CHAPTER - 2

Review of Literature
| 2.4.3. | Feeding colostrum | 68 |
| 2.4.4. | Feeding pre-lacteal feeds | 71 |
| 2.4.5. | Exclusive Breast Feeding (EBF) | 75 |
| 2.4.6. | Duration of breastfeeding | 85 |
| 2.5. | Complementary feeding | 88 |
| 2.5.1. | Nutritional recommendations | 88 |
| 2.5.2. | Successful child feeding practices | 89 |
| 2.5.3. | Initiation of Complementary Foods | 99 |
| 2.5.4. | Introducing Semi-solid Foods | 99 |
| 2.5.5. | Introducing Solid Foods | 100 |
| 2.5.6. | Introducing Family Foods | 101 |
| 2.6. | Other feeding practices | 102 |
| 2.6.1. | Feeding Water | 102 |
| 2.6.2 | Bottle feeding | 103 |
| 2.7. | Hygiene and morbidity | 105 |
| 2.7.1. | Hygienic practices | 105 |
| 2.7.2. | Infections | 107 |
| 2.8. | Diet assessment | 111 |
| 2.8.1. | Diet recall method | 112 |
2.1. Malnutrition

Malnutrition is the most widespread condition affecting the health of children. Scarcity of suitable foods, lack of purchasing power of the family as well as traditional beliefs and taboos about what the baby should eat, often lead to an insufficient balanced diet, resulting in malnutrition. Malnutrition makes the child more susceptible to infections, recovery is slower and mortality is higher. Undernourished children do not grow to their full potential of physical and mental abilities. Malnutrition in infancy and childhood leads to stunted growth. It also manifests by clinical signs of micronutrients and vitamin deficiencies.

A child having any one or more of the following signs was classified as suffering from protein–calorie malnutrition; edema, depigmentation of the hair, easy pluckability of the hair, thin sparse hair, muscle wasting, moon-face, flaky paint dermatosis. Under nutrition encompasses stunting, wasting and deficiencies of essential vitamins and minerals (collectively referred to as micronutrients) as one form of the condition known as malnutrition. Most of this stunting is expected to occur between the age of six months to two years. This fairly narrow ‘age window’ coincides with the time when foods other than breast milk are introduced.

The results of longitudinal growth studies and data from nutritional surveillance activities both indicate that growth stunting occurs within a fairly narrow “age window” from several months after birth to about two years of age. The Millennium Development Goals (MDGs) – state as the first goal “to halve between 1990 and 2015 the proportion of people who suffer from hunger.” One indicator to monitor progress for this target is the population of children who are under weight. In developing countries the growth faltering occurs...
commonly among the children in the age group of 6 to 24 months. Complementary foods are usually introduced into their diets during this period\textsuperscript{28}.

*Ellen Van de Poel et al. (2008)* conducted a study to report on socio economic inequality in childhood malnutrition in the developing world to provide evidence for an association between socioeconomic inequality and the average level of malnutrition. Both stunting and wasting were measured using new WHO child growth standards, reported that in almost all countries investigated, stunting and wasting disproportionately affected the poor\textsuperscript{61}.

*Sally Grantham–McGregor et al. (2007)* conducted a study following a database search in developing countries from 1985 to 2006. The study concludes that many children in developing countries are exposed to multiple risks for poor development including poverty and poor health and nutrition. The study estimates that more than 200 million children under 5 years of age in developing countries are not developing to their full potential. Sub-Saharan African countries have the highest percentage of disadvantaged children but the largest number live in South Asia. The children will subsequently do poorly in school and are likely to transfer poverty to the next generation. The study estimates that the loss of human potential is associated with more than 20\% deficit in adult income and will have implications for national development. There is increasing evidence that early interventions can help prevent the loss of potential in affected children and improvements can happen rapidly\textsuperscript{5}.

*Jennifer Bryce et al. (2008)* conducted a study on assessment of actions addressing under-nutrition in the countries with the highest burden of under nutrition, drawing on systematic reviews and best-practice reports. Seven key challenges for addressing under nutrition at national level are defined and reported on getting nutrition on the list of priorities,
and keeping it there. Eighty percent of the world’s undernourished children live in just 20 countries. Intensified nutrition action in these countries can lead to achievement of the first Millennium Development Goal (MDG). Nutrition should be a priority at national and sub national levels because it is central for human, social, and economic development. The period from pregnancy to 24 months of age is crucial because it is central for human social and economic development.

Susan P Walker et al. (2007) conducted a study following a database search in developing countries from 1985 to 2006, from different web sites to review the problem of loss of developmental potential in young children in developing countries. The study concludes that many children in developing countries are exposed to multiple risks for poor development including poverty and poor health and nutrition. Currently available evidence shows that specific risks encountered by young children in developing countries compromise their development. The number of children affected is enormous; in some countries 40% to 50% of children under five years are stunted. The risks described in this paper, all of which are modifiable prevent millions of children from benefiting fully from the educational opportunities to which they have access. Education is vital for both individuals and nations to emerge from poverty. Crucially we need to move forward with interventions and policies designed to prevent this loss of human potential.

Cesar G. Victoria et al. (2008) reviewed the associations between maternal and child under nutrition with human capital and risk of adult diseases in low–income and middle–income countries, Brazil, Guatemala, India, Philippines and south Africa (birth weight, height, and BMI at two years according to new WHO growth standards). Under nutrition was
strongly associated, both in the review and in new analysis, with shorter adult height, less schooling, reduces economic productivity and in women lower offspring birth weight. In the new analysis and in published work, lower birth weight and under-nutrition in childhood were risk factors for high glucose concentrations, blood pressure, and harmful lipid profiles\textsuperscript{32}. This study noted that height for age at two years was the best predictor of human capital and that under nutrition is associated with lower human capital. The study concludes that damage suffered in early life leads to permanent impairment, and might also affect future generations. Its prevention will probably bring about important health, educational and economic benefits\textsuperscript{32}.

\textit{Gary Darmstadt et al. (2005)} in the neonatal survival series identified 16 interventions with proven efficacy for neonatal survival and combine them into packages for scaling up in health systems, according to three service delivery modes pointed out universal coverage of these (99%) interventions could avert an estimated 41-72\% of neonatal deaths worldwide. The study concludes that outreach and health education of families and communities to promote adoption of evidence – based home-care practices, create demand for skilled care, and improve care seeking can bring early success in averting neonatal deaths, particularly in settings with high mortality and weak health systems\textsuperscript{64}.

The study conducted by Jennifer Bryce et al. (2005) pointed out the reason needed to save 6 million child deaths annually in 42 countries an average cost per child life saved will be US\$ 887. Achieving the MDG for child survival is affordable for donors and developing countries’, scaling up health delivery is the challenge, and along with the lack of funds, will be the limiting factor in reducing child mortality by two-thirds by 2015\textsuperscript{65}. 
The cross sectional study conducted by Bratati Banerjee et al. (2005) included 130 under five children of an urban slum in Kolkata. The study assessed the prevalence of malnutrition, according to gender and age. The study revealed that 55.38% of children were malnourished (females 77.6% and Male 31.7%, p<0.001).

Amartya Sen (2008) pointed out, - what is sometimes called “protein–energy malnutrition” - is nearly twice as high in India as in sub-Saharan Africa. About half of all Indian children are, it appears, chronologically undernourished and more than half of all adult women suffer from anaemia. India’s record is among the very worst in the world. According to Victor Aguaya, (UNICEF) one-third to one-half of all child deaths in India are due to malnutrition making it one of the biggest causes of child death.

The existing nutrition programs including the Integrated Child Development Scheme (ICDS) started in 1975 and now operating in 6284 Projects (9.3 lakh anganwadi centers) in India, is reaching two third of the nation’s children in an attempt to improve their health, nutrition and development, but has made little nutritional impact on very young children less than three years of age.

The ICDS services dominantly focused on food supplementation rather than changing family–based feeding and caring behavior. The ICDS targets children from birth to 6 years of age and mostly after the age of three, when under nutrition have already set in. Therefore, the interventions in ICDS should be redirected towards the younger children. The country should focus their attention upon children up to two years of age.
An NFHS study (1999-2000) showed that less than a third of Indian children between 6-9 months received solid or mushy foods in addition to breast milk. Achieving timely introduction of solid foods might be the most cost effective means of reducing early childhood malnutrition in India\textsuperscript{14}. In India 42.5\% of children are underweight below 3 years of age and 37.8 \% of these children are in Karnataka\textsuperscript{67}.

The Government India Launched a conditional cash transfer scheme ‘Dhana Laxmi’ to provide a set of staggered financial incentives for families to encourage them for better upbringing of girl child and to educate her. Under the DhanaLaxmi scheme an insurance cover to the tune of Rs. 1 lakh would be provided for the girl child at her birth and in all, cash package of around Rs.2 lakh will be provided to girl’s family, preferably to the mother, through the scheme\textsuperscript{68}.

**Socioeconomic context of child feeding –UNICEF model of child care**

Complementary feeding is an essential element in the care of young children. According to the conceptual framework on the causes of malnutrition adopted by UNICEF as a foundation for its country programming nutrient intake and the presence or absence of disease are the direct determinants of child survival, growth, and development. Dietary intake and the incidence of illness are, in turn, influenced by the underlying factors of household food security, available health care services, and child care practices\textsuperscript{69}.
Fig. No. 2.1: Socioeconomic context of child feeding – UNICEF model of child care
2.2. Growth and development

The term growth refers to increase in the physical size of the body and development to increase in skills and functions. Growth and development include physical, intellectual, emotional and social aspects\textsuperscript{58}. Normal growth takes place only if there is optimal nutrition and freedom from infections and adverse genetic and environmental influences\textsuperscript{58}.

Growth is commonly understood as progressive increase in the size of various parts and organs of the body. It is characterized by the pattern of changing height velocity from infancy to adulthood and is affected by genetic factors, size of the mother, socio-economic status, parity, season, nutrition and hormones. Height and weight are sensitive indicators of overall health, height is considered to be a more accurate measure of growth process. Various chronic diseases and malnutrition cause growth failure in childhood and adolescence and correction of the cause is usually followed by catch-up growth towards the size that would have been attained if the lag had not occurred\textsuperscript{54, 56}.

Development refers to change or growth that occurs in a child during the life span from birth to adolescence. This change occurs in an orderly sequence, involving physical, cognitive and emotional development. These three main areas of child development involve developmental changes which take place in a predictable pattern (age related), but with differences in the rate or timing of the changes from one person to another. Developmental change is a basic fact of human existence and each person is developmentally unique. Although there are universally accepted assumptions or principles of human development, no two children are alike. Children differ in physical, cognitive, social and emotional growth
patterns. They also differ in the ways they interact with and respond to their environment as well as play, affection and other factors\(^70\).

Growth is a complex process with a wide variability in its normal manifestations. Measurements of height and weight are still the simplest and most reliable means by which the progress of a normal child is evaluated and gross abnormalities detected even when no other clinical signs of illness are manifest\(^71\).\(^59\). The first five years of life are a time of incredible growth and learning. An understanding of the rapid changes in a child’s developmental status prepares parents and caregivers to give active purposeful attention to the preschool years and to guide and promote early learning that will serve as the foundation for later learning\(^70\).

2.2.1. Physical Development: Physical development refers to physical changes in the body and involves changes in bone thickness, size, weight, gross motor, fine motor, vision, hearing and perceptual development. Growth is rapid during the first two years of life. The child’s shape senses and organs undergo change. As each physical change occurs, the child gains new abilities. During the first year, physical development mainly involves the infant coordinating motor skills\(^70\).

2.2.1.1. Reflexes: A reflex is an automatic body response to a stimulus that is involuntary; that is, the person has no control over this response. Blinking is a reflex which continues throughout life. There are other reflexes, which occur in infancy and also disappear a few weeks or months after birth. The presence of reflexes at birth is an indication of normal brain and nerve development\(^70\). When normal reflexes are not present or if the reflexes continue past the time they should disappear, brain or nerve damage is suspected. Few such reflexes
Rooting and Sucking reflex, Moro reflex, Palmar grasp reflex and Babinski reflex, which disappear few weeks to few months after the birth. Stepping or walking reflex usually disappears in two months and reappears towards the end of the first year. 

2.2.1.2. Motor sequence: Physical development is orderly and occurs in predictable sequence. The motor sequence (order of new movements) for infants involves the following sequence.

1. Head and trunk control (infant lifts head, watches a moving object by moving the head from side to side- occurs in the first few months after birth.
2. Infants rolls over turning from the stomach to the back first, then from back to stomach- four to five months of age.
3. Sit upright in a high chair (requires development of strength in the back and neck muscles) - four to six months of age.
4. Infant gradually is able to pull self into sitting positions
5. Crawling - occurs soon after the child learns to roll on to the stomach by pulling with the arms and wiggling the stomach. Some infants push with the legs.
6. Hitching - infant must be able to sit without support; from the sitting position, they move their arms and legs, sliding the buttocks across the floor.
7. Creping - as the arms and legs gain more strength, the infant supports his weight on hands and knees.
8. Stand with help - as arms and legs become stronger.
9. Stand while holding on to furniture.
10. Walk with help with better leg strength and coordination.
11. Pull self up in a standing position.
12. Stand alone without any support.

13. Walk alone without any support or help$^{70}$. Changes in physical skills such as those listed above fall into two main areas of development, gross motor (large muscle) development refers to improvement of skills and control of the large muscle of legs, arms, back and shoulders which are used in walking, sitting, running, jumping, climbing and riding a bike. Fine motor (small muscle) development refers to use of the small muscles of the fingers and hands for activities such as grasping objects, holding, cutting, and drawing, buttoning and writing. By the age of nine months, infants improve eye-hand coordination that gives them the ability to pick up objects. Children must have manual or fine motor (hand) control to hold a pencil or crayon in order for them to write, draw, or color. Infants have the fine motor ability to scribble with a crayon by about 16 to 18 months of age when they have a holding grip (all fingers together like a cup). By the end of second year, infants can make simple vertical and horizontal figures. By two years of age, the child shows a preference for one hand$^{70}$.

2.2.1.3. Vision: At birth, an infant’s vision is blurry. The infant appears to focus in a center visual field during the first few weeks after birth. In infants, near vision is better developed than their far vision. They focus on objects held at 8 to 15 inches in front of them. As infants grow older, their vision develops, they are more interested in certain parts of face$^{65}$. At one month of age their gaze is on the hairline of a parent or other caregiver. By two months of age, infants show more interest in the eyes of a face. At three months of age, the infant seems very interested in the facial expressions of adults$^{70}$. 
2.2.1.4. Hearing: Hearing also develops early in life, and even before birth. Infants, from birth, will turn their head towards a source or direction of sound and are startled by loud noises. The startle reaction is usually crying. Newborns also are soothed to sleep by rhythmic sounds such as a lullaby or heartbeat. Infants will look around to locate or explore sources of sounds, such as doorbell. They also show reaction to a human voice while ignoring other competing sounds. A newborn can distinguish between the mother’s and father’s voices and the voice of a stranger by three weeks old. At three to six months, vocalizations begin to increase. Infants will increase their vocalizations when persons hold or play with them.  

2.2.1.5. Perception: Children to explore their world, use their senses (touch, taste, smell, sight and hearing) in an attempt to learn about the world. They form perceptions from their sensory activates. Sensory- perceptual development is the information that is collected through the senses, the ideas that are formed about an object or relationship as a result of what the child learns through the senses. When experiences are repeated, they form a set of perceptions. This leads the child to form concepts (concept formation). Concepts help children to group their experience and make sense out of the world.  

2.2.1.6. Cognitive Development: Cognitive development refers to the ways children reason (think), develop language, solve problems and gain knowledge. Identifying colors, completing a maze, knowing the difference between one and many and knowing how things are similar are all examples of cognitive tasks. They interact with the world through the senses (see, touch, hear, smell, taste) and construct meaning and understanding of the world.
2.2.1.7. Sensorimotor stage: The sensorimotor stage occurs in infancy from birth to about 12 months of age. Here, infants learn the world through their senses, looking around constantly, looking at faces of caregivers, responding to smiling faces. Their eyes focus on bright colors and they respond to sounds by looking toward the sound. During this time of sensory learning, infants also show interest in light and movement, such as a mobile above the crib. Infants also begin to recognize their own name in this stage\(^7\).

2.2.1.8. Object permanence: Between the ages of six to nine months the concept of object permanence develops. This is the infant’s understanding that an object continues to exist even if it is out of the infant’s sight. The infant understands of object permanence means that infants are developing memory and goal oriented thinking\(^7\).

2.2.1.9. Emotional Development/Social–Emotional Development: The expression of feeling about self, others and things describe emotional development. Learning to relate to others is social development. Feelings of trust, fear, confidence, pride, friendship and humor are all part of social – emotional development\(^7\).

2.2.1.10. Temperament: Children, from birth differ in the ways they react to their environment. Temperament refers to the quality and degree or intensity of emotional reactions. Passivity, irritability and activity are the three factors that affect a child’s temperament. The infant will begin to show fear, anger, and anxiety between six and nine months of age\(^7\).

