- The 1st secretion of mammary gland after parturition is known as colostrum.
- It is a highly concentrated fluid so it is good for infants
- It is straw-colored fluid produced for the first few days of the birth of the baby
- The mothers provide around 30 ml of colostrum per day for upto 2 days after birth
- Infants may drink only 2 to 10 ml (1.5-2 tsp) of colostrum per feeding in the first 2 days
- Colostrum provides about 580-700 kcal/l and is higher in protein and lower in carbohydrate and fat than mature milk (produced 2 weeks after infant birth)
- Secretory immunoglobin A and lactoferrin are the primary proteins present in colostrum, but other proteins present in mature milk are not present.
- The concentration of mononuclear cells (a specific type of white blood cell from the mother that provides immune protection) is highest in colostrum
- Colostrum is highly nutritious and rich in anti-infective properties. It could be said that the living cells, immunoglobins and antibodies in colostrum constitute the first immunization of infant
- It also protects infants from tuberculosis
- Colostrum has higher concentrations of sodium, potassium and chloride than mature milk.
- It contains relatively little water, lactose and triglycerides. So it is relatively a thick fluid on 1st day of post-partum, which is gradually increased in concentration and composition

Nutritional composition of Human milk

The nutritional components of human milk derive from three sources: Some of the nutrients of milk originate by synthesis in the lactocyte, some are dietary in origin, and some originate from maternal stores. Overall, the nutritional quality of human milk is highly conserved, but attention to maternal diet is important for some vitamins and the fatty acid composition of human milk

The nutrients include

Free water

Proteins – Protein accounts for 75% of the nitrogen-containing compounds and the non-protein nitrogen substances include urea, nucleotides, peptides, free amino acids and DNA. Breast milk contains more whey than casein (which is the reverse of cow's milk). Whey is much easier for infants to digest than casein. Complete protein, which means all of the essential amino acids, is also present in breast milk. Complete protein includes lactoferrin, an iron-gathering compound that helps to absorb iron into an infant's bloodstream.

Fats – Essential fatty acids and long-chain polyunsaturated fatty acids such as docosahexaenoic acid (DHA) and arachidonic acid (ARA) is present.

Carbohydrates – The principal carbohydrate of human milk is lactose.

In addition, breast milk provides adequate vitamins and minerals. Although absolute amounts of some micronutrients are low, they are more efficiently absorbed by infants. Other essential components include digestive enzymes that help a baby digest the breast milk. Human milk also provides the hormones and growth factors that help a newborn to develop.

Table: Composition of some of the key nutrients found in breast milk

Component	**Mean value for mature breast milk (per 100mL)**
Energy (kJ)	280
Energy (kcal)	67
Protein (g)	1.3
Fat (g)	4.2
Carbohydrate (g)	7.0
Sodium (mg)	15
Calcium (mg)	35
Phosphorus (mg)	15
Iron (mcg)	76
Vitamin A (mcg)	60
Vitamin C (mg)	3.8
Vitamin D (mcg)	0.01

Source: NHMRC Dietary Guidelines for Children and Adolescents in Australia, 2003

What are the other components of breastmilk?

Breast milk also contains important non-nutritional components, such as antimicrobial factors, digestive enzymes, hormones and growth factors that are important for passive protection against infections and immune-mediated diseases and modulate immunological development.

Immune-related components and growth factors include:

Secretory IgA – Predominant immunoglobulin in breast milk

Bioactive cytokines – Including transforming growth factor-b (TGF-b) 1 and 2 and interleukin-10 (IL-10)]

Others – leukocytes, oligosaccharides, lysozyme, lactoferrin, adiponectin, interferon-g, epidermal growth factor (EGF) and insulin-like growth factor (IGF)-1.

How long should an infant be exclusively fed breastmilk?

Breastmilk can be provided exclusively for around the first 6 months, meeting all of the Infants nutritional needs. Breastmilk is still very important beyond the first 6 months. Once solids are introduced breast milk continues to provide important nutrients and growth factors up to 2 years. The WHO recommends breast milk continue to be part of the young child's diet, to 2 years of age and beyond.

Comparison of cow's milk to human milk- which one is better?

Whole cow's milk contains too little iron, retinol, vitamin E, vitamin C, vitamin D, unsaturated fats or essential fatty acids for human babies.
Whole cow's milk also contains too much protein, sodium, potassium, phosphorus and chloride which may put a strain on an infant's immature kidneys. In addition, the proteins, fats and calcium in whole cow's milk are more difficult for an infant to digest and absorb than the ones in breast milk.