2.2.1.11. Attachment: Attachment begins early in life and infants show several early attachment behaviors. Behaviors such as kicking, gurgling, smiling and laughing show that
infants care for and respond early to people who are important to them. Infants as early as one month old show signs of attachment in the form of anxiety if they are cared for by an unfamiliar person. They may show distress signs such as irregular sleeping or eating pattern.\textsuperscript{70}

2.2.1.12. Separation Anxiety: Separation anxiety is another attachment behavior of infants. This is when a child distress by often crying when unhappy because a familiar caregiver (parent or other caregiver) is leaving. The first sign of separation anxiety appear at about six months of age and are more clearly seen by nine months of age. Separation anxiety is very strong by 15 months of age and begins to gradually weaken around this time also\textsuperscript{70}.

2.2.2. Factors influencing the growth and development:

1. Genetic inheritance  
2. Nutrition  
3. Age  
4. Sex  
5. Physical surroundings  
6. Psychological factors  
7. Infections and Parasitosis  
8. Economic factors  
9. Other factors such as birth order, birth spacing, birth weight and education of parent’s etc\textsuperscript{70}.

2.2.3. Methods of assessment: The physical development is measured in terms of kilograms and centimeters. Generally the parameters used are weight, height (length in infants), head and chest circumference. These characteristics are measured and compared with reference standards. Three methods are generally used for making comparison.\textsuperscript{70}

(1) Mean (median), values, a variation of 2 standard deviation from either side of the mean (or median) is considered as within normal limits. (2) By means of percentile (centiles). Percentile refers to percentage of individuals falling below a percentile level. By definition 3
percentile of children are below the 3\textsuperscript{rd} percentile and a further 3 percentile of children are above 97\textsuperscript{th} percentile. (3) As weight for length and weight for height which are age dependent indices\textsuperscript{70}.

2.2.4. Reference values: The well-known reference standards are -

(1) Harvard (or Boston) standards

(2) WHO reference values or NCHS

(3) Indian standards


2.2.5. Surveillance of growth and development:

2.2.5.1. Physical growth –

(a) Weight-for-age: Healthy babies on an average double their birth weight by 5 months and treble it by end of first year and quadruple by the age of two. During the first year, weight increases by about 7 kg. and by about 2.5 kg during the second year\textsuperscript{70}.

(b) Height (length) –for-age: The length of a baby at birth is about 50 cm. It increases by about 25 cm during first year and about 12 cm during the second year. Low height-for – age is known as nutritional stunting\textsuperscript{70}.

(c) Weight-for-height: Low weight for height is also known as nutritional wasting. A child who is less than 70 percent of the expected weight–for height is classified as severely wasted. A child on the 75\textsuperscript{th} percentile for both his height and weight is neither over weight nor underweight. But a child on the 75\textsuperscript{th} centile of his weight chart and 25\textsuperscript{th} centile of his height is clearly over weight\textsuperscript{70}.
2.2.5.2. Head and chest circumference: At birth the head circumference is about 34 cm. It is about 2 cm more than the chest circumference. By 6 to 9 months the two measurements become equal. Later chest circumference overtakes the head circumference\textsuperscript{70}.

2.2.6. Behavioral Development: The behavioral development is assessed in four fields.

1. Motor development
2. Personal–social development
3. Adaptive development
4. Language development\textsuperscript{65}.

The development landmarks or milestones of development provide an estimate of the time when the child can be expected to attain skills or points in development.

Poverty is associated with inadequate food, and poor sanitation and hygiene that lead to increased infections and stunting in children. Poverty is also associated with stunting in children\textsuperscript{5}. Poverty is also associated with poor maternal education, increased maternal stress and depression, and inadequate stimulation in the home. All these factors detrimentally affect child development\textsuperscript{5}.

\textit{WHO Working Group on Growth Reference Protocol, (2002)} observed that growth pattern of exclusively and predominantly breast-fed infants differ from those of non-breast-fed infants, but less is known about associations among growth patterns and different durations of exclusively breast-feeding and types of frequency of complementary foods. To examine these associations particularly between 4 and 6 months of age, the group took data from a unique longitudinal 7-country study. Multilevel analysis described growth and the
relation between growth and variables related to feeding. Small differences in growth that were statistically significant but probably not biologically important were noted among infants in whom complementary foods were introduced at different times. Weight gain was more sensitive to feeding frequencies than were gains in length. The most extreme differences were equivalent to approximately 10 centiles of the weight and height distributions at 6 months of age. These results do not provide compelling evidence of benefit or risk related to growth and the timing of introduction of complementary foods at any specific time between 4 and 6 months of age. Thus, potential growth appears to not be sensitive to the differential timing of introduction of complementary foods nor to differential types and frequencies of complementary foods in healthy infants living in environments without major economic constraints and low rates of illness. These results however may not indicate growth differences in population living in poor environments.

Christine Powell et al. (2004) conducted a study to assess the feasibility of integrating early psychosocial stimulation into primary care for undernourished children and to determine the effect on children’s development and mother’s knowledge and practices of childbearing. A cluster randomized trial in 18 clinics in three Jamaican parishes included 139 children aged 9 to 30 months and their mothers. The study concluded that integrating parenting skills and early psychosocial stimulation for undernourished children into primary care was feasible and effective in improving the children’s development and mother’s knowledge and practices of childrearing.

A multi centric study conducted by Reynaldo Martorell et al. (2005) in California, Guatemala and Tamil Nadu observed the growth faltering relative to WHO/NCHS reference
curves showed that the median for Berkeley were consistently above the reference median, while those for both the developing country samples were below the fifth percentile. Also, the median for Tamil Nadu were consistently lower than those of Guatemala. About 18% of the children in Berkeley faltered at least once between 12 and 24 months of age, compared with 4% and 42.0% in Guatemala and Tamil Nadu respectively. When a gain of less than 300g. is used as the criterion, the percentage of children in Berkeley who faltered at least once rises to 36.8%, compared with 82.4% in Guatemala and 73.6% in Tamil Nadu. This study adopted the definition of faltering in the second year of life as a weight gain of less than 300g over a three-month period\textsuperscript{73}.

*Chessa K. Lutter et al. (1990)* reported from a secondary analysis that made use of data from a randomized intervention designed to assess the effects of dietary supplementation and early childhood stimulation on the physical growth and mental development of children at risk of malnutrition under the ethical guidelines established by Harvard University. Absolute differences between supplemented and unsupplemented infants were greatest between ages 3 and 6 months: supplemented infants grew 0.61 cm and gained 162 grams more than un-supplemented infants (P <0.005)\textsuperscript{74}.

*Sguassero Y et al.* conducted a study to evaluate the effectiveness of community-based supplementary feeding for promoting the physical growth of pre-school children in developing countries. The results showed that four trials met the inclusion criteria for this review. A cluster RCT conducted in Indonesia in 1991 found no benefit in weight-for-age and height-for-age z-scores of the intervention group compared to the control group after three months of intervention. A study in Guatemala included four villages as unit of analysis.
According to this analysis, the difference in net change in the large villages was 2.55 cm and in the small villages was 2.35 cm. The mean of these differences was 2.45 ± 0.10 cm (mean ± SD). A study conducted in Jamaica (n=65 children) reported a positive effect on length (cm) in the supplemented group compared to controls after 12 months of intervention. A trial from Indonesia (n=75 children) found no benefit in growth after 12 months of supplementation. Based on these small number of available trials, no firm conclusions of the effectiveness of supplementary feeding to growth of pre-school children could be drawn. Issues of research design such as blinding and sample size calculation need to be addressed in future studies.

*Kathryn G. Dewey et al. (1992)* conducted a study collecting data from DARLING (Davis Area Research on Lactation, Infant Nutrition and Growth) study that followed infants who were either breastfed or formula fed during the first 12 months. The study concluded that groups had similar weight gain during the first 3 months, but breast-fed infants gained less rapidly during remainder of the first year. Cumulative weight gain in the first 12 months was 0.65 kg less in the breast-fed group. Length gain was similar between groups.

*Gardne JM et al. (2002)* conducted a study in Jamaica in a purposive random sample of 70 children to develop and validate viscosity and energy density of porridges fed to children. The found that the weight-for-age $Z$-scores of the children in the urban area were significantly lower than those for the children in the rural area. Weight-for-length and weight-for-age $Z$-scores were significantly associated with energy density of the porridges (Pearson’s $r = 0.33, P<0.01$ and $r = 0.24, P < 0.05$, respectively), but length-for-age was not. There were no significant association between the children’s anthropometry and the level of caregiver
encouragement or persistence observed. The mean age of the children was the same in the urban and rural areas\textsuperscript{9}.

*Onayade AA et al (2004)* conducted a study to compare the growth and illness pattern of infants who were exclusively breastfed for 6 months with those of infants who were commenced on complementary feeding before the age of 6 months and to ascertain reasons for the early introduction of complementary feeding. A comparative prospective study in urban comprehensive health centre, Obafemi Awolowo University included 352 mothers and their children with normal birth weight and aged less than 14 days. Results of the study reveal that infants who commenced complementary feeding before 4 months reported more symptoms and had more illness episodes (1.4 episodes/child) compared to those who had between 4 to 6 months (1.2 episodes/child)\textsuperscript{77}.

*Adelheld W Onyango et al. (1999)* prospectively followed up a cohort of 264 children in Western Kenya for 6 months (mean age 14 months) to investigate the nature of the association between breastfeeding and growth. Only 14 (5.3\%) children had been weaned at baseline, and 173 (65.5\%) were still breastfed at follow-up. For analysis, children were classified into three groups of breastfeeding duration as a proportion of the total follow-up period (0 - 49\%, n=42; 50 - 99\%, n=49; and 100\%, n=173). According to general linear models multivariate analysis, children in the longest-duration breastfeeding group gained 3.4 cm (p=0.001) and 370 grams (p=0.005) more than those in the shortest duration group, and 0.6 cm (p=0.0015).and 230 g (p=0.038) more than children in the intermediate group. The study supports WHO recommendation to continue breastfeeding for at least two years, especially in settings with poor sanitation and adequate water supply\textsuperscript{78}. 
A community based pilot nutritional education intervention study conducted by Georgia S. Guldan et al. (2000) included 250 infants in education and control groups was undertaken in four townships in China. The objective was to improve infant growth by improving infant feeding practices. After one year, the education group mothers showed significantly higher nutrition knowledge and better reported infant feeding practices than their control group counterparts. The children in intervention group were significantly heavier and longer only at 12 months of age compared to children in control group (weight –for – age p<0.004; height – for –age p< 0.022). Over all breastfeeding rates were higher in intervention group (83%) compared to control group (75%) p<0.034. The study concludes that pilot intervention study has potential for further adaptation and development to other rural areas in the province or other areas in China 48.

Lartey Anna et al. (1999) conducted a randomized community based trial to evaluate the effect of feeding weanimix and three other locally formulated, centrally processed complementary foods on the nutritional status of 208 breast-fed infants in Ghana. Infants were randomly assigned to receive one of four foods from 6 to 12 months of age. The results showed that there were no significant differences between intervention groups in weight or length gain between 6 to 12 months of age. From 9 to 12 months of age, z scores were lower in non intervention group than in the combined intervention group. Children in the all four intervention groups found improved growth relatively to the control group 79.

Jing Chen and Douglas Taren (1995) conducted a nutrition surveillance survey in June 1990 in four poor rural counties of Hubei Province China, included 25 villages and 3564 children to determine early feeding practices and nutrition status. The results show the mean
WAZ fluctuated around – 1SD for both boys and girls after 6 months of age. The percentage of children with a WAZ below–2SD was lowest during the first year of life (6.1%) and greatest at 12 to 17 months (32.6%). The mean HAZ was comparable to NCHS median within first few months of life, at 12 months it was -1.00 SD and by 36 months it was about -2.00 SD. The percentage of children below -2SD for HAZ increased from 9% under one year to 44% at 18 to 23 months.80

Atalah Samur et al. (1994) studied the growth of exclusively breastfed children in Chilean infants in relation to new WHO reference charts from medium-to-low socioeconomic status fed according to the current WHO guidelines observed pattern of growth was more similar to the old NCHS/WHO reference chart than to the proposed new WHO chart. The new WHO chart consequently identifies a higher proportion of breast-fed infants as showing nutritional deficits, which could contribute to premature introduction of supplemental Feeding.81

The study conducted by Vani Sethi et al. (2003) to assess the current infant feeding practices (IFP) in a relocated slum, to identify the lacunae. The aim of the study was to outline, implement, and evaluate the gain in awareness and infant feeding practices followed by mothers. Study included 35 mothers of infants aged 5-19 months. Mothers were interviewed and nutrition education was imparted to them over two months. Monthly weight and length of infants was also recorded. Study showed that 73.3% of infants had their wt. /age below - 2SD of the NCHS median at baseline and this decreased to 66.6% by post- Nutrition Education (NE). After 2 months, the proportion of infants with wt. /age less than - 2 SD of
NCHS median decreased from 35.4% at baseline to 25% by post-NE. Mean Z-scores for weight-for-age and weight for length of NE exposed group were better than for controls\textsuperscript{33}.

A group of 224 children from a rural cohort of 625 were studied by S.K. Upadhyay et al. (1992) during 1981 to 1983 in 10 villages of Varanasi, India assessed for morbidity, physical growth and behavioral development. This study observations at 16, 28, 40 and 52 weeks in relation to nutritional status showed that developmental quotient decreased progressively with the severity of malnutrition at all the points. The deterioration in scores was more marked from 28th week onwards and in nutritional grades II and III children\textsuperscript{36}.

The community based cluster randomized controlled trial, conducted by Nita Bhandari et al. (2002) developed the intervention through formative research. Eight pair matched communities were identified and each pair was randomized to receive intervention and no intervention. Trained health and nutrition workers counsel mothers for exclusive breastfeeding at multiple opportunities in the intervention communities. 1115 infants born during nine moths of time after the training (552 in intervention and 473 in control group) were enrolled for the study. The study results showed that the mean weight and length at the age of 3 months and 6 months did not differ much between the two groups. There was only a small improvement (0.18 SD units) in linear growth between 6 and 12 months\textsuperscript{47}.

In a cohort study in Varanasi by D.K. Agarwal et al. (1992) during 1981 to 1983 (625 children in 10 villages) the observations indicate that malnourished children display delayed behavior development although the expected behavior does eventually appear in these chronically malnourished children\textsuperscript{82}.
Nita Bhandari et al. (2002) conducted a cross-sectional survey in order to determine whether an affluent population in South Delhi had a growth performance similar to that in developed countries and to identify socioeconomic factors that militated against optimal growth in this group. The weights and lengths of 395 children aged 12 to 23 months and heights of 331 mothers and 153 grandmothers were measured and information was obtained on family socioeconomic status and child-feeding practices. Children born prematurely, (before 37 weeks of gestation) and those with illness adversely affecting growth were excluded from the analysis. The results show that the mean Z-scores for weight-for-age, length-for-age and weight-for-length were -0.45, -0.28 and -0.32 respectively. About 6% of the children were underweight, 3% were stunted, and 4% were wasted. The children in this affluent population were close to the NCHS/WHO reference population with regard to anthropometric indicators. The mean birth weight of the children was 3120 g. and the mean birth length calculated from birth records was 49.5 cm.  

The Mira Purohit et al. (1977) study in State Zanana Hospital Jaipur during 1968 followed 125 infants for 6 months. The observations regarding the physical measurements, the results generally coincide with those of other Indian studies but infants studied are seen to be somewhat smaller, and have a slower rate of growth than of more advanced countries.  

Nita Bhandari et al. (2001) conducted a controlled trial including 418 infants aged 4 months, individually randomized to one of the four groups and followed till 12 months of age. The study was designed to determine whether micronutrient food – fortified food supplement supported by counseling would significantly improve physical growth between 4 and 12 months of age. The food supplementation infants gained 250 grams (95% CI; 20–480
grams) more weight than did the visitation group. The difference in the mean increment in length during the study was 0.4cm (95% CI: 0.1–0.9cm). The nutritional counseling group had higher energy intake ranging from 280 to 752 KJ at different ages (p<0.05 at all ages) but no significant benefit on weight and height increments\textsuperscript{85}.

\textit{DK Agarwal et al. (1994)} conducted a study in Bangalore, Kolkata, Delhi, Kota, Ludhiana and Varanasi. The growth characteristics measured in two cohorts included height, weight and circumference of head, chest and mid-arm measured on urban affluent children from birth to 12 months and 1 year to 6 years. The weight percentile data shows marginally higher by around 0.3 kg at all age points except for birth weight. Indian children are lighter by 1.5 kg for boys and girls as compared to the NCHS data. The differences in growth seem to be possibly due to lower velocity in Indian children of present study in the first 18 months as compared to American children\textsuperscript{86}.

\textit{Dinesh Kumar et al. (2006)} conducted a cross sectional study in four selected anganwadi areas of urban Allahabad with a two stage stratified random sampling technique. A total of 217 under five children and their mothers participated in the study. Nutritional assessment by WHO criterion (SD-classification) using summary indices of nutritional status: weight-for-age, height-for-age and weight-for-height shows proportion of underweight and stunting reached peak levels of 45.5 % and 81.8 % respectively during 13 to 24 months of age and then it decreased gradually with increasing age\textsuperscript{13}.