Table 16.4: Composition of Milk from Various Species (per 100 ml)[1]

Nutrients	*Human milk*	*Cow's milk*	*Goat's milk*	*Buffalo's milk*	*Ass's milk*
Energy (kcal)	65	67	72	117	48
Protein (g)	1.1	3.2	3.3	4.3	2.1
Fat (g)	3.4	4.1	4.5	8.8	1.5
Carbohydrate (g)	7.4	4.4	4.6	5.0	6.5
Minerals (g)	0.1	0.8	0.8	0.8	—
Calcium (mg)	28	120	170	210	80
Phosphorus (mg)	11	90	120	130	—
Iron (mg)	—	0.2	0.3	0.2	—
Vitamin A (mcg)	42	52	54	48	—
Thiamin (mcg)	20	50	50	40	60
Riboflavin (mcg)	20	190	40	100	30
Niacin (mcg)	—	100	300	100	100
Vitamin C (mg)	3	2	1	1	10

Benefits of breastfeeding

- Emotional bonding
- ✓ close, loving relationship between mother and baby
- ✓ mother more emotionally satisfied
- ✓ baby cries less
- ✓ baby may be more emotionally secure

- Breastfed infants are sick less often than bottle-fed infants
- protect against Type 1 diabetes and obesity, asthma and allergies
- children perform better on intelligence tests

Contraindications to Breastfeeding

- A new mother with HIV should not breastfeed, because the infection can be transmitted through breast milk.
- Breastfeeding also is not recommended women undergoing radiation or chemotherapy treatment for cancer
- if an infant is diagnosed with galactosemia, meaning an inability to process the simple sugar galactose, the child must be on a galactose-free diet, which excludes breast milk.

Bottle-Feeding

For parents who choose to bottle-feed, infant formula provides a balance of nutrients. However, not all formulas are the same and there are important considerations that parents and caregivers must weigh. Standard formulas use cow's milk as a base.

The modifications made in cow's or buffalo's milk to prepare commercial formulas are:

1. Protein content is usually lowered; if possible, protein is treated to produce soft curd.

2. Carbohydrate such as glucose or sucrose is added.

3. Butter fat is reduced, if need be.

4. Calcium level is reduced by dilution.

5. Vitamins A, D and ascorbic acid are usually added.

6. Iron may be added.

Soy-based formulas are usually given to infants who develop diarrhea, constipation, vomiting, colic, or abdominal pain, or to infants with a cow's milk protein allergy. Hypoallergenic protein hydrolysate formulas are usually given to infants who are allergic to cow's milk and soy protein. This type of formula uses hydrolyzed protein, meaning that the protein is broken down into amino acids and small peptides, which makes it easier to digest. Preterm infant formulas are given to low birth weight infants, if breast milk is unavailable. Preterm infant formulas have 24 calories per fluid ounce and are given until the infant reaches a desired weight.

Infant formula comes in three basic types:

1. Powder that requires mixing with water. This is the least expensive type of formula.
2. Concentrates, which are liquids that must be diluted with water. This type is slightly more expensive.
3. Ready-to-use liquids that can be poured directly into bottles. This is the most expensive type of formula. However, it requires the least amount of preparation. Ready-to-use formulas are also convenient for traveling.

Most babies need about 2.5 ounces of formula per pound of body weight each day. Therefore, the average infant should consume about 24 fluid ounces of breast milk or formula per day. When preparing formula, parents and caregivers should carefully follow the safety guidelines, since an infant has an immature immune system. All equipment used in formula preparation should be sterilized. Prepared, unused formula should be refrigerated to prevent bacterial growth. Parents should make sure not to use contaminated water to mix formula in order to prevent foodborne illnesses. Follow the instructions for powdered and concentrated formula carefully—formula that is overdiluted would not provide adequate calories and protein, while

overconcentrated formula provides too much protein and too little water which can impair kidney function.

Complementary feeding or Weaning

When breast milk is no longer enough to meet the nutritional needs of the infant, complementary foods should be added to the diet of the child. The transition from exclusive breastfeeding to family foods, referred to as complementary feeding, typically covers the period from 6 to 18-24 months of age, and is a very vulnerable period.

Why is it a crucial period?

It is the time when malnutrition starts in many infants, contributing significantly to the high prevalence of malnutrition in children under five years of age world-wide. WHO estimates that 2 out of 5 children are stunted in low-income countries.

Why Wean?