A community based cross-sectional study was carried out by \textit{N. Srivastava et al. (2007)} in urban Vadodhara to create an Infant Feeding Index (ICFI) from a set of complementary feeding practices using a semi-structured interview schedule. 204 children
from slum (104) and two private clinics (100) were included in the study. The nutritional status revealed that about 50.5% of the children were stunted and 25.5% were underweight and only 3% were wasted. A significant trend observed was that the mean HAZ decreased with age (p>0.05) and prevalence of stunting was high in all socioeconomic strata. WAZ scores were found to be related positively only with age of initiation of complementary feeding and hand washing practice of mothers. Age of initiation of complementary feeding was also found to be significantly associated with WAZ. The study suggests stunting, indicative of cumulative nutritional insults and faulty feeding practices, was very high across socioeconomic strata and also showed a marked increase with age$^{37}$.

Chinnamma John et al (1993) conducted a study in city of Baroda; in which twenty – one pair matched children for age and weight was included. The children consumed a mean of 199 kcal/child/day diet in experimental group and in control group consumed 50 kcal/child/day for a period of 180 days. A modest addition of nearly 150 kcal/child/day to the home diet of children in the experimental group (6-24 months) resulted in weight increments which were significantly better at the p <0.001 level. The results confirm the same trend in height increments as reported for weight increments. However, the significant difference in height at the end of the study was not as dramatic as those for weight. The growth increments at the end of the study were significantly better in all the three age groups (6-12 months, 13-18 months, and 19-24 months) amongst the experimental as compared to the pair matched counterparts in the control children. Study concludes that the much higher intake of the amylase –rich food (ARF) treated gruel in the experimental group was responsible for the substantially better growth$^{87}$. 
Nandini Saxena et al. (1997) study conducted in two urban slums of National Capital Territory (NCT) of Delhi constituted 7000 individuals. A total of 630 children under 6 years constituted the sample size. The results reveal that 57.6% of the children were suffering from under nutrition (z-scores < -2) with 20.3% children falling under Grade II of (i.e. z-score < -3). The height-for –age data showed that 53% of the children were stunted. Similarly 22.5%, of children were wasted (Z score < -2). A lower energy and protein intake was found amongst the undernourished children when compared to that of the normal children. A high prevalence of under-nutrition and a poor dietary intake was documented amongst the under six children living in urban slum of Delhi.

The study conducted by M.J. Mehta et al. (1973) in Civil Hospital Surat included infants who were followed from birth to 12 month of age. The measurements were recorded at birth and thereafter every month (±1 week). The study shows a mean birth weight of 2.71 kg, and infants gained 5.49 kg. at the end of one year. The mean length at birth was 48.1 cm and children gained 22.1 cm more length at the end of one year. The increment in head circumference at the end of first year was recorded to be 11.9 cm.

A Sinha et al. (1987) conducted a longitudinal study to study prevailing feeding practices and their role on the physical growth of infants. Measurement of weight, length and chest circumference of infant’s upto the age of 12 months, belonging to low income families of some selected villages at Pant-nagar were carried out during 1987-88. The results showed that infants growth pattern in terms of anthropometric measurements were not found significantly different in groups with different feeding practices.
A cross-sectional nutritional survey of children belonging to Tamil Nadu State of India, aged 0 to 3 years was conducted by Rajarthnam Abel et al. (1998) on a representative sample of 2039 children in 20 districts. A multi stage sampling technique was used to select families from the districts. The children were measured for weight, height, length and mid-upper arm circumference (MUAC) using the measurement techniques standardized according to UN manual. The study results showed prevalence of underweight was 51.8%. The stunting, wasting and underweight were at their lowest among children below 6 months, but steadily increased reaching the peak between 18 and 23 months of age\textsuperscript{6}.

In a longitudinal birth Cohort conducted by Andrea M. Rehman et al. (2009) in three neighboring slums in Vellore, South India, and the field workers collected details of morbidity twice a week. The height and weight measured monthly from one month to 3 years of age. The growth analysis was done using the 2006 WHO child growth standards. The factors associated with stunting at three years were birth weight less than 2.5kg (OR 3.63, 95% CI 1.36–9.70), beedi – making (manual production of cigarettes for a daily wage) in the household (OR 1.74, 95% CI 1.05–2.86), maternal height less than 150cm (OR 2.02, 95% CI 1.12–3.62). This study suggests that interventions are needed urgently during pregnancy, and interventions are required on early breastfeeding and proper weaning in the population\textsuperscript{90}.

2.2.7. Growth Assessment

R Khadgawat et al. (1998) in a study conducted in Lucknow, India assessed the suitability of recently published reference anthropometric data for evaluation of the growth of children. This study suggests that Agarwal Charts are better representative of the growth of
normal Indian children than ICMR or NCHS Charts. The fifth percentile of this chart is expected to form an appropriate cut off for identifying the short child for further evaluation.

Linda Vesel et al. (2010) conducted a study to compare the estimated prevalence of malnutrition using WHO new child growth standards versus the NCHS growth reference. A secondary analysis of data on 9424 mothers – Infants pairs in Ghana, India and Peru enrolled in a trial of Vitamin A supplementation. During this study the infants’ weight, length and feeding practices were assessed regularly. The results showed the prevalence of stunting, wasting and underweight in infants aged < 6 months was higher with WHO than NCHS standards. The prevalence of underweight in infants aged 6 to 12 months was much lower with WHO standards. The WHO standards were better predictors of mortality than those determined using NCHS standards.

P R Deshmukh et al. (2007) conducted cross sectional study in 20 anganwadi centers under primary health centre Anji, included 1491 children under six years of age. Nutritional status was analyzed by NCHS standards and newly introduced WHO Child Growth Standards. The prevalence of underweight as assessed by WHO standards was significantly lower when compared with the assessment based on NCHS reference (p<0.01). WHO standards gave higher prevalence of severe underweight than NCHS reference though the difference was not statistically significant (p >0.05).
2.3. Dietary intake

2.3.1. Energy consumption

The science of human nutrition is mainly concerned with defining the nutritional requirements for the promotion, protection and maintenance of health in all groups of the population\textsuperscript{58}. Such knowledge is necessary in order to assess the nutritional adequacy of diets for growth of infants, children and adolescents, and for maintenance of health in adults of both sexes and during pregnancy and lactation in women\textsuperscript{58}.

Energy is a prime requisite for body functioning and growth. When a child’s intake of food falls below a standard reference, growth slows, and if a low level of intake persists, adult stature will be reduced\textsuperscript{58}. This underlines the need for an adequate intake of food which is the source of all energy. This energy value of foods has long been expressed in terms of the Kilo-calorie (kcal). This has been replaced by the “joule” expressed as J, which has been accepted internationally (1 kcal = 4184 j)\textsuperscript{58}.

**Recommended Daily Allowance (RDA)** – The term “recommended daily intake” is defined as the amounts of nutrient sufficient for the maintenance of health in nearly all the people\textsuperscript{58}. If meals are provided multiple times/day - energy requirements can be met with diets having lower energy density. If energy density of the food is increased - adequate energy intake can be achieved with fewer meals. Controlling for the level of energy density- total daily amount consumed was approximately 16\% more, when the number of meals was increased from 3 to 4 times per day and 7\% when increased to 4 to 5 times per day\textsuperscript{27}. 
Energy required from complementary foods.

6 to 8 months - 275 - (275 - 465) kcal
9 to 11 months - 230 - (230 - 675) kcal
12 to 23 months - 750 - (490 - 1000) kcal

These figures used as general guidelines, but the best indicator of adequacy will be the infant’s growth\textsuperscript{27}.

2.3.2. Energy density

Energy density is the amount of energy or calories (kcal) per 100 grams of food eaten\textsuperscript{93}.

Table No. 2.1 : The mean amounts of breast milk consumed and mean energy density of the milk\textsuperscript{94}

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk consumed</td>
<td>776 ±141g/day</td>
<td>764 g/day</td>
</tr>
<tr>
<td>Energy density (kcal)</td>
<td>0.67 ± 0.16 kcal/day</td>
<td>0.74 kcal/g</td>
</tr>
<tr>
<td>Energy density (MJ)</td>
<td>0.280 ± 0.067MJ /100g</td>
<td>0.38 MJ/100g</td>
</tr>
</tbody>
</table>

Minimum dietary energy density required to attain the level of energy needed from complementary foods taken in meals per day with an average level of breast milk intake\textsuperscript{94}. 
Table No. 2.2: Frequency of meals and dietary energy density required from complementary foods

<table>
<thead>
<tr>
<th>Meals / day</th>
<th>6–8 months</th>
<th>9–11 months</th>
<th>12–23 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.88</td>
<td>0.71</td>
<td>1.16</td>
</tr>
<tr>
<td>3</td>
<td>0.59</td>
<td>0.48</td>
<td>0.77</td>
</tr>
<tr>
<td>4</td>
<td>0.44</td>
<td>0.36</td>
<td>0.58</td>
</tr>
<tr>
<td>5</td>
<td>0.35</td>
<td>0.29</td>
<td>0.46</td>
</tr>
</tbody>
</table>

Table No. 2.3: Energy Requirements from complementary foods according to age

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6-8</td>
<td>682</td>
<td>615</td>
<td>413</td>
<td>269</td>
</tr>
<tr>
<td>9-11</td>
<td>830</td>
<td>686</td>
<td>379</td>
<td>751</td>
</tr>
<tr>
<td>12-23</td>
<td>1,092</td>
<td>894</td>
<td>346</td>
<td>746</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6-8</td>
<td>2.85</td>
<td>2.57</td>
<td>1.73</td>
<td>1.12</td>
</tr>
<tr>
<td>9-11</td>
<td>3.47</td>
<td>2.87</td>
<td>1.59</td>
<td>1.88</td>
</tr>
<tr>
<td>12-23</td>
<td>4.57</td>
<td>3.54</td>
<td>1.45</td>
<td>3.12</td>
</tr>
</tbody>
</table>

These figures are based on recently revised estimates. The total energy requirements are approximately 25% to 32% less than those published in 1998 by WHO/UNICEF.
Table No. 2.4: The different frequency of feeding and required energy density of the foods to satisfy the energy requirement\textsuperscript{27}

<table>
<thead>
<tr>
<th>Age in Months</th>
<th>2 meals</th>
<th>3 meals</th>
<th>4 meals</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 – 8</td>
<td>0.88</td>
<td>0.59</td>
<td>0.44</td>
</tr>
<tr>
<td>9 -11</td>
<td>1.16</td>
<td>0.77</td>
<td>0.51</td>
</tr>
<tr>
<td>12-23</td>
<td>1.48</td>
<td>0.98</td>
<td>0.74</td>
</tr>
</tbody>
</table>

\textit{Julie Meeks Gardner et al. (2002)} conducted a study to develop and validate a field method for measuring the viscosity of small quantities of weaning porridges. The study measured the viscosity and energy density of porridges fed in urban and rural environments, related the findings to ingredients used and feeding practices. The viscosity and energy density of porridges fed to young children were measured. The ingredients were obtained by recall, and caregiver feeding behaviors were observed in one urban and one rural community in Jamaica. A purposive random sample of 70 children aged 3 to 14 months was studied. Most children (80\%) were fed porridges with medium viscosity (1700–2900 mPa s) or thicker. The mean energy density was $3.18 \pm 0.92$ kJ/ g. Energy density was only moderately related to viscosity, being higher only in porridges $>4000$ mPa s (analysis of variance (ANOVA, $p < 0.05$). Energy density was correlated ($p < 0.05$) with the amounts of sugar ($r = 0.28$) and milk powder ($r = 0.24$) used. Viscosity and energy density were lower in porridges fed by bottle than in those fed by spoon. An energy density of $2.73$ kJ/g has been estimated to meet the requirements of nearly all non-breast-fed infants if the infants are fed at least four times per day. For breast-fed infants aged 6–24 months, assuming average intakes of breast milk, the minimum energy density recommended ranges from $1.85$ to $3.11$ kJ/g depending
on age if fed four times and from 2.48 to 4.12 kJ/g if fed three times daily. Thus the energy density of most of the porridges measured in this study would meet the requirements of the infants except perhaps in the oldest age group. However, the older children are more likely to be also eating significant amounts of other family foods. Energy densities ranged from 1.70 to 7.31 kJ/g (40.6 to 174.5 kcal/100 g), with a mean of 3.18 ± 0.92 kJ/g (76.0 ± 22.0 kcal/100 g). There were no significant differences in energy density by age group, gender or area of residence.

The study conducted by Kenneth H Brown et al. (1995) measuring total daily energy consumption from semisolid food mixtures with energy densities of 1.67, 2.93, 4.18 or 6.28 kJ/g (0.4, 0.7, 1.0 or 1.5 kcal/g) were fed to infants 3, 4 or 5 times per day to 18 fully weaned children from 6 to 18 months of age who were recovering in hospital from malnutrition. The study recorded that an energy density >5.05 kJ/g (1.2 kcal/g) diet should be provided if only three meals per day can be assured. Alternatively, an energy density of 3.48 kJ/g (0.83 kcal/g) diet would be sufficient if most children receive at least four meals per day.

Kenneth H. Brown et al. (1995) assessed the validity of maternal reports of poor infant appetite and compared with measured energy consumption on 1621 day’s observation of 131 Peruvian infants in a low-income community. Mean (± SD) total energy intakes on days with reported anorexia were 338 ±88kJ/kg body weight in infants of 1 to 6 months of age and 299 ±92kJ/kg body wt. in infants aged more than 6 months compared with 395 ±92kJ/kg and 342 ±88 kJ/kg body wt. in the respective age groups when appetites were reportedly normal (P<0.001). The study results show that it seems possible that the
occurrence of poor appetite, rather than the lack of available food, may explain in part the low energy intakes and poor growth of infants in this and other similar communities\textsuperscript{96}.

\textit{Hilary Creed de Kanashiro et al.}(1990) have done a study on consumption of breast milk, liquids and foods in 131 poor Peruvian infants who were measured on 1661 child-days of observation during their first year of life. Breast-milk intake was estimated by 12-h test-weighing; macronutrients were analyzed in samples of milk. Other foods and liquids were weighed at preparation and consumption tables. Mean energy intake increased with age but declined from 95\% to 78\% of recommended amounts during the year. Mean protein intakes were generally above recommended amounts but more than one-third of infants received <80\% of the suggested safe intakes in the second semester. Breast milk was the major source of energy and protein during the first semester. Breast milk and cow milk together contributed more than half of the energy and protein during the second 6 months, when cereals were also an important source of energy and protein\textsuperscript{97}.

The study conducted by M Munirul Islam et al. (2008) to evaluate the effect of various energy densities and feeding frequencies of complementary foods on energy intake and breast milk consumption. Eighteen healthy breastfed children in the age group of 8 to 11 months were studied. The results show the mean amount of complementary foods consumed were inversely related to their energy density and positively related to the number of meals/day (p< 0.001 for both). However, milk intake decreased slightly but progressively, with greater energy density and feeding frequency of complementary foods. Total energy intakes (kcal/day) increased in relation to both factors (p<0.001 for both). The study findings conclude that energy density and feeding frequency of complementary foods affect infants total daily energy intake and breast milk consumption. Recommendations can be developed
for the appropriate combinations of these dietary factors that are compatible with adequate energy intake, although longer-term effects of complementary feeding practices or breast milk intake and breastfeeding duration need further community-based studies.

DG Harendra de Silva et al. (2007) conducted a study in child health welfare clinics, Ragama, Srilanka, to assess the efficacy of a homemade energy dense weaning food, containing 110–130 kcal per 100 ml on prevention of growth faltering during infancy. The study included 152 infants (83 in intervention group and 69 in control group). The results showed the infants in the intervention group gained significantly more weight than the control group \((\text{Intervention group } 2.43 \pm 0.72 \text{kg control group } 2.02 \pm 0.62 \text{ kg } p=0.002).\) This study concluded a high energy density homemade complementary food was effective in improving the weight gain of infants during the weaning period.

The study conducted by Chinnamma John et al. (1993) included 21 pairs of slum children (6-24 months) were pair-matched for age and weight. The experimental group consumed a complementary feed of high energy providing 199kcal/child/day and control group which consumed an identical but high bulk gruel providing a mean 50 kcal/child/day for a period of 180 days. The home diet (breast milk + family diet) provided about 470 kcal/child/day in both groups. The results showed that the children in experimental group imbibing much higher amounts of the energy-dense-low-bulk gruel which gave them a mean caloric advantage of 148, 258 and 238 Kcal/child/day in the 6-12, 13-18 and 19 to 24 months age groups, respectively. The energy intake per kg body weight was 73 and 62 kcal, respectively, in the experimental and control groups at the end of the study. The mean addition of nearly 150 kcal/child/day to the home diet of children in the experimental group (6-24 months) resulted in weight increment which were significantly better at the \((p<0.001)\)
level. The study concluded that the much higher intake of the amylase-rich food (ARF) treated gruel in the experimental group was responsible for the substantially better growth. Growth improvement is possible even within the poor socio-economic and environmental conditions\textsuperscript{87}.

2.3.3. Consumption of proteins

The word protein by derivation means that which is of first importance. Indeed they are the greatest importance in human nutrition. Proteins constitute about 20 percent of the body weight in an adult. They are made up of smaller units, called amino acids. Some 24 amino acids are stated to be needed by the human body, of which nine are called essential because the body cannot synthesize them in amounts corresponding to its needs, and therefore they must be obtained from dietary proteins\textsuperscript{58}.

Proteins are needed by the body for body building. 1) This body building component is small compared with the maintenance component, except in the very young child and infants 2) Repair and maintenance of body tissues 3) Maintenance of osmotic pressure 4) Synthesis of certain substances like antibodies, plasma proteins, hemoglobin, enzymes, hormones and coagulation factors\textsuperscript{58}. Proteins are connected with the immune mechanism of the body. The cell mediated immune response and bactericidal activities of leucocytes have been found to be lowered in severe forms of protein energy malnutrition. Protein can also supply energy (4kcal per one gram) when the calorie intake is inadequate, but this is not their primary function. It is considered wasteful if protein were used for such purpose\textsuperscript{58}. 

\textsuperscript{87}Growth improvement is possible even within the poor socio-economic and environmental conditions.

\textsuperscript{58}Proteins are connected with the immune mechanism of the body. The cell mediated immune response and bactericidal activities of leucocytes have been found to be lowered in severe forms of protein energy malnutrition. Protein can also supply energy (4kcal per one gram) when the calorie intake is inadequate, but this is not their primary function. It is considered wasteful if protein were used for such purpose.
Sources of Proteins: Humans obtain protein from two main dietary sources.

(a) Animal sources – Proteins of animal origin are found in milk, meat, eggs, cheese, fish and fowl. These proteins contain all the essential amino acids in adequate amounts. Egg proteins are considered to be the best among food proteins because of rich biological value and digestibility. They are used in nutrition studies as a “reference protein”.

(b) Vegetable sources: Vegetable proteins are found in pulses (legumes), cereals, beans, nuts, oil-seed cakes, etc. They are poor in essential amino acids. In developing countries such as India, cereals and pulses are the main sources of dietary protein because they are cheap, easily available and consumed in bulk.

Protein requirements: Protein requirements are expressed as 1.0 g. protein/kg body weight for an Indian adult, assuming a NPU of 65 for dietary proteins.

2.4. Breastfeeding practices

2.4.1. Breast feeding

Breast feeding is a natural and traditional infant feeding practice throughout the world. Pre-modern societies were known to have a high incidence and long duration of breastfeeding. Nutrition and nurturing during the first 3 years are both crucial for lifelong wellbeing. In infancy, no gift is more precious than breastfeeding; yet barely infants are exclusively breastfed during the first four months of life.

But in modernizing societies such as India, newly emerging social forces are leading to the breakdown of age old custom which adversely affects certain practices like breastfeeding. Simultaneously, the newly created economic markets based on highly advanced and
imported technologies are promoting the administration of artificial feeds for infants from a very early age\textsuperscript{100}.

From time immemorial breast feeding has been the only method of feeding infants in our country (Charaka Samhita). Even in royal families where women never wanted to feed their babies, they deployed wet nurses (healthy lactating women) to feed them rather than depending on cow or buffalo milk. Although breast milk was thought to be ideal, but colostrum was never fed to the newborn child. The Kashyap Samhita recommends offering fruits by 6 months and semi solid cereal preparation at 10 months. Susruta advised cereals after 6 months of age. This is the ancient culture on infant feeding practices which has been adopted with variations in different parts of the country\textsuperscript{102}.

It is well documented that breast feeding improves child survival by providing protection against infectious diseases and malnutrition for the baby and some contraceptive effect for the mother\textsuperscript{103,104}. Breast milk is the perfect food for infants in the first six months of life. It has all the nutrients an infant requires to maintain optimal health and growth. It also protects the baby from the two leading causes of death; respiratory infections and diarrhoea. Breast milk also stimulates the immune system and response to vaccinations while containing hundreds of antibodies and enzymes. Breastfed children are less susceptible to pneumonia, allergies, asthma, childhood diabetes, gastrointestinal illness and have lower rates of childhood cancers such as leukemia and lymphoma\textsuperscript{105}.

Optimal infant and young child feeding practices (IYCF) – especially early initiation and exclusive breast-feeding for the first six months of life – help ensure young children the best possible start to life. Breastfeeding is nature’s way of nurturing the child, creating strong
bond between the mother and the child. A breastfed child is likely to have an Intelligence quotient (IQ) of around 8 points higher than a non-breastfed baby. Breastfeeding is not only important for young child survival, health, nutrition, the development of baby’s trust and sense of security – but it also enhances brain development and learning readiness as well.


Breast milk is all that a baby needs during the first six months of life. Breast milk is a normal ideal food because it contains all the nutrients that a baby needs for the first 6 months of life. It is quickly and easily digested. Breast milk at different stages of lactation is defined by different terms namely colostrum, transition milk, preterm milk and mature milk.

Breastfeeding is an unequalled way of providing ideal food for the healthy growth and development of infants. It is also an integral part of the reproductive process with important implications for the health of mothers. As a global public health recommendation, infants should be exclusively breastfed for the first six months of life to achieve optimal growth, development and health. Thereafter, to meet their evolving nutritional requirements, infants should receive nutritionally adequate and safe complementary foods while breastfeeding continues for up to two years of age or beyond.
Breast feeding should be initiated within half an hour after the delivery if it is normal delivery and within 4 hours if a mother had a caesarian delivery. The full-term infants with appropriate weight for gestational-age should be exclusively breast-fed until about six months of age\textsuperscript{27}. Scientific evidence from hundreds of studies over the past 25 years confirms that breastfeeding – and especially exclusive breastfeeding during the first six months of a baby’s life - is the optimal way to nourish and nurture infants. Breast milk contains all the essential nutrients babies need as well as antibodies that counter infection. No infant formula made of cow’s milk, soya or other ingredients can ever equal this natural way of feeding\textsuperscript{27}.

Sometimes certain simple problems faced by mothers result in stoppage of breastfeeding or giving of supplements of animal milk/commercial infant formula to the baby. Problems may be: flat nipples, inverted nipples, breast engorgement, swelling, sore nipple or not enough milk etc. These problems are preventable if due care is taken from the pregnancy period to prepare for breastfeeding\textsuperscript{106}.

On an average, breast milk intake of the order of 800 ml a day would meet the infant’s energy needs by the age of 2-3 months. It is clear that many mothers, if they are well-nourished and well-motivated, are able to feed their babies satisfactorily on breast milk alone\textsuperscript{107}. To achieve optimal health, development and survival of infants and young children, all infants should be exclusively breastfed for the first six months followed by introduction of appropriate complementary feeds along with continued breastfeeding for two years or beyond\textsuperscript{25}.

As recently reviewed several studies have shown that when women are randomly assigned to nurse often or “on demand” rather than according to a fixed schedule of every 3
to 4 hours, the onset of full milk production occurs sooner. Those mothers have fewer problems of breast engorgement or sore nipples their infants receive more breast milk and gain weight more rapidly and they are more likely to continue fully breast-feeding beyond the first month of postpartum\textsuperscript{27}.

A study conducted by Catherine Hubbard, (1977) in London included 66 children aged between 12–24 months who were interviewed with a precise questionnaire found out that 91% of mothers were breast-feeding their children from birth, 33% stopped breast-feeding before 6 months of age and 59% stopped before the first birthday. The reason for stopping was lactation failure (36%), pregnancy (11%), breast rejection (11%) and breast infection (3%)\textsuperscript{108}.

Jonas F Ludvigsson. (2003) conducted a cross sectional study in La Paz, Bolivia to describe the breastfeeding pattern and its determinants including socio-economic, religious and ethnic background. The study included 518 mothers with infants and who were interviewed. The study results showed that breastfeeding rates remained above 85% during the first year, exclusive breastfeeding rates fell from 89 % at one week of age to 45% at one month of age, further declined to 20 to 25% in 6 months of age. The pre-lacteal feeds (p<0.001, n=436) and not feeding the infant colostrum (p<0.008, n=436) were associated with a shorter duration of exclusive breastfeeding. The rural mothers were four times more likely to discard the colostrum than urban mothers (p=0.01, n=501). The study concludes that the rate of exclusive breastfeeding in Bolivian infants fell rapidly during the first month of life. Avoidance of pre-lacteal feeding and use of colostrum were associated with improved breastfeeding patterns\textsuperscript{107}.
Grummer-strawn LM et al. (2004) conducted a study to find out the impact of breastfeeding on the prevalence of overweight in childhood were drawn from the United States Centers for Disease Control and Prevention (CDC) Pediatric Nutrition Surveillance system. Children were seen at a clinic at least twice a year and, at each visit, weight and height are measured. Data concerning breastfeeding for less than two years of age were also collected. Data from 1,77,304 children up to five years of age were included in the final pediatric–only analysis and 12,587 were included in the pediatric–pregnancy linked analysis. Breastfeeding duration (never <1month, 1-2 months, 3-5 months, 6-11 months and >12 months) was related to overweight among 4 year old, defined as a BMI for age above the 95th percentile of the 200 CDC growth chart. The logistic regression analysis showed among non-Hispanic Whites, the adjusted odds ratio of being overweight at four years of age if breast-fed for 6-12 months vs. never was 0.70 (95% CI, 0.50-0.99); if breastfed for >12 months vs. never, the odds ratio for being over-weight was 0.49 (95% CI, 0.25-0.95)\textsuperscript{109}.

Jing Chen and Douglas Taren (1995) conducted a nutrition surveillance survey in June 1990 in four poor rural counties of Hubei Province China, included 25 villages and 3564 children to determine early feeding practices and nutrition status. The study results indicated that during a time of sleeping economic change and expanded health care availability breastfeeding was maintained in more than 90% of the infants under 6 months and 75% of these at 12 months and 26% of these at 24 months of age\textsuperscript{80}.

A prospective observational study conducted by Peter W. Howie et al.(1990) in Dundee to assess the relations between breast feeding and infant illness in the first two years of life. A total of 674 and 618 children were included and followed up to two years.
Intervention was a detailed observation of infant feeding and illness at two weeks, at 1, 2, 3, 4, 5, 6, 9, 12, 15, 18, 21 and 24 months of age. The study showed strongly, breastfeeding during the first 13 weeks of life confers protection against gastrointestinal illness that persists beyond the period of breastfeeding itself. The study suggests that breastfeeding still has an important part to play preventing infection among infants in developed countries. Much evidence shows that compared with artificial feeding, breastfeeding protect infants from gastrointestinal infection in developing countries\textsuperscript{18}.

The study conducted by Valeria Beral, Collaborative Group on Hormonal Factors in Breast Cancer, collected individual data from 47 epidemiological studies in 30 countries, included information on breastfeeding pattern and other childbearing aspects, and analyzed for 50,302 women with invasive breast cancer and 96,973 controls included in the study. Estimates of the relative risk for breast cancer associated with breastfeeding in parous women were obtained after stratification by fine divisions of age, parity and women’s ages when their first child was born, as well as by study and menopausal status. The finding of the study shows the relative risk of breast cancer decreased by 4.3\% (95\% CI 2.9–5.8; p<0.001) for every 12 months of breastfeeding in addition to a decrease of 7.0\% (5.0–9.0; p<0.001) for each birth. The size of the decline in the relative risk of breast cancer associated with breastfeeding did not differ significantly for women in developed and developing countries and did not very significantly associated with other variables studied. It is estimated that the cumulative incidence of breast cancer in developed countries would be reduced by more than half from 6.3 to 2.7 per 100 women by age 70 if women had the average number of births and life time duration of breastfeeding that had been prevalent in developing countries until recently. Breastfeeding could account for almost two - thirds of the estimated reduction in
breast cancer incidence. The study concludes that the longer women breastfed the more they are protected against breast cancer\textsuperscript{110}.

*Rahul Malhotra et al. (2008)* conducted a study to assess socio-demographic and health services determinants of termination of breastfeeding within the first 2 years of life in India analyzing data from the nationally representative National Family Health Survey -2 using Cox regression modeling techniques. Overall, findings of the present study suggest that breastfeeding promotion programmes in India should focus on certain high-risk mother-child pairs such as female infants, first-born babies, babies born in the private sector and in urban areas, as well as mothers who are literate, have a higher wealth status, are aged less than 20 years and belong to Sikh or Christian communities. As overall probability of continuing breastfeeding till 2 years of age in the NFHS -2 dataset is low (63.14\%), a sustained effort to discourage premature discontinuation of breastfeeding across all population subgroups and providers is needed\textsuperscript{111}.

*Shalini C. et.al. (1995)* conducted a study of the knowledge and attitude towards infant feeding in Udupi taluk, Karnataka, South India on a group of 300 mothers whose babies age from 3 days to 17 months. The study found that only 32\% of mothers felt that breast milk should be the first feed whereas others felt that pre-lacteal feeds are necessary\textsuperscript{112}.

### 2.4.2. Initiation of breastfeeding

Early initiation of breastfeeding is extremely important for establishing successful lactation as well as for providing ‘colostrum’ (mother’s first milk) to the baby. Ideally, the baby should receive the first breastfeed as soon as possible and preferably within one hour of birth. In case of caesarean deliveries, new born infants can be started with breastfeeding
within 4–6 hours with support to the mother. Late initiation of breastfeeding not only deprives the child of the valuable colostrum, but also becomes a reason for introduction of prelacteal feeds that are potentially harmful and invariably contribute to diarrhoea in the newborn and also causes engorgement of breasts that further hampers establishment of successful lactation.

Initiate breastfeeding within half an hour of birth because -

1. Babies are most active during first 30-60 minutes.
2. Suckling reflex is most active at birth and it increases success for exclusive breastfeeding
3. It ensures intake of colostrum, the first feed and the first immunization of the baby.
4. It will promote emotional bonding between the mother and the child.
5. It helps in developing a loving relationship between the mother and the baby.
6. It prevents the problem of breast engorgement, postpartum bleeding and uterine involution in mothers.

In India 24.5% of mothers breast feed their newborns within the first hour of their life. Karnataka is ranking in the 13th place with 35.7% of mothers initiating breast milk within 1 hour of delivery.

_Els J. Kools it al. (2005)_ conducted a study to evaluate the determinants of initiation of breast feeding at birth. The study was based on a Social- psychological model, the Attitude- Social Influence- Self Efficacy (ASE) model. This model states that behavior is best predicted by intention, which in turn is predicted by attitudes, social influence and self-efficacy. Study candidates were pregnant women who applied maternity care at their Home.
Health care services. Mothers with infants who had a birth weight of less than 2 kg were excluded from the analysis. The study results show that previous breast feeding experience, higher maternal education and being a non-smoker are associated with a higher rate of initiation of breast feeding. The multivariate analysis without ASE determinants, previous breast feeding experience was the single independent predictor of breast feeding initiation and maternal age, education and non-smoking were not independently associated with breast feeding. Maternal education and maternal age are correlated with previous breast feeding experience; one of the reasons not to breast feed is a bad previous experience. Less well educated women have an increased risk to have a first baby at a young age, having a bad breast feeding experience and low self-efficacy in breast feeding the next time. Self-reported reasons for giving formula feeding such as too busy, no time for breast feeding are related to self-efficacy and indicate that interventions could be focused on strengthening self-efficacy and professional support for breast feeding. The study found out low level of social support for breast feeding and of social support for breast feeding at work place. This indicates that there is still room for improvement.

Daniel W. Sallen conducted (2001) a small scale, prospective study of breastfeeding and weaning practices in a semi nomadic pastoral population in Northern Tanzania. A community based, mixed longitudinal, purposive sample was selected through complete and repeated census in each of these settlements. Forty infants from 21 households were visited monthly to collect 24-hour maternal report of breastfeeding and no breast milk substances consumed by the child. Four group’s participants suggested that weaning patterns are strongly influenced by seasonal factors, and individual mothers often stated an intention to introduce adult staple foods and terminate breastfeeding at the end of the long rains. However, a
combination of maternal self-perception, assessment of infant well-being, and indicators of household food supply influenced the actual progression of weaning for individual children. The results suggest that interventions to promote exclusive breastfeeding and improve complementary feeding practices in rural East African pastoral populations could build on maternal attention to infant centered cues and address household level constraints on caregivers making decisions about young child feeding\textsuperscript{115}.

Griffiths L J et al. (2010) conducted a study to examine the effect of breastfeeding initiation, breastfeeding duration and age of introduction of solid foods on weight gain from birth to 3 years in England, Wales, Scotland and Northern Ireland. The results pointed out breastfeeding initiation and breastfeeding duration were significantly associated with weight gain from birth to 3 years. The study points out initiating and prolonged breastfeeding may reduce excess weight gain in children by preschool age. Study suggests strategies to support mothers to follow internationally recommended infant feeding practices\textsuperscript{116}.

Karen M. Edmond et al. (2006) conducted a study to assess the contribution of the timing of initiation of breastfeeding on any advantage of the 4–week surveillance system from a large ongoing maternal vitamin A supplementation in rural Ghana. Study included women of childbearing age and their infants. The analysis was based on 10,947 breastfed singleton infants born from July 2003 to June 2004. The results showed that 71% of infants were breastfed within 1\textsuperscript{st} hour of birth and 70% of infants were exclusively breastfed during their neonatal period. There was increase in risk of neonatal mortality with increasing delay in initiation of breastfeeding (1 hour to day 7). Overall late initiation (after 1 day) was associated with a 2.4 fold increase in risk. The size of this effect was similar when the model
was refitted excluding infants at high risk of death when deaths during the first week (day 2-7) were excluded. Promotion of early initiation of breastfeeding has the potential to make a major contribution to the achievement of the child survival millennium development goal. If all infants were breastfed from day one 16% of neonatal deaths could be saved and 22% of neonatal deaths will be saved if breastfeeding started within the first hour. Breastfeeding – promotion programs should emphasize early initiation as well as exclusive breastfeeding.