The purpose of introducing solid foods alongside an infant's milk feeds is to:

- provide extra energy (calories) and nutrients when breast milk or infant formula no longer supplies them in sufficient amounts to sustain normal growth and optimal health and development
- provide infants the opportunity to learn to like new tastes and textures, based on family foods,

  at a time when they are receptive to learning to like them.

Features of complimentary feeding

1. Complementary feeding should be *timely*, meaning that all infants should start receiving foods in addition to breast milk from 6 months onwards.
2. It should be *adequate*, meaning that the complementary foods should be given in amounts, frequency, consistency and using a variety of foods to cover the nutritional needs of the growing child while maintaining breastfeeding.
3. Foods should be prepared and given in a safe manner, meaning that measures are taken to minimize the risk of contamination with pathogens.

4. And they should be given in a way that is *appropriate*, meaning that foods are of appropriate texture for the age of the child and applying responsive feeding following the principles of psycho-social care.

Infant feeding practice

The adequacy of complementary feeding (adequacy in short for timely, adequate, safe and appropriate) not only depends on the availability of a variety of foods in the household, but also on the feeding practices of caregivers. Feeding young infants requires active care and stimulation, where the caregiver is responsive to the child clues for hunger and also encourages the child to eat. This is also referred to as active or responsive feeding.

WHO recommends that infants start receiving complementary foods at 6 months of age in addition to breast milk, initially 2-3 times a day between 6-8 months, increasing to 3-4 times daily between 9-11 months and 12-24 months with additional nutritious snacks offered 1-2 times per day, as desired.

Inappropriate feeding practices are often a greater determinant of inadequate intakes than the availability of foods in the households.

The Kinds of Foods Given

The first food fed is normally cooked cereals, which are prepared for the family or prepared baby cereals may be purchased. The cereal must be thoroughly cooked, if coarse, it should be strained. The cereal at first is mixed with milk, curd, buttermilk or dal soup. The amount given is gradually increased to four or five teaspoons by the seventh or eighth month.

Dal: Soft cooked dal or dal soup can be mixed with rice and fed. Mixed preparation such as khichudi or any similar preparations can be fed by seven to eight months of age.

Fruits, Mashed, Strained: Fruits such as banana, mangoes, papaya, etc., are started at about five months of age. Cooked or baked apples may also be fed after removal of skin and other fibrous parts. Mild flavoured fruits in small amounts are a good choice to begin with.

Vegetables: Cooked and mashed or strained vegetables in small amounts can be added a little to the cereal by six to eight months. By the end of first year, the consistency of vegetables fed to the baby should be changed over gradually to chopped or coarsely mashed cooked vegetables. The baby needs to learn to like different flavours and textures. The addition of vegetables and fruits helps to achieve this objective.

Egg: Egg yolk can be given to the infant between the age of four to six months of age. The yolk contains protein, iron and vitamins which are valuable additions to the baby's diet. Hard cooked egg yolk seems to agree well with the babies. A very small amount is given in the beginning. The white of the egg is given only by the end of first year, as some babies are allergic to it.

Fish and Meat: Cooked ground and strained fish and meat may be given about the same time as egg yolk at five to six months of age. The fish or meat serving may be alternated with egg yolk and dal.

A very small amount of each new food should be added to the infant's diet. New foods should be introduced gradually, one at a time to permit the infant to get used to it. The foods should be of soft, smooth consistency. It is normal for an infant to bring out the food in the beginning until the ability to swallow is established. The child should be encouraged to try new flavours and textures.

The amount of feed should be increased as the number decreases. By the beginning of the second year, the baby will have three to four meals. The foods included for a good daily diet for a one year old child are given in Table below:

Table 16.5: Diet for One Year Old Child.

Milk	2 to 3 cups	Fruit for Vitamin C	1 serving
Dal	2 tablespoons	Other Fruit	1/4 cup
Egg	1	Rice*	1/4 cup (cooked)
or Meat or Fish	2 tablespoons	*Chapati*/bread	1/2 to 1 *chapati* or sliced bread
Cooked green or yellow vegetable	2 tablespoons	Butter/ghee *vanaspati*	1 teaspoon
Other vegetables including potatoes	2 tablespoons	Fish liver oil	Enough to supply 5 mcg (200 I.U.) vitamin D

**Rawa*, ragi, *jowar, pohe* or any other cereal could wholly or partially replace rice.

Table 4.2.2 Types of food to be introduced at different weaning stages

Stage	Age guide	Skills to learn	New food textures to introduce
1	Around 6 months but not before 4 months (17 weeks)	Taking food from a spoon Moving food from the front of the mouth to the back for swallowing Managing thicker purées and mashed food	Smooth purées Mashed foods
2	6–9 months	Moving lumps around the mouth Chewing lumps Self-feeding using hands and fingers Sipping from a cup	Mashed food with soft lumps Soft finger foods Liquids in a lidded beaker or cup
3	9–12 months	Chewing minced and chopped food Self-feeding attempts with a spoon	Hard finger foods Minced and chopped family foods

Importance of texture during complementary feeding

At this stage foods should be a thicker mash with soft lumps and soft finger foods can be introduced. Meat may still need to be puréed at first but can be mashed if it is very soft.