*Rukhsana Haider et al. (1996)* conducted a randomized controlled trial with the intervention of trained peer counselors to enable the mothers to breastfeed exclusively for the recommended duration of 5 months. Forty adjacent zones in Dhaka were randomized to intervention or control group. Women were enrolled during the last trimester of pregnancy. About 363 women were enrolled in each group and followed for 5 months. The mothers in the intervention group initiated breastfeeding earlier than control mothers and were less likely to give pre-lacteal and post-lacteal foods. Mothers in the intervention group practice rooming in earlier after delivery than control group mothers (median 1 vs. 2h, range 0-33 vs. 0-60, p<0.0001). In intervention group breastfeeding was initiated earlier (median 1h, 0 - 49) and 64% did so within the first hour. In control group the median time for initiating breastfeeding was 9h (0-95), with 15% starting in the first hour (p<0.0001). More mothers in the intervention group fed breast milk alone during the first 4 days as compared to to control group (56% vs. 3% (p< 0.0001). More mothers in the intervention group than control group (93% vs. 42%, (p<0.0001) were helped with positioning and attachment of the baby at the breast, mostly by the peer counselors.
In a longitudinal study conducted by Kulsoom U. et al. (1997) assessed beliefs and practices related to the feeding of 52 infants in an urban community of Lahore. In this study through collection of qualitative and quantitative data during infancy it was found that 98% of mothers started breast feeding within the first week and 54.3% continued until 12 months. The mean age for exclusive breast feeding was 1.08 (±1.109) months. Breastfeeding was initiated after 47.4 (±32.58) hours after birth and prelacteal feeds were given to 94% infants. In 34 infants (65.4%) colostrum was not given and water was considered essential from the very first day in 55.4% of cases. 48% of babies were put on bottle feeding during the first week and by five months of age, 97% were bottle fed and the most common reason for starting bottle feeding was perceived insufficiency of breast milk.  

*TS Chandrasekhar et al. (2006)* conducted a cross-sectional survey on breastfeeding initiation and feeding practices in Pokhara, Nepal during 2005. Three hundred and eighty-five mothers who had delivered a child within the previous 2 months attending immunization clinics were interviewed through a semi-structured questionnaire. The results showed that 72.7% of women initiated breast-feeding within 1 hour of delivery.  

To assess the nutritional status and breast feeding practices among children and to correlate the findings with some potential determinants, a cross-sectional study was conducted by Rasania SK et al. (2001) in Mehrauli Delhi. This study showed that 92.37% of children were breastfed. Children who were not breastfed were found to be underweight and stunted significantly in this study.  

*Arun Gupta Regional Coordinator, IBFAN (2007)* in his study reported that 30% of infants were initiated on breastfeeding after day 1 (late initiation) and 30% were not
exclusively breastfed in the neonatal period. An additional 2.5 fold reduction in risk of death was demonstrated in babies who survived to day 2 who initiated breastfeeding on the first day of life (early initiation) compared to infants who initiated after the first day of life (late initiation). This type of effect of early initiation has never been reported. If translating these benefits to the whole population of neonates (breastfed and not breastfed) means that 16% of neonatal lives can be saved if all babies were breastfed from day 1, and 22% of neonatal lives can be saved if breastfeeding were started within the first hour\textsuperscript{121}.

\textit{Nita Bhandari et al. (2002)} conducted a cross sectional survey in order to determine whether an affluent population in south Delhi had a growth performance similar to that in developed countries. Children born prematurely, (before 37 weeks of gestation) and those with illness adversely affecting growth were excluded from the analysis, as with the NCHS/WHO reference population. Breastfeeding was initiated in 60.8% of the infants within 12 hours of birth. About 17.4% children had the benefit of breastfeeding only after 24 hours of their birth\textsuperscript{83}.

The Socio cultural factors influencing the weaning practices of infants were studied in a cohort of 200 infants over a period of one year during 1985-86 by Hassen J. \textit{et al} reveals that initiation of breastfeeding started between 6 and 72 hours of birth\textsuperscript{122}.

The National coordinator \textit{BPNI, Arun Gupta (2009)} in his article pointed out there is epidemiological evidence to suggest that beginning breastfeeding within first day postpartum would have additional benefit with regard to mortality even in exclusive breastfed infants, reaffirming the recommendation to begin breastfeeding immediately after delivery.
Breastfeeding promotion itself contributes to 11.6% reduction in IMR if coverage of promotion is 99%, and can avert 21.9 million DALYs at 3 years.  

Indira Narayanan et al. (1984) studied the supplementary formula feeds inhabited the protective effect of expressed raw and pasteurized human milk in 226 high risk neonates in a randomized controlled trial. The study found out that the infection rate in the group given pasteurized human milk and formula (33%) was significantly higher than the rates in the groups given raw human milk (10.5%).

Shally Awasthi et al. (2006) conducted a study to assess household practices that can affect neonatal health, from the perspective of caregivers and health workers; to identify signs in neonates leading either to recognition of illness or health-care-seeking. The study was carried out in a rural community in Sarojini Nagar Block –U.P. India using a quantitative and qualitative research designs. The study highlighted most mothers initiated breastfeeding only on day 3 (64%).

A community based cross sectional study was conducted by Dinesh Kumar et al. (2008) during 2003 in four randomly selected anganwadi areas selected by a stratified two stage random sampling technique in Allahabad. The study pointed out that 17.4% of mothers practicing initiation of breast-feeding within six hours of birth.

R.K Agarwal President IAP 2008 observed that large scale community-level behavior change programs designed to improve breastfeeding practices are feasible and should be a central component of any child health strategy. Another multi centric study concluded that over 3 to 4 years timely initiation of breastfeeding (within 1 hour of birth) increased from
56% to 74% (p<0.001) in Bolivia, 32% to 40% (p<0.05) in Ghana and 34% to 78% (p<0.001) in Madagascar\textsuperscript{25}.

The study conducted by Abusaleh Shariff et al. (1990) around Bangalore included 647 urban and 153 rural women to find out the problems they were facing in breast-feeding their infants. The study shows that only 32% of all women initiated breast-feeding of their children (rural 12.4%, urban 36.4%) within a day (24 hours) of delivery while about 44% had not initiated the breastfeeding of their new born even after two whole days\textsuperscript{100}.

2.4.3. Feeding colostrum

Before baby is born baby is protected in the womb from all infections and after birth breastfeeding takes over the protection process. The secretion from the breast for the first 2 to 3 days after birth will be rich with colostrum. Colostrum is found to be rich in antibiotics and proteins. It is very rich in Vitamin A. Colostrum is basically the first immunization a child receives from the mother. It has been discovered to be the best prophylaxis for diarrhoea, septicemia and many types of allergies\textsuperscript{106}. Because of the association between the discarding of the colostrum, the timing of the initiation of breastfeeding and the performance of the ceremonies, the deprivation of the advantages of colostrum to the newly born baby is rampant in this society\textsuperscript{100}. The practice of discarding colostrum and not putting the child to breast for the first twenty four hours of the birth still persists\textsuperscript{125}.

Hananto Wiryo et al. (2005) conducted a quasi-experimental design study with non equivalent control and intervention groups. The incidence of symptoms of intestinal obstruction (SIO) and low birth weight (LBW) were selected as indicators to compare the intervention and control groups. Two thousand six hundred and seventy neonates were
followed from birth to 28 days. Mothers traditionally provide banana to their neonates as well as discard their colostrum prior to breastfeeding. The study has showed that overall neonatal banana feeding decreased by 18.3% and colostrum feeding increased by 32.8% in intervention group. The religious leaders, who had strong community influence, had the highest health module execution in this study\textsuperscript{126}.

\textit{Kulsoom U. et al. (1997)} conducted a study to know the beliefs and practices related to the feeding of infants included 52 infants in the study. They were assessed in an urban community of Lahore in a longitudinal study through qualitative and quantitative data during their first year of life. The study showed that about 65.4\% of infants were deprived of colostrum\textsuperscript{118}.

A health worker- administered questionnaire was used to carry out during one year in 2005 by \textit{TS Chandrasekhar et al. (2008)} to assess rates of initiation of breast feeding and exclusive breastfeeding in Nepal. The results reveal that 82.3\% of children had the benefit of breast milk/ colostrum as their first feed\textsuperscript{119}.

\textit{Dinesh Kumar et al. (2008)} during 2003 conducted a community based cross sectional study in four randomly selected anganwadi areas selected by a stratified two stage random sampling technique in Allahabad. The study included 268 ever married women and 69 lactating mothers interviewed. The study documented that only 34.8\% of mothers fed colostrum to their newborn babies\textsuperscript{35}.

The study conducted by \textit{Katiyar GP et al. (1981)} in Varanasi interviewed 784 mothers using a pre-tested proforma to find out feeding practices prevalent in urban slum and rural
areas. This study found out that 90% of children of urban slum and rural group were not given colostrum, but it was found that 63.7% urban mothers fed colostrum to their children\textsuperscript{127}.

A cross sectional study was conducted by Dinesh Kumar et al. (2006) in four selected areas of urban Allahabad with a two stage stratified random sampling technique. Study included 217 under five children and their mothers. Nutritional assessment by WHO criterion (SD-classification) using summary indices of nutritional status: weight-for-age, height-for-age and weight-for-height shows that 54.8% of mothers discarding colostrum came out to be significant\textsuperscript{13}.

The study conducted by Singh MB et al. (1997) in Jaipur district, included 328 mothers residing in 38 villages to find out the pattern of existing infant feeding and weaning practices. Information was recorded in pre-designed and pre-tested schedules following interview technique. The selection of villages was made on the basis of population proportion to size (PPS). Based on the population the villages were divided into 4 groups and from each group 5% of villages were selected proportionately. At the village level, households were selected on the basis of systematic random sampling procedure. The results show 77% of mothers discarded colostrum and the children were deprived of the benefit\textsuperscript{128}.

A cross-sectional nutritional survey of children belonging to Tamil Nadu State of India, aged 0 to 3 years was conducted by Rajarthnam Abel et al. in (1998). A representative sample of 2039 children in 20 districts were included in the study. A multi stage sampling technique was used to select families from the districts. The survey was conducted by trained field workers in two phases. The children were measured for weight, height, length and mid-
upper arm circumference (MUAC) using the measurement techniques standardized according to UN manual. The study showed that, only 27% of mothers had given colostrum to their children and majority of the remaining mothers had given sugar water (64%), others given honey and donkey’s milk for the children\(^6\).

The \textit{Abusaleh Shariff et al. (2005)} study conducted around Bangalore shows that only 15.8% of the newborn were started with breastfeeding within one hour of birth and only 37.1% within a day of birth\(^{100,4}\).

A study conducted by \textit{Shalini C. et.al. (1995)} to find out the knowledge and attitude towards infant feeding in Udupi taluk, Karnataka, South India. The study included a group of 300 mothers whose babies ages between from 3 days to 17 months. The study pointed out three fourth of mothers were of the view that colostrum should be fed to the babies\(^{112}\).

\textbf{2.4.4. Feeding pre-lacteal feeds}

Any practices that interfere with the infant’s desire or ability to nurse effectively, such as provision of other fluids, should be avoided. Normal newborns are born with relatively high levels of tissue hydration and do not require any fluids other than breast milk. The use of supplementary donor’s milk or formula during the early neonatal period has been associated with early termination of breast-feeding. Use of pacifiers should also be discouraged, as there is evidence that their use is associated with more breast-feeding problems and a shorter duration of breast-feeding\(^{27}\).
Avoid use of pre-lacteal feeds and pacifiers because -

1. Giving prelacteal feeds such as sugar water, honey, water, butter or concoctions lead to infections and interfere with breastfeeding success.

2. Pacifiers interfere with success of breastfeeding\textsuperscript{113}.

The Kulsoom et al.\textsuperscript{(1997)} conducted a longitudinal study through quantitative and qualitative data to assess beliefs and practices related to feeding practices of 52 infants in Lahore. The study observed that 94\% of infants were fed with pre-lacteal feeds, and water was considered essential in 55.4\% cases in this study\textsuperscript{118}.

A randomized controlled trial was conducted by Rukhsana Haider et al.\textsuperscript{(1996)} with the intervention of trained peer counselors to enable the mothers to breastfeed exclusively for the recommended duration of 5 months. Forty adjacent zones in Dhaka were randomized to intervention or control groups. In the study 363 women were enrolled in each group and followed for 5 months. The results revealed that peer counseling significantly improved breastfeeding practices. Pre-lacteal feeds were given to 101 (31\%) babies in the intervention group compared to 294 infants (89\%) in control group (p<0.001). Despite these difficulties and a strong cultural tradition, peer counselors had a significant influence in reducing pre-lacteal feeds and post lacteal feeds in the intervention group\textsuperscript{40}.

TS Chandrasekhar et al.\textsuperscript{(2006)} conducted a cross-sectional survey on breastfeeding initiation and feeding practices in Pokhra, Nepal during 2005. Three hundred and eighty-five mothers who had delivered a child within last two months attending immunization clinics were interviewed through a semi-structured questionnaire. The results showed that pre-lacteal
feeds were given to 14% of the babies. The common pre-lacteal feeds given were formula feeds (Lactogen 6.2%); sugar water (5.9%) and cow’s milk (2.8%) \(^{119}\).

*Katiyar GP et al.* (1981) conducted a study in Varanasi interviewed 784 mothers using a pre-tested proforma to find out feeding practices prevalent in urban slum and rural areas. This study reported milk was used most frequently as the first feed given to children in both the groups. Diluted cow’s milk in urban group and goat’s milk in other two groups were commonly used. Boiled water and honey with water, were also used frequently as first feed. In urban slum the first feed was given within 6 to 8 hours, while in rural area it was given within 4 to 6 hours of birth. Only in 5% of newborn the first feed was given within one hour of birth \(^{127}\).

*Hassen J. et al.* (1991) studied the socio cultural factors influencing the weaning practices of infants in a cohort of 200 infants over a period of one year. The study reveals that among the children who were followed up till one year of age 99% of children received pre-lacteal feeds especially Ghutti (94%) within 6 hours of delivery. Almost all mothers believed that Ghutti cleans the intestines and that colostrum is harmful for the baby and colostrum was discarded \(^{122}\).

In a hospital based study conducted by *Lala VR et al.* (1970) in the postnatal ward of civil hospital Ahmadabad, 410 mothers were included in the study. The newborns were thoroughly examined and observed for 3 to 7 days to detect any complications either in newborn or the mother. The study showed that 66.2% of mothers offered boiled water as pre-lacteal feeds for the infants and only 5.12% of mothers fed breast milk to their children \(^{129}\).
Deshpande SG et al. (1994) conducted a clinic based study carried out at Chitharanjan Das Mobile Hospital Camp at Amaravati (Madhya Pradesh). The study included 994 tribal women. The study showed that 91.2% of mothers used honey as a prelacteal feed for the newborn children\textsuperscript{130}.

The study conducted by Singh MB et al. (1997) in Jaipur district, Rajasthan included 328 mothers residing in 38 villages to find out the pattern of existing infant feeding and weaning practices in the rural communities. The information was recorded in pre-designed and pre-tested schedules following interview technique. The selection of the villages was made in the basis of population proportion to size (PPS). The villages were categorized into 4 groups based on population and from each group 5% of villages were selected proportionately. Village level households were selected on the basis of systematic random sampling procedure. The study found out 65.2% of mothers gave jaggery water and 33.2% gave tablets containing jaggery to their new born as their first feed\textsuperscript{128}.

The study conducted by Abusaleh Shariff et al. (1990) around Bangalore included 647 urban and 153 rural women to find out the problems they were facing in breast-feeding their infants during 1990. The study found out that 94.5% children received pre-lacteal feeds like tamarind juice, honey, jaggery, sugar, glucose water, animal milk, commercial powdered milk and castor oil etc\textsuperscript{100}.

CR Banapurmath et al. (1996) conducted a study to assess the prevailing breastfeeding and infant feeding practices in rural area of central Karnataka. About 1050 infants in the age group of 0 to 24 months of age were selected by a stratified sampling
method in a community based study. The findings showed that pre-lacteal feeds were routinely given to all babies and nearly one third of mothers discarded colostrum\textsuperscript{131}.

A study was conducted by Shalini C. et.al. (1995) to find out the knowledge and attitude towards infant feeding in Udupi taluk, Karnataka, South India. The study pointed out that 68% of mothers considered pre-lacteal feeds in the form of glucose water, herbal water or water are necessary\textsuperscript{112}.

2.4.5. Exclusive Breast Feeding (EBF)

There is no doubt that breastfeeding is the ideal food for infants and it has been documented that an infant needs no supplement and does well easily on breast milk alone up to the age of six months\textsuperscript{41}. Therefore exclusive breastfeeding is promoted worldwide by WHO to improve infant and child health. However, evidence obtained from randomized studies showing that exclusive breastfeeding is beneficial to child health is limited\textsuperscript{41}. Only two randomized studies in which mothers were randomized to receive counseling about the benefits of exclusive breastfeeding have been conducted in Belarus and India to evaluate the direct effect of promotion of exclusive breast-feeding on infant morbidity and growth\textsuperscript{41}.

1. Exclusively breastfeed babies for first six months (not even water)
2. Babies exclusively breastfed for six months grow normally.
3. Breast milk quantity is reduced if breastfeeding is not exclusive.
4. Water supplementation to exclusively breastfed babies is unnecessary and can be a dangerous source of infection.
5. Babies have lesser infections, allergies and eczema.
6. It helps in birth spacing. The Lactation Amenorrhea Method (LAM) provides 98% protection for women who meet three criteria: baby is exclusively breastfed; baby is less than six months old, women’s menstrual periods have not resumed.

7. It contributes to better intelligence development.

8. It reduces the risk of breast and ovarian cancer and anemia in mothers.

9. Under-nourished and anemic mothers can also successfully exclusively breastfed their babies.\textsuperscript{113, 4}

The Department of Women and Child Development with active co-operation of the Department of Health, a landmark decision was taken in the World Health Assembly in May 2001. The Resolution 54.2 made a global recommendation for promoting exclusive breastfeeding during the first six months, introduction of complementary foods thereafter with continued breastfeeding up to the age of two years and beyond. Further, a new Resolution on Infant and Young Child Nutrition (WHA 55.25) was adopted by the 55\textsuperscript{th} world Health Assembly in May 2002. The resolution endorses a Global Strategy on Infant and Young Child Feeding\textsuperscript{3}. It was recommended that all infants should be exclusively breastfed till they are six months of age and continued to be breastfed until 2 years or beyond. Breastfeeding is advantageous for all mothers, baby and the society\textsuperscript{106}.

In India the persistent effort of the Department of Women and child Development helped in enacting the Infant Milk substitute, Feeding Bottle and Infant Foods (Regulation of Production, Supply and Distribution) Amendment Act, 2003 came into action from 1 January 2004\textsuperscript{4}. The important amendment in the act related to extending the age of exclusive breastfeeding from 4-6 months to 6 months and bringing infant foods at par with infant milk
substitute in so far as advertising, promotion and other regulations are concerned. India now has one of the strongest Legislation to protect breastfeeding from commercial influence.\(^4\)

The *National coordinator BPNI (2006)* in his article pointed out 1.4 million deaths (12% of under five) and 43.5 million DALYs (10% of global under five DALYs) are attributable to suboptimal breastfeeding\(^7\). Out of these attributable deaths 77% (1.06 million) child deaths are due to non-exclusive breastfeeding during 0-6 months of life. Similarly, 85% of DALYs lost are due to non-exclusive breastfeeding\(^7\).

*Aidam BA et al. (2005)* (Systematic review by WHO) concluded that exclusive breastfeeding defined as giving only breast milk without any additional food or liquid, to 6 months confers multiple benefits to the infant and mother. Thus, exclusive breastfeeding for 6 months has become a public health priority worldwide\(^132\).

There is abundant evidence that exclusive breast-feeding in early life protects against infections and reduces mortality, particularly in developing countries where microbial contamination of foods and fluids is common. In Peru, exclusively breast-fed infants were less likely than other infants to experience diarrhoea and respiratory illness in the first six months. The relative risks were particularly high for those given solid foods, but even when the only items given were non-milk fluids (water, tea, and other infusions) the prevalence of diarrhoea was doubled\(^27\).

Similarly high diarrhoeal risks were reported from Philippines due to mixed feeding. Not only does diarrhoea occur less frequently in exclusively breast-fed infants, but also when it does occur, it is less likely to have a negative impact on their nutritional status. Infant
demand is the primary determinant of maternal milk production, avoidance of other foods and fluids is essential to optimize breast milk intake. Most other items offered to young infants are less nutritious than breast milk. Numerous studies have demonstrated that the hydration status of exclusively breastfed infants is normal even in hot climates, thus there is no need to provide extra fluids to breastfed infants to satisfy their fluid requirements. To achieve optimal health, development and survival of infants and young children, all infants should be exclusively breastfed for the first six months followed by introduction of appropriate complementary feeding along with continued breastfeeding for two years or beyond.

In a randomized controlled trial conducted by Ardythe L Morrow et al. (1999) in Mexico two intervention groups with different counseling frequencies, six visits (44) and three visits (52) were compared with a control group (34) that had no intervention. 170 pregnant mothers were identified and home visits were made during pregnancy and early postpartum by peer counselors recruited from the same community. The results showed that in 6 visit group 80% of mothers at 2 weeks and 67% of mothers at 3 months and in 3 visit group 62% of mothers at 2 weeks and 50% of mothers at 3 months were exclusively breast feeding their children in intervention group. However only 24% of mothers at 2 weeks and 12% of mothers at 3 months in control group were exclusively breastfeeding their children. The difference between the groups was found to be statistically significant.

Daniel W. Sallen (2001) conducted a small scale, prospective study of breastfeeding and weaning practices in a semi nomadic pastoral population in northern Tanzania. A community based, mixed longitudinal purposive sample was selected by identifying, through complete and repeated census in each of these settlements. All children less than 3 years old,
in 41 families were visited once. Forty infants from 21 households were visited monthly to collect 24 hours maternal reports of breastfeeding and no-breast milk substances consumed by the child. A combination of maternal self-perception, assessment of infant well-being and indicators of household food supply influenced the actual progression of weaning for individual children. The result suggest that interventions to promote exclusive breastfeeding and improve complementary feeding practices in rural East African pastoral populations could build on maternal attention to infant centered cues and address household level constraints on caregivers making decisions about young child feeding$^{115}$.

Susan Horton et al. (1995) studied the estimates of the costs and impacts of three breastfeeding promotion programs, implemented through maternity services in Brazil, Honduras and Mexico. The study suggests that the breastfeeding program was more effective in reducing the proportion of non-breast feeders in Mexico, and change from partial to exclusive breastfeeding was less dramatic$^{133}$.

Onayade AA et al. (2004) conducted a study to compare the growth and illness pattern of infants who were exclusively breastfed for 6 months with those of infants who commenced a complementary feeding before the age of 6 months and to ascertain reasons for the early introduction of complementary feeding. A comparative prospective study in urban comprehensive health centre, Obafemi Awolowo University included 352 mothers and their children with normal birth weight. The results revealed that 76.5% of children were exclusively breastfed at six months of age. Infants who were exclusively breastfed for 6 months had median weight above the 50th percentile of WHO/NCHS reference and the mean weight of these babies at age 6 months was above those babies who had complementary
foods before 6 months. They also reported fewer symptoms and had fewer illness episodes (0.1 episode/child) compared to children who had complementary food before six months

*Rukhsana Haider et al.* (1996) conducted a randomized controlled trial with the intervention of trained peer counselors to enable the mothers to breastfeed exclusively for the recommended duration of 5 months. Forty adjacent zones in Dhaka were randomized to intervention or control groups and 363 women in each group were enrolled during the last trimester of pregnancy. The study showed exclusive breastfeeding at day 4 was more in intervention group than control group (84% vs. 30% (p < 0.0001) and at 5 months was 70% in intervention and 6% in control group (difference was 64%; 95% CI 57% - 71%, p > 0.001)

*R.K. Agarwal* (2008) in a multi-centric study in Africa and Latin America showed marked increase in exclusive breastfeeding of infants from 0 to 6 months of age, from 54% to 65% (p < 0.001) in Bolivia, 68% to 79% (p < 0.001) in Ghana and 46% to 68% (p < 0.001) in Madagascar.

A cross sectional study was conducted by *BA Aidam et al.* (2005) (based on a 24-h recall data) to assess factors associated with exclusive breastfeeding in Accra, Ghana. Data on current and past infant feeding patterns, socio-demographic, biomedical and bio-cultural factors were collected from a sample of 376 women with infants 0-6 months of age. The results showed that 70.2% mothers exclusively breastfed their children using the 24-h recall data and 51.4% mothers were exclusively breastfeeding since birth to their children until six months age.
Sonia Bechara Coutinho et al. (2005) study included women giving birth during March to August 2001 at two hospitals in Pernambuco, Brazil. They were randomized to receive or not to receive ten postnatal home visits to promote and support breastfeeding. The maternity staff at both hospitals was trained according to the Baby Friendly Hospital Initiative (BFHI). The primary outcome was the rate of exclusive breastfeeding from birth to 6 months. The results showed hospital training achieved a 70% rate of exclusive breastfeeding in-hospital but the rate at 10 days of age was 30% only. These rates were greater than that those before the BFHI intervention but not nearly as greater as the rates of exclusive breastfeeding for 6 months in the group that received home visits. There was a 45% prevalence of exclusive breastfeeding at 6 months of age among the group assigned to home visits vs. 13% in the group assigned to none. The study suggests that reliance on the BFHI alone as a strategy for promoting breastfeeding is reassessed. There is a need for both hospital-based and community-based promotional system if long-term rates of exclusive breastfeeding are to be improved.

The community based cluster randomized controlled trial; conducted by Nita Bhandari et al. (2003) developed the intervention through formative research and pair-matched eight communities on their baseline characteristics. Trained health and nutrition workers counseled mothers for exclusive breastfeeding at multiple opportunities in the intervention communities. Infants born during 9 months of time after the training (552 in intervention and 473 in control group) were enrolled for the study. The results showed that exclusive breastfeeding rates at 3 months was 79% in intervention and 48% in control communities (odds ratio 4.02, 95% CI 3.01-5.38, p<0.0001).
The study conducted by Nita Bhandari et al. (2005) to promote exclusive breastfeeding and appropriate complementary feeding practices in under two years of age to ascertain the feasibility of using available channels for nutrition counseling. In the community based randomized trial in Haryana with four intervention and four control communities the trained nutrition workers in the intervention communities counsel the mothers at multiple contacts on breastfeeding exclusively, on appropriate complementary feeding practices thereafter. The results demonstrated that an increase in the number of channels through which caregivers were counseled was positively associated with exclusive breastfeeding prevalence at 3 months (p=0.002) after controlling for potential confounding factors. The proportion of children exclusively breastfed at 3 months of age increased with the number of channels at which caregivers were counseled (p=0.002). This relationship was also statistically significant at 4 month of age (p=0.001). The study establishes the justification for introducing counseling to improve breastfeeding practices within existing child health and nutrition programmers. In the Indian context, the study highlights that mobilizing anganwadi workers and mothers is more rewarding in terms of counseling than training health workers for the purpose.

A longitudinal study conducted by Kulsoom et al. (1997) through quantitative and qualitative data to assess beliefs and practices related to feeding practices of 52 infants in Lahore, showed that the mean age of exclusive breast feeding was 1.08 (±1.109) months.

A community based cross sectional study conducted by Dinesh Kumar et al. (2008) to investigate the knowledge of ever-married women regarding maternal and child health and to assess existing gap between awareness and practice levels of lactating mothers included 283
women in the reproductive age. The results showed that only 5.8% of mothers were exclusively breast-feeding their children at 6 months of age and significant gaps between knowledge and practice were observed\(^\text{35}\).

\textit{Nita Bhandari et al.}(2002) conducted a cross sectional study in order to determine whether an affluent population in south Delhi had a growth performance similar to that in developed countries and to identify socioeconomic factors that militated against optimal growth in this group. The weights and lengths of 395 children aged 12 to 23 months, heights of 331 mothers and 153 grandmothers were measured, and information was obtained on family socioeconomic status and child feeding practices. The studies showed that only 24.6% of infants were exclusively breastfed up to the age of four months\(^\text{83}\).

\textit{Anju Aggarwal et al.} (2008) conducted a study to assess the practice of complementary feeding in children aged 6 months to 2 years regarding knowledge of mothers and reasons for inappropriate feeding practices using a semi-structured questionnaire. Among the 200 children studied, 63% of mothers were exclusively breastfeeding their children till 6 months of age\(^\text{30}\).

\textit{A Sinha et al.} (1991) conducted a longitudinal study to know the prevailing feeding practices and their role on the physical growth of infants at Pantnagar in 1987. The infants were divided two groups and data was collected on feeding practices and anthropometric measurements. Study shows 83% of infants were exclusively breastfed up to the age of 6 months. In addition to breastfeeding, 77% of infants between 9 and 12 months of age were also receiving semi-solids\(^\text{89}\).
Tiwari SK and Chaturvedi P. (2003) reviewed the Infant Milk Substitutes (IMS) Act and point out the limitations and loopholes and emphasized the need for more amendments and publicity to make the Act work. They recommend that “exclusive breastfeeding for first six months is a must for each and every child” and “use of artificial feeding should be restricted to orphanages”\textsuperscript{136}.

Anju Aggarwal et al. (1998) conducted a study to find out various reasons for early introduction of Complementary feeds in infants before four months of age. The mothers of the infants were selected after ensuring their mood and the condition of their children permitted to be informally interviewed. The results showed that most of the infants (98.7\%) were rooming in with the mother. In conclusion exclusive breastfeeding is the most effective intervention to promote infant nutrition and decrease their morbidity and mortality. In order to ensure exclusive breastfeeding for 6 months it is mandatory that mothers are educated during their antenatal period regarding undisputed beneficial effects of exclusive breastfeeding in early in infancy\textsuperscript{137}.

The Indira Narayanan et al. (1984) in a study observed that supplementary formula feeds inhibited the protective effect of expressed raw and pasteurized human milk in 226 high-risk neonates in a randomized controlled trial. The infection rate in the group given pasteurized human milk and formula (35\%) was significantly higher than the rates in the groups given raw human milk (10.5\%). This accord with the impressions that some of the association of infection with artificial feeding is partly attributable to the lack of protective effect of human milk. Heating expressed human milk to 62.5°C for 30 minutes significantly reduces its protective effect\textsuperscript{123}. 
CR Banapurmath et al. conducted a study to assess the prevailing breastfeeding and infant feeding practices in rural area of central Karnataka. In this community based study 1050 infants from birth to 24 months of age were included with a stratified sampling method. The study observed that proportion of mothers who were exclusively breastfeeding were 94% at 1 month, 83.5% at 2 months, 72.5% at 3 months, 61.2% at 4 months, 43.4% at 5 months and only 26.8% at 6 months of age\textsuperscript{131}.

SB Bavdekar et al. conducted a study in two slum areas in a Mumbai suburb covering a total population of 4879. In the study, 153 mothers having children below 2 years of age were interviewed. The results showed that 96% of the infants below 4 months of age were receiving breast milk; exclusive breastfeeding was practiced only by 37% of mothers\textsuperscript{138}.

Shalini C. et.al. (1995) conducted a study to find out the knowledge and attitude of mothers towards infant feeding practices in Udupi taluk, Karnataka, South India. The study included 300 mothers whose babies were 3 days to 17 months of age. The results showed that 71% of the mothers considered 3 to 5 months to be the optimum period to give exclusive breast feeding\textsuperscript{112}.

2.4.6. **Duration of breastfeeding**

Continuing breastfeeding while giving adequate complementary foods provides all the benefits of breastfeeding to the baby. In other words, the child gets energy high quality protein, vitamin A, anti – infective properties and other nutrients besides achieving emotional satisfaction from the breastfeeding much needed for optimum development of the child. Breastfeeding especially at night ensures sustained lactation\textsuperscript{4}.
Continue frequent breastfeeding up to 2 years and beyond along with appropriate complementary feeding –

1. Increases energy
2. Lessens the risk of under-nutrition and infection in children
3. Helps in emotional bonding and connection\textsuperscript{113,4}.

The Kulsoom et al. (1997) conducted a longitudinal study through quantitative and qualitative data to assess beliefs and practices related to feeding practices of 52 infants in Lahore, observed that 54.3\% of mothers continued breast feeding until 12 months of age\textsuperscript{118}.

Shanthi Ghosh et al. (1976) conducted a longitudinal study in South Delhi; the infant feeding practices were studied among 802 mothers. The mother’s socio-economic status and literacy were recorded. Breastfeeding and time of introduction of animal milk, semisolids, solids etc. were noted. Study reported that literate and older mothers tended to breastfed for shorter period of time whereas illiterate mothers tend to prolong breast feeding\textsuperscript{139}.

Nita Bhandari et al. (2002) conducted a cross sectional study in order to determine whether an affluent population in south Delhi had a growth performance similar to that in developed countries and to identify socioeconomic factors that militated against optimal growth in this group. The weight and length of 395 children aged 12 to 23 months and height of 331 mothers, 153 grandmothers were measured and information was obtained on family socioeconomic status and child feeding practices. The study results point out that two-third of mothers stopped breastfeeding before their infants completed one year of age\textsuperscript{83}.
A cross sectional study was conducted by Rasania SK et al. (2001) in Mehrauli Delhi, to assess the nutritional status and breastfeeding practices among children and to correlate the findings with some potential determinants. The study shows the duration of breastfeeding was found to be significantly associated with malnutrition (p<0.05)\textsuperscript{120}.

*Lala VR. et al. (1970)* conducted a hospital based study in the postnatal ward of civil hospital Ahmadabad in which 410 mothers was interviewed using a questionnaire. The newborn were thoroughly examined and observed for 3 to 7 days to detect any complications. The study showed 38% of mothers continued breastfeeding even after one and half years and only 8.8% of these mothers continued till two and half to 3 years\textsuperscript{129}.

*Abusaleh Sheriff et al. (1990)* conducted a study around Bangalore included 647 urban and 153 rural women to find out the problems they were facing in breast-feeding. The study reveals that 53% of urban women and 85% of rural women are breast-feeding their children even after one year of age\textsuperscript{100}.