Infants who begin weaning at or just before 6 months of age should be moved onto mashed food as quickly as possible to ensure nutritional adequacy and for them to learn to cope with new textures. Finger foods offered with all meals will keep infants engaged in the meal and give them the opportunity to develop self-feeding skills.

Some infants are more sensitive to texture changes and benefit with slow gradual changes. Those who spit out lumps need more practice managing them rather than being moved back to smooth purées.

Which foods to avoid <12 months

The DH (2010) recommends that infants <12mths should avoid:

For food safety reasons

- Raw eggs (risk of salmonella).
- Some fish—swordfish, marlin and shark (mercury affects CNS growth)
- Honey (risk of infant botulism—11 cases between 1980 and 2010).
- Whole nuts (choking risk).
- Shellfish (risk of food poisoning).

For healthy diet reasons

- Salt (kidneys immature).
- Sugar (encourage sweet tooth).
- High fibre foods (risk of high bulk → low energy intake → faltering growth).
- Low fat/low energy foods (risk of → low energy intake → faltering growth).

Feeding practice for toddlers

Nutritional Requirements

MyPlate may be used as a guide for the toddler's diet (http://www.choosemyplate.gov/preschoolers.html). A toddler's serving sizes should be approximately one-quarter that of an adult's. One way to estimate serving sizes for young children is one tablespoon for each year of life. For example, a two-year-old child would be served 2 tablespoons of fruits or vegetables at a meal, while a four-year-old would be given 4 tablespoons, or a quarter cup. Here is an example of a toddler-sized meal:

- 1 ounce of meat or chicken, or 2 to 3 tablespoons of beans
- One-quarter slice of whole-grain bread
- 1 to 2 tablespoons of cooked vegetable
- 1 to 2 tablespoons of fruit

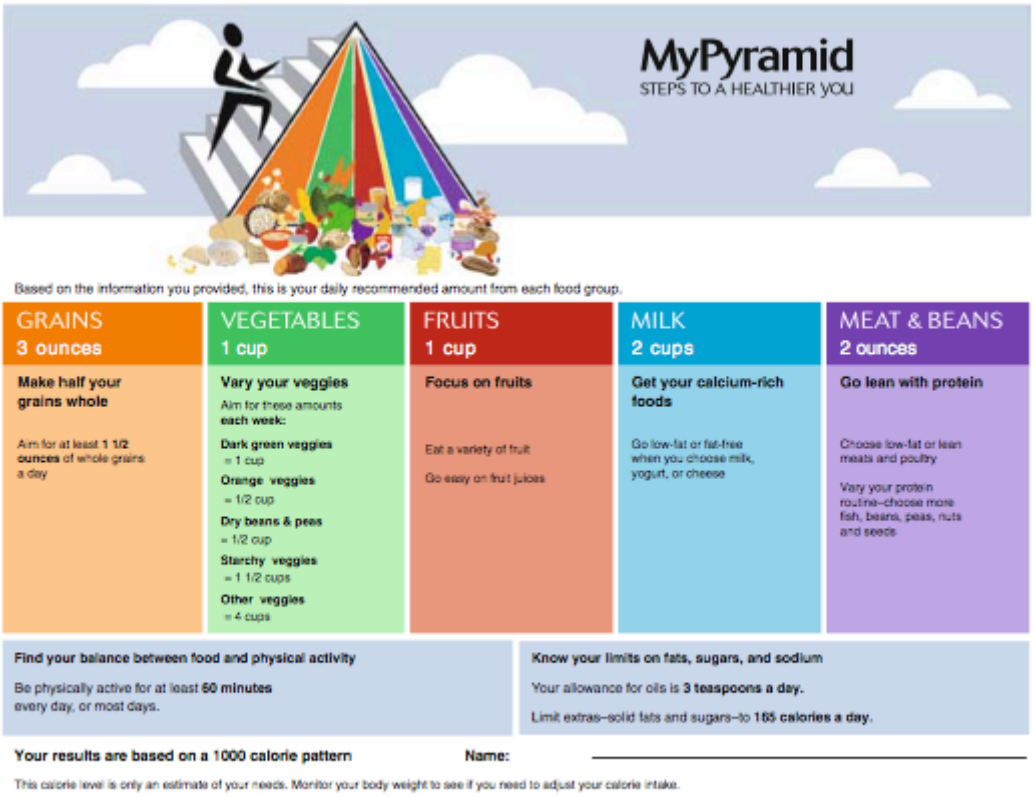

Fig. 1. MyPyramid individual plan for a 2-year-old boy who is physically active for 30–60 min/day *(10)*.