The study conducted in Udupi by *Shalini C. et al. (1995)* to find out the knowledge and attitude of mother towards infant feeding practices, included 300 mothers. The study showed that 78.5% of mothers view that breastfeeding should continue beyond 1 year of age\textsuperscript{112}.
2.5. Complementary feeding

An infant incapable of demanding food is dependent on his mother for his nutrition. The nature of food is determined largely by the socio-cultural factors, rather than its availability\textsuperscript{139}.

Complementary feeding (CF) is an essential element in the care of young children, the nutrient intake and presence or absence of disease is the direct determinants of child survival, growth, and development. Dietary intake and the incidence of illness are in turn, influenced by the underlying factors of household food security, available health care services, and child-care practices\textsuperscript{27}.

2.5.1. Nutritional recommendations\textsuperscript{114}

1. Introduce complementary (additional) foods when a baby is six months old –

2. Nutritional requirements often cannot be met with breast milk alone after the age of 6 months

3. Complementary foods given before six months do not result in improved growth, but replace breast milk intake.

4. Appropriately introduced complementary food reduces the risk of diarrhoeal diseases which is 3 to 13 times higher in those babies who are, introduced these foods early\textsuperscript{113}.

The period during which other foods or liquids are provided along with breast milk is considered the period of complementary feeding. Any nutrient-containing foods or liquids other than breast milk given to young child during the period of complementary feeding are defined as complementary foods\textsuperscript{27}.
Children should continue to be breast-fed for up to 2 years of age or beyond, while receiving nutritionally adequate and safe complementary foods\textsuperscript{27, 140}.

2.5.2. Successful child feeding practices are

1. Provide sufficient amount of food of adequate quality to satisfy nutrient requirement
2. Protect the airway against aspiration of foreign food substances.
3. Do not exceed the functional capacity of the gastrointestinal tract and the kidneys.

The three critical determinants of child care are adequate nutrition, access to food and health care services. The socio-economic determinants of complementary feeding practices function at macro level (regional, national, and international), community level, household level and caregiver’s level. An appropriate diet is critical in growth and development of children especially in the two-year life. WHO recommends exclusive breast-feeding for the first 6 months, addition of complementary feeds at 6 months of age with continued breast-feeding till at least 2 years of age\textsuperscript{30}.

When the baby is 6 months old, it is the time that solids should be gradually introduced in addition to breastfeeding. The food given should be nutritious, adequate and not contaminated. After the age of six months breast milk alone cannot meet the needs of growing child. Giving complementary food too early or too late could lead to malnutrition and other problems. If given too early it may not ready to digest properly and breast milk intake may be reduced leading to inadequate intake of energy for his growth. Early introduction of complementary food replaces breast milk by food which is usually less nutritious\textsuperscript{106}. 
Children are dependent and are at the mercy of their parents and health care professionals for their dietary intake. Optimal nutrition during pregnancy and first 3 years of life is most crucial because 70% of the human brain develops during fetal life and remaining 30% during pre-school years\textsuperscript{15}.

A number of studies have shown that there is no growth advantage in breastfed children being given complementary foods from four months of age, even with very high quality foods. Complementary feeding also often results in displacement of breast milk. Infants regulate the amount of breast milk they consume, and if they are receiving other foods they will reduce the amount of breast milk they consume accordingly. The nutrients found in breast milk are often absent or less bio-available in complementary foods, such as calcium, protein, fatty acids, vitamins and minerals. After six months of age, the displacement of breast milk is reduced and is less important\textsuperscript{105, 4}.

The new information is available from several observational studies and intervention trials concerning the optimal age of introduction of complementary foods. The recent data on the adequate energy density of foods for young children provide useful guidelines on the proper formation of complementary foods\textsuperscript{27}.

In India 56.7\% of mothers gives complementary foods to their infants at 6 to 9 months of age where as in Karnataka 72.5\% of mothers give complementary foods at 6 to 9 months of age\textsuperscript{67}.

\textit{Gretel H. Pelto et al. (2003)} studied 18 case studies of best practice on complementary feeding behaviors that were derived combining principles of psychosocial
care with current knowledge in nutritional sciences. The study suggested that, (1) there is a need for interventions to improve nutrition-related care giving practices during the period of complementary feeding. (2) Nutrition related care-giving behaviors are always impelled in a much larger complex of family and caregiver activities and a broad socio-cultural context. (3) Interventions undertaken for changing specific behaviors must be designed in relation to their socio-cultural context and in relation to situation-specific determinants\textsuperscript{141}.

*Jing Chen and Douglas Taren (1995)* conducted a nutrition surveillance survey in June 1990 in four poor rural counties of Hubei Province China, included 25 villages and 3564 children to determine early feeding practices and nutrition status. Rice was introduced always first in diet. Sixty percent of children were consuming rice at 12 months of age. Eggs and vegetables followed by soya beans and fruits were taken by 50\%, 35\%, 27\% and 20\% of the children respectively by 12 months of age. Meat was introduced last with 20\% consuming by 12 months of age\textsuperscript{80}.

*Ellen G Piwoze et al. study (2003)* suggests that the lessons learned from the promotion of breastfeeding should be applied to complementary feeding and the new global strategy for infants and young child feeding provides an excellent first step in this process\textsuperscript{142}.

The study conducted by *Bernadette Daelmans, et al. (2003)* concludes that improvement of complementary feeds has received insufficient attention as a public health intervention. Internationally agreed goals for the reduction of malnutrition and child mortality will be achieved only if families can support. Families need to care adequately for their child’s nutritional needs, thus contributing to improved survival, growth and development\textsuperscript{143}.
Chessa K. Lutter et al. study (1990) made the secondary analysis and made use of data from a randomized intervention trial. The study designed to assess the effects of dietary supplementation and early childhood stimulation on the physical growth and mental development of children at risk of malnutrition. The study recommends targeting supplementation programs to coincide with periods of high nutritional risk should maximize their effectiveness in reducing malnutrition. The caution should be exercised to avoid disruption of breast-feeding.

The study conducted by Hotz C et al. (2005) using a quasi-experimental questionnaire in southern Malawi, Central Africa. Mothers and children aged 6 to 23 months of age were compared for the dietary intakes from complementary foods between three intervention and one control group. The results show that the amount of complementary foods (g/day) and intake of energy, animal protein, niacin, riboflavin, calcium, iron, and zinc, but not vitamin A, were significantly greater (p < 0.05) in the intervention compared to control group.

In a randomized intervention study conducted by Marianne S. Jacobsen et al. (2008) to evaluate the impact of promotion of exclusive breastfeeding on infant health in Guinea-Bissau West Africa. A birth cohort of 1721 infants was randomized to receive health education. Promotion of exclusive breastfeeding for the first 4-6 months of life according to WHO recommendations was aimed as part of the health education. All children were followed from birth to 6 months of age. The results showed 31.8% of mothers not started introducing complementary foods at the age of 4 months and at 6 months of age. Complementary foods were significantly delayed in the intervention group compared with the control group.
The study conducted by Gardne JM et al. (2002) aimed to develop and validate a field method for measuring the viscosity of small quantities of weaning porridges, to measure the viscosity and energy density of porridges fed in urban and rural environments, and to relate the findings to ingredients used and feeding practices. By purposive random sampling method, 70 children aged 3 to 14 months were selected from one urban and one rural community in Jamaica. The results showed most (77.5%) of the children were receiving some meat or fish, and 80% a staple food (e.g. potato or rice) besides porridge. Many children also received cheese (63%), fruits (53%), soup (54%), vegetables (47%) and eggs (29%). Most of these items were introduced between 5 and 7 months of age, and none was said to have been introduced before 3 months of age. Thirty-four per cent of the children were receiving herbal teas and 47% had commercial sweet drinks. The prevalence of under nutrition (weight-for-age < -2SD) in children under 5 years has fallen from 14% in 1985 to 6% in 1996. The fact that porridges are more energy-dense than they used to be, and are part of a mixed diet rather than the sole or dominant complementary food, may have contributed to this trend.\(^9\)

Synove Daneel-Otterbeach (2003) conducted a study in African and European women. In this second series of studies, the possibility of increasing ascorbic acid content of human milk by acid supplementation or by consumption of fresh orange juice was evaluated. The results showed the mean increase in ascorbic acid content from 18mg to 60mg/kg in 22 African women (p < 0.001) and from 60mg to 70 mg/kg in European women (p < 0.02). The children studied showed that 85% younger children (6-21 months) and 96% of older children (13-18) were anemic, 86% were iron deficient. The low intake of dietary iron seemed to be the major cause of IDA. The diet was of low iron bioavailability, with high acid, low muscle tissue, and negligible ascorbic acid and home-iron content.\(^{145}\)
A longitudinal study conducted by Kulsoom U. et al. (1997) through quantitative and qualitative data assessed beliefs and practices related to feeding practices of 52 infants in Lahore. The study shows the mean age of initiating complementary feeding with semi-solid food was 4.4 (± -0.99) months in the study population.

Nita Bhandari et al. (2002) conducted a cross sectional study in order to determine whether an affluent population in south Delhi had a growth performance similar to that in developed countries. Children born prematurely and those with illness adversely affecting growth were excluded from the analysis, as with the NCHS/WHO reference population. In this study, mothers were feeding animal or formula milk introduced at a mean age of 3 months, animal milk was fed to 83.5% of infants and formula milk was fed to 62.5% of infants. Eggs were fed to 57% of infants, and non-vegetarian foods (chicken, fish, or meat) were fed to only 2.4% of infants (57.5% of parents are consuming no-vegetarian foods). During the first year of life only three quarters of children were consuming all family foods.

To assess the nutritional status and breast feeding practices among children and to correlate the findings with some potential determinants, a cross sectional study was conducted by Rasania SK et al. in Mehrauli Delhi, during 2001. The study shows that in 32.6% of children, complementary foods were introduced beyond six months of age and study observed severe malnutrition was significantly higher among these (p < 0.05) children.

Hassan J. et al. (1991) studied the socio cultural factors influencing the weaning practices of infants in a cohort of 200 infants over a period of one year. The study found that 73% of infants received top milk diluted and 50.5% of mothers did not give their infants
semi-solid foods until 9 months of age. Around 20.5% of mothers were not given any semi-
solids or solid foods at one year of age and 15% of mothers were feeding biscuits to their
children. Rajaaratnam Abel et al. (1998) conducted a cross sectional nutritional survey of
children in Tamilnadu State, India. Children aged 0-3 years on a representative sample of
2039 were selected for the study. The results showed that, only 17.1% of mothers giving
complementary foods at 6 months of age, 25% of mothers started from 4 months onwards
(11.3% at 4 months, and 13.7% at 5 months of age). 43.3% of mothers initiated the
complementary foods very late, (14.2% at 7 and 28.1% at 8 months of age) and 15.5%
mothers not started till one year of age.

A cross sectional study was conducted by Wijga A. et al. (1983) consisted of
households living in villages where the Tribhunadas Foundation was working. Four villages
were selected as sample villages, ranging in size from 1300 to 3500 inhabitants and two were
in the wealthier part and two in the poorer part of the district. From these four villages a
sample of 80 children was obtained, (46 boys and 34 girls) aged 0 to 18 months. The results
shows that majority of mothers did not introduce foods other than breast milk before 9
months of age.

Jeeson C. Unni et al. (1986) studied 271 full term, normal babies attending a under-
five clinic seen at 6, 10, 14, 18 and 22 weeks of age in Vellore Tamil Nadu. The study found
that at 22 weeks 50% of middle class and 71% of upper middle class infants were receiving
food supplements.
The study conducted by Singh MB et al. (1997) in Jaipur district, Rajasthan included 328 mothers to find out the pattern of existing infant feeding and weaning practices. The information was recorded in pre-designed and pre-tested schedules following interview technique. The selection of the villages was made on the basis of population proportion to size (PPS) sampling. Village level households were selected on the basis of systematic random sampling procedure. The study showed that mean age for food supplementation initiation was 8.7 months$^{128}$.

Anju Aggarwal et al. (2008) in a study showed that only 17.5% of mothers started giving complementary feeds at 6 months of age and 61% of children received delayed complementary foods (between 7 to 23 months) where as 16% of children have not received any complementary foods at two year of age. The mean age of starting feeds was 13.37 months. Most common reason given for delayed weaning was an unsuccessful attempt in 52% of cases (child vomiting). Quantity of complementary feeds given was less than recommended amount for particular age in 75% of these children. Only 3.5% of mothers started complementary feeds at proper time, in adequate quantity and with proper consistency. Eighty percent of children received top milk and out of this 56.1% of mothers were diluting the milk$^{30}$.

Deeksh Kapoor et al. study (2004) shows the nutrient intake of children ranged from 45% (for iron) to 143% (for vitamin C) of Indian RDA. The chronic calorie deficit was the basic cause of poor nutritional status among children under three years of age. This study provides a strong evidence to suggest low food intake as the main cause of under/malnutrition and growth retardation (stunting) in early childhood in poor communities$^{147}$.
Vani Sethi et al. study (2003) to assess current infant feeding practices (IFP) in a relocated slum, to identify the lacunae, to outline, implement, and evaluate the gain in awareness and IFP followed by mothers. Thirty five mothers of infants aged 5-19 months were interviewed and nutrition education was imparted to mothers over two months. Tools used were individual counseling, participatory learning methods, positive deviance and early adopters approach aided with existing information education communication materials. The results showed 80% of mothers incorporating green leafy vegetables at post –Nutrition Education (NE) as against only 20% pre-Nutrition Education. The food given to the infants was of thick and mashed consistency by 56.6% of the mothers in post-NE as against only 3.3% at pre-NE. Most mothers (66.6%) adopted active feeding behaviors after 2 months of intervention as compared to only 6.6% mothers practiced this behavior at pre-NE. 72% of mothers adopted supervised bowl feeding at post-NE.

Asha Arya and Rohini Devi (1991) conducted a study to find out the impact of maternal literacy status on the nutritional status of the pre-school children in Prabhani. Two hundred children of both sexes aged between one to five years were randomly selected for the study. Results revealed that the children of literate mothers had better anthropometric measurements than children of illiterate mothers. Nutrient deficiency signs especially of protein energy malnutrition were more predominant among the children of illiterate mothers. Food consumption pattern was better in children with literate mothers as compared to children of illiterate mothers. The consumption of milk and milk products, fruits, sugar and jiggery was significantly greater in children with literate mothers.
A longitudinal study was conducted by A Sinha et al. (1987) to know the prevailing feeding practices and their role on the physical growth of infants at Pantnagar in 1987. The infants were divided into two groups and collected data on feeding practices and anthropometric data. The study showed that 77% of infants between 9 to 12 months received semi-solids in very small quantities of cereals, pulses, biscuits and fruits as complementary foods.

CR Banapurmath et al. (1996) conducted a study to assess the prevailing breastfeeding and infant feeding practices in rural area of central Karnataka. In this community based study 1050 infants from 0 to 24 months of age were included with a stratified sampling method. The study revealed that 57.3% infants received complementary feeding at 6 to 10 months of age.

Bhavna Dhingra et al. study in Delhi included one hundred infants between the age of 6 to 12 months in a pediatric outpatient department to determine the prevalence of use of dal–water as a weaning food and its various correlates. The findings showed that 64% of the mothers were using dal–water as weaning food with half of these using bottle-feeding along with dal–water. The source of information was a health professional (46%) divided equally amongst the government and private set-up. 33% of the mothers took this decision on their own accord.

The study conducted by Abusaleh Shariff et al. (1990) around Bangalore included 647 urban and 153 rural women to find out the problems they were facing in breast-feeding their infants. The study revealed that 53% of mothers had initiated complementary feeding when the baby was less than 4 months of age (22% in rural and 31% in urban area). On the other
hand, 31.4% of rural mothers and 8.6% of urban mothers had not introduced complementary foods to their children at one year of age. The mean age at weaning for all those women who terminated breast-feeding was 14 months (21 months of rural women and 13 months of urban women)\(^\text{100}\).

### 2.5.3. Initiation of Complementary Foods

*M. Jane Heining (2006)* conducted a study where focus groups were used to examine relationships between maternal beliefs, feeding intentions and infant-feeding behaviors among 65 women. Focus groups were chosen as the method of data collection because of their ability to provide in-depth, individualized information and to identify and characterize group attitudes, beliefs and norms. Participants shared common beliefs that breastfeeding was beneficial; nevertheless, many believed that early introduction of formula and solid foods was unavoidable in certain situations. Medical providers and women, infants and children staff were sources of infant-feeding information, and the Spanish-speaking mothers attempted to adhere to the guidance. However, the English-speaking mothers often ignored this advice if it was not perceived as working for the family’s circumstances. Educational efforts should acknowledge mother’s true circumstances, target support to each situation, and emphasize the health value of complementary foods rather than their association with infant motor development\(^\text{150}\).

### 2.5.4. Introducing Semi-solid Foods

*Onayade AA et al. (2004)* conducted a study to compare the growth and illness pattern of infants who were exclusively breastfed for 6 months with those of infants commenced a complementary feeding before the age of 6 months. The results showed that infants who
commenced complementary feeding before 4 months reported more symptoms and had more illness episodes (1.4 episodes /child/year) compared to those who had between 4 to 6 months (1.2 episodes/child/year). The reasons given for early introduction of complementary foods include insufficient breast milk, thirst and convenience. In conclusion early introduction of complementary foods did not provide any advantages in terms of weight gain; it was frequently associated with illness episodes and growth faltering\(^\text{77}\).

*Kumar S. et al (1992)* conducted a study in a resettlement colony for urban dwellers in New Delhi to study weaning practices and its implications. The study pointed out one third of the children less than 3 months age group received animal milk and 44.6% between 3 to 6 months, 74.2% between 6 to 9 months and 88.7% between 9 to 12 months were receiving supplements including animal milk. The mean age of introduction of semi solids was 10.3 months where as in one third it was delayed till more than one year of age\(^\text{151}\).

### 2.5.5. Introducing Solid Foods

*Kirk A. Dearden et al.* have conducted a formative research designed to improve understanding about what distinguishes care givers who practice optimal behaviors from those who do not practice. Study was conducted in a rural northern province in Viet-Nam. One hundred caregivers of children (6 to 17.9 months of age) from five communities were interviewed. Results showed that 27% of caregivers continued to give as much or more foods and liquids during diarrhoea as when child was healthy, where as 73% did not give enough food. More caregivers (69%) fed their children positive deviant foods (doers of this behavior) than non-doers 31%). The most common positive deviant foods were eggs, fish, animal fat, meat\(^\text{152}\).
Lala VR et al. (1970) conducted a hospital based study in the postnatal ward of civil hospital Headband. Study included 410 mothers and was interviewed using a questionnaire. The newborns were thoroughly examined and observed for 3 to 7 days to detect any complications. The study observed the delayed introduction of solid foods at 1 to 2 years in 85.3% of children\textsuperscript{129}.

2.5.6. Introducing Family Foods

Hoppe C. et al. (2005) in their study raising debate on cow’s milk’s possible long-term effects on overweight development in older children shed more light in the growth-promoting mechanisms of animal proteins. The study suggests that components in milk, but not meat, stimulate the neuro-endocrine effectors of enhanced growth\textsuperscript{153}.

R.Singh et al. (1992) selected randomly 73 Muslim women in the reproductive age group who were residents of an urban area of district Lucknow for the study. The study results revealed that the solid foods were introduced at a mean age of 8.2 months and included rice, kheer, porridge, bread, biscuits, boiled eggs, egg yolks, bananas, pudding, curd and wheat\textsuperscript{104}. 

2.6. Other feeding practices

2.6.1. Feeding Water

In a randomized intervention study conducted by Marianne S. Jakobsen et al. (2008) to evaluate the impact of promotion of exclusive breastfeeding on infant health in Guinea-Bissau West Africa, a birth cohort of 1721 infants were randomized to receive health education. All children were followed from birth to 6 months of age. The results showed that overall water was introduced significantly later in the intervention group compared with the control group (p=0.003)\(^41\).

The longitudinal study conducted by Kulsoom U. et al. (1997) studied beliefs and practices related to the feeding of 52 infants assessed in an urban community of Lahore. The study pointed out that 55.4% of mothers fed water to their newborn children that they found very essential from the very first day of birth\(^118\).

H.P.S. Sachdev et al. (1991) study designed to determine the need for water supplementation to maintain water homoeostasis in exclusively breastfed infants during summer in a tropical country. A pre study questionnaire revealed that 97% of 34 nurses and 63% of 70 Doctors advocated such supplementation. The study included 45 healthy male exclusively breastfed babies, aged 1 to 4 months, who had never received supplemental water plus a random selection of 14 others were allocated to group1 (breast milk only); the remaining 22 infants were allocated to group 2 (breast milk plus supplemental fluid according to the mother’s usual practice). The babies were studied at hospital for 8 hours. However, there were no significant differences between the groups in urine output, urine or serum osmolality, weight change or rectal temperature whether or not the factors adjusted for...
included total fluid intake. Thus, exclusively breastfed infants do not need supplemental water to maintain water homoeostasis; a reduced breast milk intake is a potential disadvantage of this practice\textsuperscript{154}.

2.6.2 Bottle feeding

If a baby is put on bottle feeding the child is prone to have the major problems like,

1. Baby starts refusing the breast due to nipple confusion.
2. Mother will reduce her breast milk supply.
3. The baby becomes more prone to infections because of bottle.

In spite of boiling the bottle the chances of infection are higher in the babies who are bottle-fed than who are not given bottle\textsuperscript{105}.

A study conducted by Catherine Hubbard, \textit{(1977) in London} included 66 children aged between 12–24 months were interviewed with a precise questionnaire found out that 65\% of mothers used bottles initially for supplementary feeds and by the second year 52\% were still using bottles to feed the children\textsuperscript{108}.

\textit{Camel T. Collins et al. (2004)} conducted a randomized controlled trial to determine the effect of artificial teats (bottle and dummy) and cups on breastfeeding in preterm infants in a hospital setting. The study included 319 preterm infants randomly assigned to four groups with singleton or twin infants < 34 weeks gestation who wanted to breastfeed. The results showed infants randomized to cup feeds were more likely be fully breastfed on discharge home (odds ratio 1.73, 95\% CI 1.04 to 2.88, \(p=0.03\)) but had a longer length of stay (hazard ratio 0.71, 0.53 to 0.92, \(p = 0.01\)). The study concludes that dummies do not affect
breastfeeding in preterm infants. Cup feeding significantly increases the likelihood that the baby will be fully breastfed at discharge home. The study adds some support to the theory that avoiding bottle increases the success of breastfeeding.

**Kulsoom U. et al. (1997)** studied beliefs and practices related to the feeding of 52 infants in an urban community of Lahore in a longitudinal study. The study showed that 48% of children were put on bottle-feeding during the first week and 97% at 5th month.

**Jeeson C. Unni et al. (1986)** studied 271 full term, normal babies attending an under-five clinic at 6, 10, 14, 18 and 22 weeks of age in Vellore Tamil Nadu. The study found that 58% of infants bottle-fed received diluted cow’s milk or commercial milk.

The study conducted by **CR Banapurmath et al. (1996)** to assess the prevailing breastfeeding and infant feeding practices in rural area of central Karnataka, included 1050 infants from birth to 24 months of age with a stratified sampling method in a community based study. The findings of the study showed 49.4% infants were bottle fed below one year of age. The chief reasons for introducing bottle-feeding were ‘not enough milk’.

**S.B. Bavdekar et al study (1994)** conducted in two slum areas of Mumbai found that 23% of mothers used bottle for administration of supplementary foods or water.
2.7. Hygiene and morbidity

2.7.1. Hygienic practices

*William Checkley et al. (2004) study* was conducted in Pampas de San Juan, a peri-urban community in Lima, Peru to assess the effects of water and sanitation on linear growth, diarrhoeal diseases and prevalence of parasites. Children were recruited at birth and followed up to 35 months. The children were followed once a day for diarrhoea and once a month for anthropometric and obtained data for household water and sanitation at baseline. The study recommends that better water and sanitation were associated with an improved rate of linear growth and decreased risk of diarrhoea\(^{156}\).

*Stephen P. Luby et al. (2005)* conducted a study in Karachi, Pakistan, randomized 25 neighborhoods to hand washing promotion; 11 neighborhoods (306 households) were randomized as controls. In neighborhoods with hand washing promotion, 300 households each were assigned to antibacterial soap containing 1.2% triclocarban and to plain soap. Weekly home visits for one year to encourage hand washing by residents in soap and to record symptoms in all households. Primary outcome of the study was diarrhoea, and acute respiratory-tract infections. Incidence of disease did not differ significantly between households given plain soap compared with those given antibacterial soap. Hand washing with soap prevents the two clinical syndromes that cause the largest number of childhood deaths globally-namely, diarrhoea and acute lower respiratory infections\(^{157}\).

*Kirk A. Dearden et al. (2002)* have done a formative research designed to improve understanding about what distinguishes caregivers who practice optimal behaviors from those who do not practice. The study is a one-time, cross-sectional baseline assessment of factors
that affect nutrition-related behavior change. Study was conducted in a rural northern province in Viet-Nam. One hundred caregivers of children of 6 to 17.9 months of age from five communities were interviewed and four behaviors were examined. These behaviors include feeding the child ‘positive deviant’ foods, feeding the child during diarrhoeal episodes, washing the child’s hands, and taking the child to the health centre when ill. Results indicate that 56% of caregivers washed children’s hands with water before every meal whereas 44% did not. For all four behaviors, favorable social norms distinguished those who practiced each behavior from those who did not. Positive reinforcing beliefs and attitudes were important determinants of every behavior except hand washing 152.

A study conducted by Catherine Hubbard, (1977) in London included 66 children aged between 12–24 months were interviewed with a precise questionnaire. The study found out that 49% of mothers never boiled the feeding bottle, 33% boiled the bottle once a day and only 18% of mothers boiled the bottle before each feed 108.

The cross-sectional study conducted by Naidu Philips, et al. (1997-98) concluded that “While the timing of complementary feeding in and of itself may not lead to improved nutritional status, timely introduction of foods of appropriate quantity and quality in a hygienic environment, along with increased maternal interaction time would likely have desired positive growth of young children” 14.

Anju Aggarwal et al. (1998) conducted a study to find out various reasons for early introduction of complementary feeds in infants before four months of age who were initially started on breastfeeds. The mothers of the infants were selected after ensuring their mood and the condition of their children permitted to be informally interviewed. Only 6.7 of mothers
were able to maintain proper hygiene. In this study 51.3% of infants received complementary feeds within 6 weeks of age. The commonest reason for starting top feeds was not ‘enough milk’ as perceived by 49.4% of mothers\(^{137}\).

### 2.7.2. Infections

Diarrhoea causes dehydration; children are more likely than adults to die from diarrhoea because they become dehydrated more quickly. Diarrhoea is also a major cause of child malnutrition. The main causes of diarrhoea are poor hygiene, lack of clean drinking water, overcrowding and trend towards bottle-feeding rather than breastfeeding. Infants who are fed only breast milk seldom get diarrhoea. Diarrhoea can be prevented by breast-feeding, by immunizing all children for measles, by using latrines, by keeping food and water clean, and by washing hands before touching food. Thousands of deaths could be averted through interventions such as oral rehydration therapy, appropriate drug therapy, optimal breast-feeding practices, improved nutrition, increased access to clean water and sanitation facilities and improved peers and domestic hygiene\(^{158}\).

About two million children will die every year due to diarrhoea, which in most cases can be treated with simple oral rehydration therapy\(^{159}\). Nearly two-third of the deaths in the 42 countries analyzed (57% of child deaths worldwide) occur in just 19 countries where the predominant causes are pneumonia, diarrhoea and neonatal disorders – with very little contribution from malaria and AIDS\(^{160}\). The WHO regards illness due to contaminated food as one of the most widespread health problem in the contemporary world. Food safety especially in the weaning groups is one of the major concerns that have posed a threat to
health of the children. Millions of children in the world die each year from diarrhoeal diseases\textsuperscript{161}.

\textit{The WHO study team (2000)} conducted a study using meta-analytical techniques assessed the protective effect of breastfeeding according to the age and sex of the infant, the cause of death, and the educational status of mother. The data available from eight studies provided 1223 deaths of children under two years of age. Results showed protection provided by breast milk declined steadily with age during infancy \{pooled odds ratio: 5.8 (95\% CI 3.4 -9.8) for infants < 2 months of age, 4.1 (2.7 to 6.4) for 2-3 months-old 2.6 (1.6-3.9) for 4-5 months old, 1.8 (1.2-2.8) for 6-8 month-old and 1.4 (0.8-2.6) for 9 to 11 months-old\}. In the first 6 months of life, protection against diarrhea was substantially greater \{odds ratio 6.1(4.1-9.0)] than against deaths due to acute respiratory infections \{2.4(1.6-3.5)\}. The results also showed that infants who are not breastfed have a six-fold greater risk of dying from infectious diseases in the first two months of life than those who are not breastfed. The raw human milk provided substantial protection against the incidence of septicemia, conjunctivitis, diarrhoea, and umbilical sepsis\textsuperscript{162}.

A randomized intervention study was conducted by Marianne S. Jakobsen et al. (2008) to evaluate the impact of promotion of exclusive breastfeeding on infant health in Guinea-Bissau West Africa, A birth cohort of 1721 infants were randomized to receive health education. A total of 588 episodes of diarrhoea were observed following 58001 diarrhoea free days (1.01 episodes per 100 days). All children were followed from birth to 6 months of age, reported that the incidence of diarrhoea in intervention group was 1.00/100 diarrhoea free days and in control group the incidence was 1.01/100 diarrhoea free days. The 7-day
diarrhoea prevalence was significantly lower in the intervention communities compared to controls at both 3 months and 6 months of age\textsuperscript{41}.

The study conducted by Mauricio L Barreto et al. (1994) investigated the effect of vitamin A supplementation on diarrhoea and acute lower-respiratory tract infections (ALRI) in children from northeastern Brazil in a randomized, double-blind, placebo-controlled community trial. The study included 1240 children aged 6 to 48 months were assigned vitamin A or placebo every 4 months for one year. They were followed up at home three times a week, and data about the occurrence and severity of diarrhoea and ALRI were collected. The results showed that the overall incidence of diarrhoea episode was significantly lower in the vitamin A supplemented group than in the placebo group. The benefit of supplementation was greater with reference to severe episodes of diarrhoea. The incidence was 20\% lower in the vitamin A group than in the placebo group \{rate ratio 0.80 (0.65-0.98)\}. This study showed a very clear protective effect of vitamin A supplementation against severe diarrhoea. The effect was very strongly reflected in a decrease in the overall incidence of diarrhoea in the vitamin A supplemented children\textsuperscript{163}.

Mini Sheth et al. (2006) pointed in a study on food safety education intervention imparted through change agents resulted in reduction in the prevalence of diarrhoea. Improvements were found in the knowledge and practice of mothers related to etiology of diarrhoea, hand washing practices, preparation and feeding of ORS. Significant impact of education was found in the fully educated mothers, which can be a result of enhanced training of mothers by the volunteers as well as the portable information offered by the leaflets and
calendars. After imparting food safety education for a period of about one month consisting of 5 sessions, there was 33% reduction in diarrhoea in children below two years of age\textsuperscript{161}.

The community based cluster randomized controlled trial, conducted by Nita Bhandari et al. (2002) developed the intervention through formative research. Trained health and nutrition workers counsel mothers for exclusive breastfeeding at multiple opportunities in the intervention communities. The study results shows 7 days diarrhoea prevalence was lower in the intervention than in the control communities at 3 months (0.64, 0.44-0.95, p=0.028) and 6 months of age. (0.85, 0.72-0.99, p=0.04)\textsuperscript{42}.

S.K. Upadhyay et al. (1992) studied a group of 224 children from a rural cohort of 625 during 1981 to 1983 in 10 villages of Varanasi. The study reveals that each child suffered 5.9 sickness episodes per year with 9.9 days duration per episode. Diarrhoeal diseases, Respiratory infections, Eye infection, Skin infection and Fever contributed to 39.7\%, 18.7\%, 16.3\%, and 10.9\%, of the total sickness episodes respectively. This showed that the rural children on an average are sick for almost 52 days in a year\textsuperscript{36}. 
2.8. Diet assessment

Dietary assessment is an integral part of community nutrition survey. It involves collection of information concerning food habits, food supply and procurement, preparation and distribution of food. Besides this, information on food wastage, adequacy and inadequacy of diet is also collected. These studies provide only baseline information, and cannot be used as absolute indicators to adequate nutrition\textsuperscript{164}.

Accurate and reliable methods for assessing dietary intake of a free living population are needed to answer important questions regarding association between dietary factors and physiological processes involved in the etiology of diseases\textsuperscript{164}.

The overall objectives of dietary studies are

1. To determine dietary or nutrient intake of one or more individuals and to assess the need for an appropriate intervention programme.
2. To determine the need of community nutrition programme for various population groups\textsuperscript{164}.
3. To evaluate the ongoing programme and/or compare dietary status of groups within a given geographic area or with similar groups from other areas.
4. To determine the method of food procurement and distribution, actual amounts of foods consumed, loss or waste of individual foods.
5. To provide a basis for dietary modification and counseling.
6. To generate information regarding the economic and social factors influencing food production and consumption\textsuperscript{164}.
2.8.1. Diet recall method

This is a frequently used method to obtain current dietary intake information from individuals. This is based on the principle that, food consumption for a specified period of time prior to the survey can be recalled as accurately as possible. It is often referred to as the, ‘24 hour recall’ method. The respondents recalls what and how much food was consumed and when it was consumed. The ingredients recalled are recorded in household standardized volumetric measures. The volume of cooked food is also recorded. Standardized vessels are used mainly to aid in recapitulating the amount of food stuffs used and distribution of food to family members. From the raw weight of food stuffs their nutritive value is calculated\textsuperscript{164}.

\[
\frac{\text{Individual intake (in volume)}}{\text{Total cooked quantity}} \times \text{raw amounts} = X
\]

Advantages
1. Useful method in quick recapitulation of one’s habitual diet.
2. It is helpful in revealing extreme daily variations in the diet.

Disadvantages
1. A day’s intake may not be representative of usual intake.
2. Estimation becomes difficult when diet has a lot of variety
3. Subjects reporting may not be entirely truthful\textsuperscript{164}.