Food Group	Daily Serving	Examples
Grains	About 3 ounces of grains per day, ideally whole grains	• 3 slices of bread • 1 slice of bread, plus ⅓ cup of cereal, and ¼ cup of cooked whole-grain rice or pasta
Proteins	2 ounces of meat, poultry, fish, eggs, or legumes	• 1 ounce of lean meat or chicken, plus one egg • 1 ounce of fish, plus ¼ cup of cooked beans
Fruits	1 cup of fresh, frozen, canned, and/or dried fruits, or 100 percent fruit juice	• 1 small apple cut into slices • 1 cup of sliced or cubed fruit • 1 large banana
Vegetables	1 cup of raw and/or cooked vegetables	• 1 cup of pureed, mashed, or finely chopped vegetables (such as mashed potatoes, chopped broccoli, or tomato sauce)
Dairy Products	2 cups per day	• 2 cups of fat-free or low-fat milk • 1 cup of fat-free or low-fat milk, plus 2 slices of cheese • 1 cup of fat-free or low-fat milk, plus 1 cup of yogurt

Feeding Problems in the Toddler Years

During the toddler years, parents may face a number of problems related to food and nutrition. Nutritionist Ellyn Satter states that feeding is a responsibility that is split between parent and child. According to Satter, parents are responsible for what their infants eat, while infants are responsible for how much they eat. In the toddler years and beyond, parents are responsible for what children eat, when they eat, and where they eat, while children are responsible for how much food they eat and whether they eat. Satter states that the role of a parent or a caregiver in feeding includes the following:

- selecting and preparing food
- providing regular meals and snacks
- making mealtimes pleasant

- showing children what they must learn about mealtime behavior
- avoiding letting children eat in between meal- or snack-times

Picky Eaters:

The parents of toddlers are likely to notice a sharp drop in their child's appetite. Children at this stage are often picky about what they want to eat. Although it may seem as if toddlers should increase their food intake to match their level of activity, there is a good reason for picky eating. A child's growth rate slows after infancy, and toddlers ages two and three do not require as much food.

Toddler Obesity:

There are a number of reasons for this growing problem. One is a lack of time. Parents and other caregivers who are constantly on the go may find it difficult to fit home-cooked meals into a busy schedule and may turn to fast food and other conveniences that are quick and easy, but not nutritionally sound. Another contributing factor is a lack of access to fresh fruits and vegetables. This is a problem particularly in low-income neighborhoods where local stores and markets may not stock fresh produce or may have limited options. Physical inactivity is also a factor, as toddlers who live a sedentary lifestyle are more likely to be overweight or obese. Another contributor is a lack of breastfeeding support. Children who were breastfed as infants show lower rates of obesity than children who were bottle-fed.

Iron-Deficiency Anemia

An infant who switches to solid foods, but does not eat enough iron-rich foods, can develop iron-deficiency anemia. It causes a number of problems including weakness, pale skin, shortness of breath, and irritability. It can also result in intellectual, behavioral, or motor problems. In infants and toddlers, iron-deficiency anemia can occur as young children are weaned from iron-rich foods, such as breast milk and iron-fortified formula. They begin to eat solid foods that may not provide enough of this nutrient. As a result, their iron stores become diminished at a time when this nutrient is critical for brain growth and development.

There are steps that parents and caregivers can take to prevent iron-deficiency anemia, such as adding more iron-rich foods to a child's diet, including lean meats, fish, poultry, eggs, legumes, and iron-enriched whole-grain breads and cereals. A toddler's diet should provide 7 to 10 milligrams of iron daily. Although milk is critical for the bone-building calcium that it provides, intake should not exceed the RDA to avoid displacing foods rich with iron. Children may also be given a daily supplement, using infant vitamin drops with iron or ferrous sulfate drops. If iron-deficiency anemia does occur, treatment includes a dosage of 3 milligrams per kilogram once daily before breakfast, usually in the form of a ferrous sulfate syrup. Consuming vitamin C, such as orange juice, can also help to improve iron absorption.